世界数字教育大会
WORLD DIGITAL
EDUCATION CONFERENCE

Best Practices in AIED:

Scenarios-Driven Educational Transformation

世界数字教育创新案例集
——场景驱动的人工智能+教育变革

世界数字教育联盟
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Preface

The intelligent era brings about reconstruction of education ecosystems. Artificial intelligence is reshaping not merely the tools we use, but fundamentally what we learn, how we teach, how we manage, and how we assess, from school-based learning to lifelong education systems for all. In response to this pivotal moment, the World Digital Education Alliance (WDEA) launched a global initiative calling for cases of best practices on ***Scenario-Driven Artificial Intelligence + Education Transformation***. This call aimed to identify, verify, and share promising AI-powered educational practices across all educational levels and fields. The call presented eight scenarios, namely, to enable immersive & practical learning, innovate classroom instruction, personalize teaching & learning, optimize management & services, transform assessment & evaluation, pioneer new frontiers in education, enable AI-powered scientific research, and last but not least, towards AI-enabled lifelong learning.

We were seeking innovative applications and technical solutions driven by real-world scenarios, addressing real problems, and delivering outstanding results. We received over 500 submissions from over 50 countries and regions, spanning every continent and every education level. Five evaluation dimensions guided our selection: innovation, effectiveness and value, replicability, content quality, and supporting evidence. We prioritized cases that demonstrated not mere technological novelty, but genuine educational transformation—processes that could be adapted across different resource settings, cultural contexts, and educational stages.

After experts' evaluation, 100 exemplary cases were selected, and the Top 10 Innovative Cases have been identified. They are not theoretical proposals. They are real solutions addressing real problems in real classrooms, campuses, and smart learning environments. Some leverage AI to personalize instruction at scale. Others rebuild classroom structures, enhance immersive experiences, automate intelligent campus management, or construct entirely new evaluation frameworks and smart educational ecosystem. What unites them is a shared commitment to measurable impact, ethical responsibility, and sustainable replicability.

This collection is a global public good. It is our hope that these cases, which can be accessed through the QR code at the back of this book or the official WDEA website (https://wdea.bnu.edu.cn/)—serve not as a final destination, but as a starting point, a blueprint and an invitation. We invite policymakers, school leaders, teachers, and EdTech innovators around the world to study these models, adapt them to local contexts, and build upon them. The future of education will not be written by a single nation or institution. It will be written together.

Finally, we would like to extend our deepest gratitude to all case contributors and selection experts. The intelligent era promotes exchanges and mutual learning between civilizations. Let's work together to advance a digital education future that is equitable, smarter and more human-centered.

Joint Secretariat for WDEA

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Case 1

Leading Science in Hangzhou: SEC Underpins a New Paradigm for AI-Enabled Scientific Literacy Development

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Background

Vigorously strengthening science and technology education and striving to enhance the scientific literacy of young people is crucial not only for individual comprehensive development, but also for the nation's innovative vitality and long-term development. Currently, science education is confronted with three major practical challenges. First, the implementation rate of experimental teaching is difficult to evaluate, teachers face heavy workloads in lesson preparation and pedagogical research, and there is an insufficient supply of inquiry-based practical learning opportunities for students. Second, the teaching paradigm lags behind technological advancements, making it difficult to align with the cognitive characteristics of AI natives. It fails to stimulate their scientific curiosity and in-depth desire for exploration, and the learning environment lacks sufficient support built upon personalized learning resources and intelligent tools. Third, academic evaluation methods are rigid and oversimplified, relying excessively on paper-and-pencil tests, while lacking individual process-based evaluation and regional collective evaluation data that can truly reflect the cultivation of scientific literacy. Conducting science education emphasizes practice, integration, and synergy. It requires revitalizing resources and leveraging the Smart Education of China (SEC) to provide primary and secondary schools and students nationwide with a menu-based selection system, thereby creating new momentum and advantages for science education. Coinciding with the poised takeoff of generative artificial intelligence technology, and to break through the aforementioned teaching and learning bottlenecks while innovating the paradigm for cultivating youth scientific literacy, the Hangzhou Municipal Bureau of Education officially launched the "Leading Science in Hangzhou" project in November 2024. This project is designed to empower science education through AI. During its implementation, the State Council issued *the Opinions on Further Implementing the "AI Plus" Initiative* which explicitly proposed utilizing AI to "promote more effective learning methods." This has provided a solid policy foundation and clear development guidance for the in-depth advancement of the project.

Case Implementation Status

Since November 2024, Leading Science in Hangzhou has adopted a **government-enterprise-school-community collaborative governance model** with clear division of responsibilities. The Hangzhou Municipal Bureau of Education has first signed a cooperation agreement with iFLYTEK to establish a collaborative mechanism involving government, enterprises, schools and communities, clarifying the responsibilities of all parties. Subsequently, relying on large model technology, two intelligent agents have been jointly developed and deeply integrated with the **DingTalk** and the **Zhejiang Provincial Government Mobile Office Platform,** connecting to the science and technology education resources on the SEC. Meanwhile, an intelligent tutor **"Lao Wantong"** based on the Hangzhou-born scientist Shen Kuo, and an intelligent learning partner **"Xiao Wantong"** for students have been created. It also built three supporting modules—**the AI Curriculum Center, the AI Practice Center, and the AI Assessment Center**—have been established to form a three-dimensional support system.

Following the completion of core technology development and the deployment of intelligent agents in the first half of 2025, the project immediately entered the pilot and iterative promotion stage. It expanded gradually from the initial 22 pilot schools to nearly 180 schools across three districts in Hangzhou, with Version 2.0 released. Interactive experience and heuristic interaction design have been continuously optimized, forming a full implementation closed loop of **"standard guidance, pilot verification, iterative upgrading, and promotion and radiation".**

Innovation Highlights

1. Collaborative Mechanism: Establishing a New Collaborative Mechanism for Joint Construction by Government, Enterprises, Schools and Communities

Based on the practical and inquiry-based requirements of science education, the project aims to cultivate students' core competencies such as scientific concepts, scientific thinking, inquiry practice, attitudes and responsibilities. The Hangzhou Municipal Bureau of Education and iFLYTEK have established a collaborative mechanism featuring "government leadership to set standards, cooperation between education and enterprises to develop scenarios, school practice to promote application, and joint support from social forces". Relying on large models, the two parties have jointly developed application scenarios and dual intelligent agents for the Leading Science in Hangzhou project, which have been deeply integrated into DingTalk and the General Office of the People's Government of Zhejiang Province platforms. This enables convenient access and full coverage for teachers and students, and fully supports the high-quality development of science education. Schools are making full use of offline social science popularization resources such as regional science and technology museums and museums. Furthermore, relying on the science and technology education sections of the SEC for Primary and Secondary Schools, they empower the innovative application of the "Leading Science in Hangzhou" project with high-quality resources and AI tools to improve quality and efficiency (as shown in Figure 1).

Figure 1 Science and Technology Education Resources on the SEC for Primary and Secondary Schools

2. Dual Intelligence-Driven Learning: Creating New Scenarios Powered by "Dual Intelligent Agents"

Combining the characteristics of science education of “curiosity-driven and practice-deepened”, the project created two visualized intelligent agents: the intelligent learning partner “Xiao Wantong” and the intelligent tutor “Lao Wantong”. Integrating with the “AI Zone” of the SEC, they empower future education and explore the infinite possibilities of artificial intelligence.

"Xiao Wantong" adopts a futuristic technological image, guides students to observe and think through interesting questions, and stimulates their interest in inquiry through gamified honor incentives such as the "Good Question Wall" and "Lighting Up the Science and Technology Map of China", realizing learning through play and integrating knowledge acquisition with national identity. "Lao Wantong" is a digital image built based on the Hangzhou-born scientist Shen Kuo, integrating cases of famous and excellent teachers. It provides intelligent guidance when students carry out project-based learning such as surveys, experiments, and productions, and records the practice process through a unified points system to improve students' scientific thinking and practical ability. Through coordinated interaction and gamified points incentives, the dual intelligent agents form a complete human-machine collaborative learning closed loop, from inspiring curiosity (inquiry) to improving practical abilities (practice).

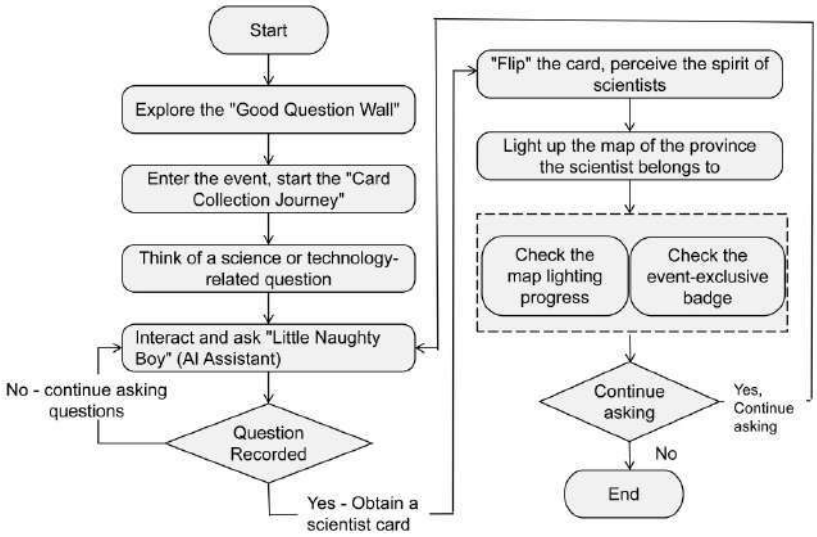

Figure 2 "Tech Youth Light Up China" Questioning Event Flow

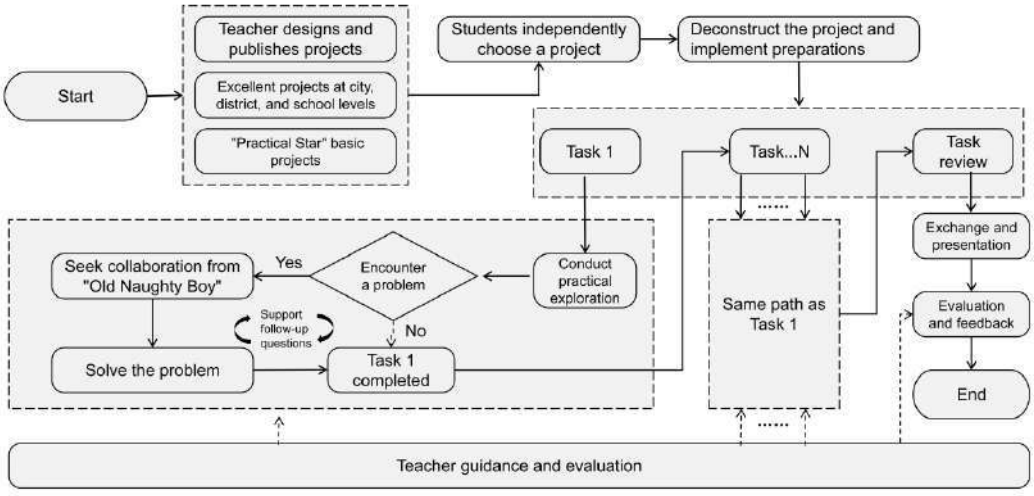

Figure 3 Practical Exploration of Human-Machine Collaboration

3. Three-Dimensional Support System: Building Three AI Centers to Support a New Model of Science Education

(1) Smart Teaching and Research Module (AI Curriculum Center) integrates functions including AI-assisted lesson planning, classroom voice monitoring, experiment implementation rate statistics, and AI video-based lesson evaluation. It helps reduce teachers' workload and improve efficiency, promotes the full implementation of experimental teaching, and effectively guarantees the quality of practical teaching in science education.

(2) Intelligent Three-Star Module (AI Practice Center) is developed on the basis of the dual intelligent agents, extending to form the "Exploration Star". It links social popular science resources to form a growth loop of "curiosity (inquiry) – practice (operation) – exploration (research)", expanding the boundaries of science learning.

(3) Diversified Assessment Module (AI Assessment Center) explores student scientific literacy profiles based on process data, covering multiple dimensions such as knowledge mastery, practical ability, and scientific attitude. It provides accurate data support for personalized learning guidance and regional

education quality monitoring.

Meanwhile, relying on the “AI Testing Ground” of the SEC to experience the latest educational large models and intelligent tools, the project builds a scenario-driven support system for cultivating scientific literacy.

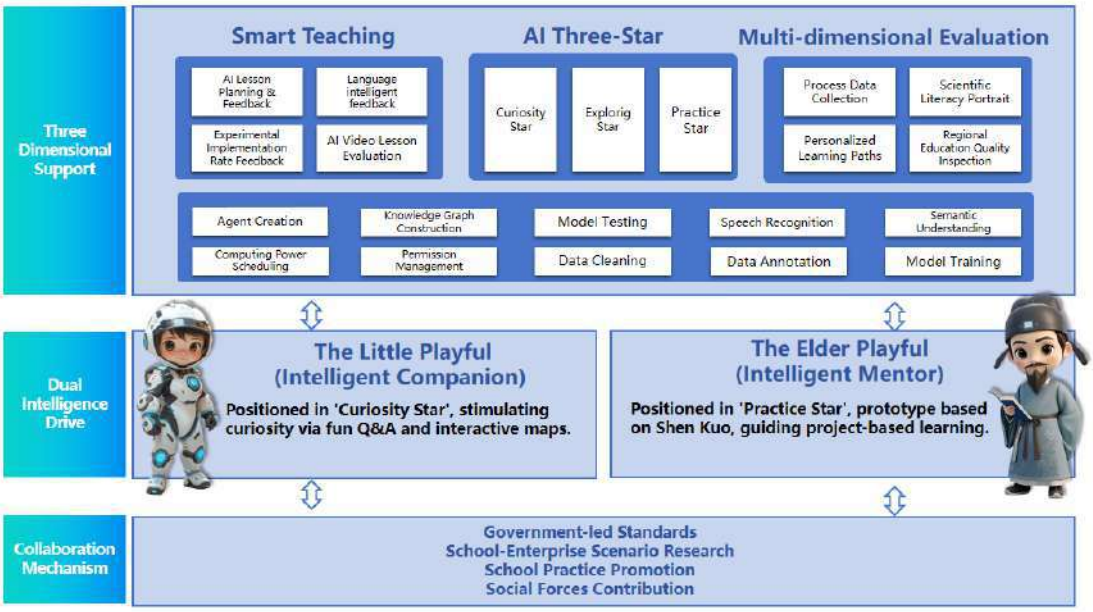

Figure 4 Technical Module Diagram of the "Science Leading Hangzhou" Project

Case Effects

1. Empowering Teachers and Improving AI Literacy

The project has realized the statistics of experimental teaching data in primary and secondary schools across the city. Teachers have accumulated more than 8,000 hours of AI-assisted lesson preparation and over 1,500 hours of AI-supported teaching. Relying on the teaching and research activity of "AI Empowering Science Classrooms", the project has promoted the transformation of science teaching towards data-driven and literacy-oriented, effectively improving teachers' ability to apply artificial intelligence in teaching.

2. Stimulating Student Interest and Expanding Science Learning Paths

Through gamified scenarios and immersive intelligent interaction, the project has effectively aroused students' enthusiasm for scientific inquiry. Since the launch of Version 2.0, students in the promotion districts have asked more than 310,000 questions in total, and completed over 300 project-based practical tasks with the assistance of "Lao Wantong". Science learning scenarios have been extended from classrooms to homes, venues and nature, encouraging students to explore actively and realizing the educational transformation from knowledge transmission to literacy improvement.

3. Innovating the Cooperation Mechanism and Forming a Sample of Artificial Intelligence Education Scenarios

The project has established a collaborative mechanism featuring “government leadership in setting standards, cooperation between education and enterprises in developing scenarios, school practice in promoting application, and joint support from social forces”. By integrating into the applications of the SEC for Primary and Secondary Schools, it achieves the inclusive sharing of high-quality resources and the deep empowerment of intelligent teaching, which effectively solves

practical problems such as disconnection between technology and teaching as well as insufficient resource supply. In November 2024, the Municipal Bureau of Education signed a strategic cooperation agreement with iFLYTEK. Up to now, Version 2.0 has been launched, forming an implementation path of "standard guidance, pilot verification, iterative upgrading, and promotion and radiation". Relying on the digital ecosystems of DingTalk and the General Office of the People's Government of Zhejiang Province apps, the project has achieved low-cost and large-scale implementation. Its achievements have been reported by mainstream media, making it a landmark innovative practice for Hangzhou in building a national experimental zone for science education in primary and secondary schools.

4. Human-AI Collaborative Teaching and Learning: Building an Intelligent Interactive Learning Scenario

Guided by the philosophy of "people-oriented education, technology for good, and integrated intelligence", the project has been continuously optimized in three key aspects: improving the knowledge base while balancing scientific rigor and educational ethics; adapting to students' learning habits to enhance the interactive experience of the dual intelligent agents; and refining heuristic interaction design. With the application of the human-machine collaborative teaching model, students have adapted to intelligent learning methods, and the effectiveness of scientific literacy cultivation has been continuously improved.

Replicability and Promotion

The **Leading Science in Hangzhou** has actively exerted its radiating and driving effect, promoting the extension of high-quality science education experience to the Yangtze River Delta. Piloted first in Hangzhou, the project has been gradually expanded from the **initial 22 pilot schools to nearly 180 schools** across three districts: Xihu, Yuhang and Fuyang, forming a replicable "Hangzhou Experience" for science education. Through the on-site meeting of the 15th Cooperation Group of the National Science Education Experimental Zone, it focused on presenting phased achievements, attracting more than 30 experimental schools and over 700 teachers in the province to observe and exchange experience. At the same time, the project achievements have been landed across regions. The Hangzhou model has been piloted in many schools in Hefei, Anhui Province, including the Primary School Affiliated to Hefei Normal University and Hefei Qingnian Road Primary School, where localized practices are explored. This provides a practical model for the coordinated development of science education in the Yangtze River Delta.

By providing a proven model for **government-led, industry-supported, school-based, AI-empowered science education**, the project offers valuable experience for **global sustainable development of education (SDG 4)**, especially for large economies seeking equitable, high-quality, and intelligent science education.

The national and local smart education platforms are seamlessly connected and integrated. Resources, tools, and services for learning, teaching, creating, and exploring science and technology are becoming increasingly abundant. AI-empowered scenario-based, project-based, inquiry-based, and interdisciplinary teaching models are gradually being popularized. These advancements promote the organic connection between schools as the main battlegrounds for science and technology education and society as a broad classroom, striving to sow the seeds of science in children's hearts and inspire them to dream of becoming scientists.

Case 2

An AI-Powered Innovative Solution for Students' Comprehensive Quality Evaluation in China

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Background

Educational evaluation is a key lever for advancing quality-oriented education. Its core value lies in providing an authentic and comprehensive picture of student development, thereby driving fundamental changes in how students are educated and supported. Students' comprehensive quality refers to the cross-disciplinary values, essential character, and key competencies that students develop through education. These attributes are complex, contextual, and developmental in nature, and therefore cannot be adequately captured through conventional paper-and-pencil tests or simple quantitative indicators alone.

The Chinese government places strong emphasis on students' comprehensive quality evaluation. A series of national policy initiatives has created favorable conditions for its implementation. However, limitations in evaluation capacity and methodology have constrained the role of comprehensive quality evaluation in student selection, developmental diagnosis, and educational guidance throughout the full process of student development.

Recent advances in artificial intelligence (AI) offer new possibilities for addressing these challenges. In AI-enabled digital task environments, students can engage in authentic problem-solving through interactions with intelligent agents, texts, images, and multimedia resources. With appropriate ethical safeguards, AI makes it possible to capture and analyze multimodal process data, generating richer and more dynamic evidence of students' development. Combined with expert judgment, these technologies enable more authentic and objective modeling and evaluation of students' development, while supporting timely feedback and educational guidance.

Since 2021, under the guidance and support of the Ministry of Education and the Ministry of Science and Technology, the Beijing Normal University team has worked with 44 regional pilot areas and more than 8,000 primary and secondary schools nationwide to develop and implement an AI-powered solution for students' comprehensive quality evaluation. The solution offers a large-scale, policy-aligned,

and contextually grounded model for advancing digital transformation in student evaluation, contributing valuable Chinese experience to the global community.

Case Implementation Status

In 2021, Beijing Normal University took the lead in a National Key Research and Development Program project of the Ministry of Science and Technology, titled "Large-Scale Longitudinal Tracking Study of Student Development Across School Stages." In 2022, building on the project outcomes, China's Ministry of Education launched a pilot initiative in parallel on "Information Technology Supporting Students' Comprehensive Quality Evaluation." Under the joint guidance of the two ministries, the team first conducted a baseline study to map current practices and identify major bottlenecks in students' comprehensive quality evaluation reform. It then brought together interdisciplinary expertise to reconstruct the theoretical framework and address key technological challenges, developing an AI-powered solution for students' comprehensive quality evaluation. across 44 regions nationwide to explore application models tailored to diverse local education contexts.

1. Needs assessment and challenges identification

To better understand current practices, the team conducted extensive field research across 28 provincial-level divisions. The investigation identified two central implementation challenges. The first concerned the scientific validity of evaluation. Across regions, existing frameworks for students' comprehensive quality evaluation varied substantially in indicators, standards, and operational procedures. In many cases, assessment relied on descriptive student records and subjective judgments from multiple stakeholders. While such approaches reflected sound educational intentions, inconsistencies in criteria and evidence weakened the scientific validity of the results. The second related to objectivity and credibility. As comprehensive quality evaluation has increasingly been incorporated into high-stakes progression and admissions decisions in many regions, ensuring the authenticity of recorded evidence and the objectivity of subjective judgments has been more difficult. Together, these two challenges have limited the public credibility and practical utility of assessment outcomes and highlighted the need for stronger methodological and technical support.

2. Framework development and technological innovation

In response, the project team worked with multiple institutions to develop an integrated solution combining conceptual, methodological, and technical innovation.

First, building on sustained academic research and extensive field investigations across more than 20 provincial-level divisions, the team developed a preliminary theoretical framework that integrates the five dimensions of moral, intellectual, physical, aesthetic, and labor education with the Core Competencies and Values for Chinese Students' Development. The framework then underwent expert review and an initial round of refinement. Based on this framework, the team subsequently developed an assessment system and conducted continuous validation and iterative optimization using large-scale empirical data from over one million students. This process resulted in a robust theoretical framework (as illustrated in Figure 1), consisting of three dimensions, ten indicators, and thirty-six elements. Guided by this framework, the team further developed a corresponding set of assessment technologies and tools, thereby establishing an integrated methodological and technical foundation for implementation.

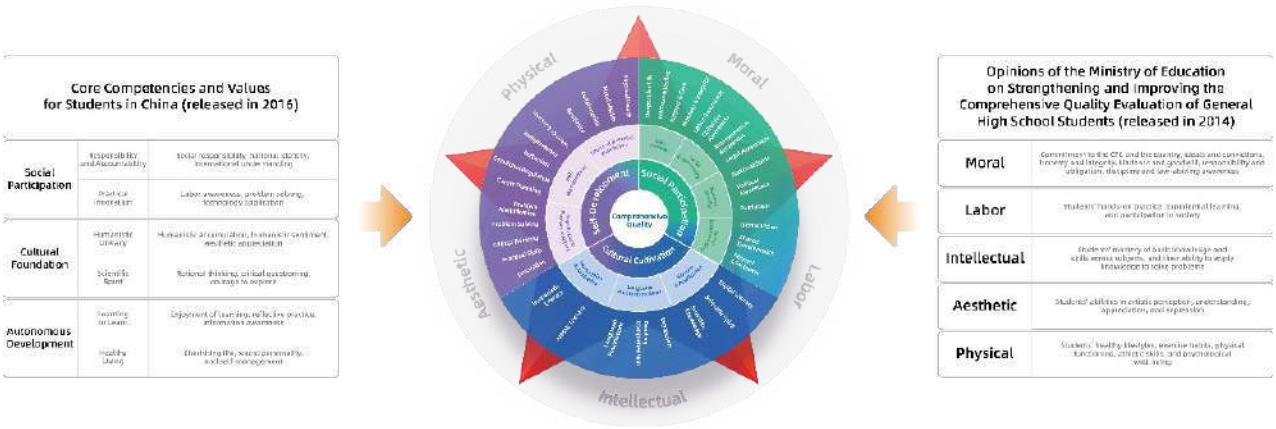

Figure 1 Theoretical Model

Second, the team pioneered an AI-powered performance-based assessment system centered on problem-solving in virtual task environments. Guided by the theoretical framework, the team designed 13 sets of intelligent assessment activities (as illustrated in Figure 2) aligned with multiple dimensions and indicators, aiming at capturing multimodal data on student performance throughout the assessment process. These activities underwent expert review and repeated piloting, achieving significant advances in scenario-based task design, process data collection, and multidimensional competency assessment. Large-scale validation demonstrated strong psychometric properties, including high reliability and validity, as well as appropriate difficulty and discrimination.

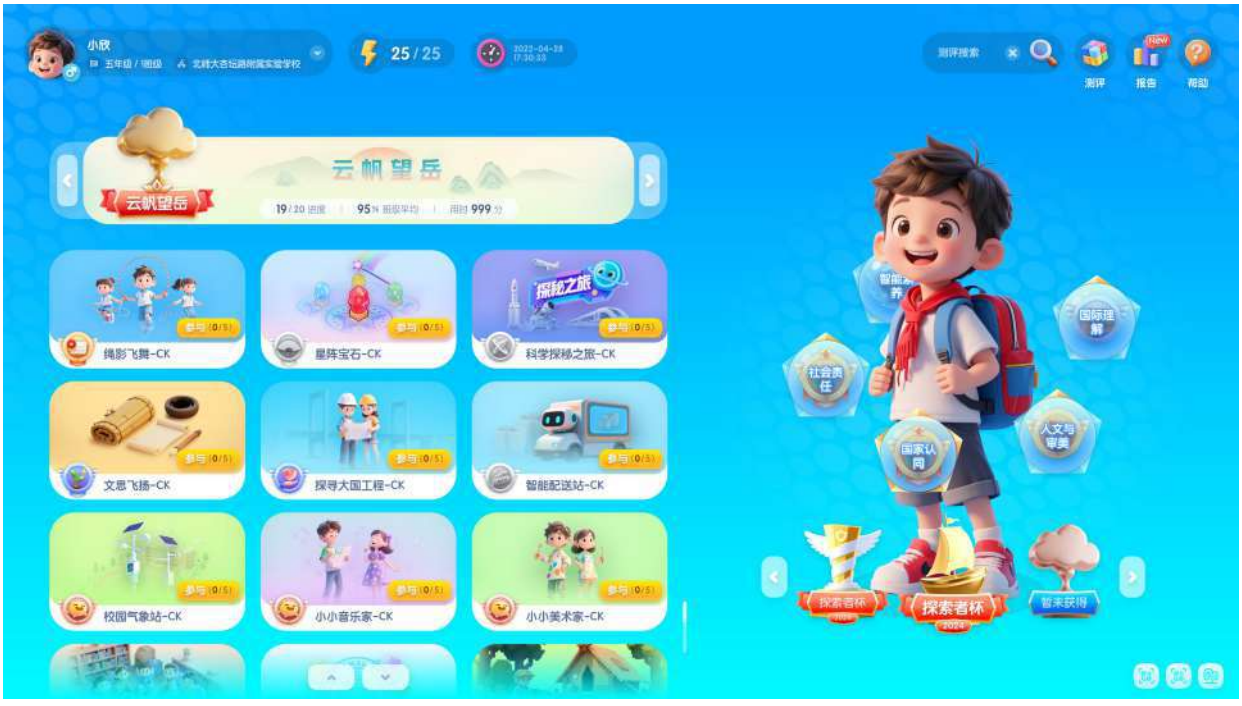

Figure 2 An AI-enabled system of performance-based evaluation tools

Third, the project made significant advances in multimodal learning analytics. Four categories of intelligent analytical technologies were developed: video-based behavior analysis, audio feature recognition, semantic text analysis, and image processing, as illustrated in Figures 3 and 4 Validated through three years of large-scale application involving more than one million students nationwide, the multimodal algorithms achieved an average accuracy rate of over 85 percent and demonstrated stable and reliable performance in terms of both processing efficiency and cross-scenario adaptability. These technologies enabled the intelligent mapping of student task performance onto 110 key developmental features, thereby providing a solid technical foundation for building digital profiles of students' comprehensive quality and supporting precision evaluation.

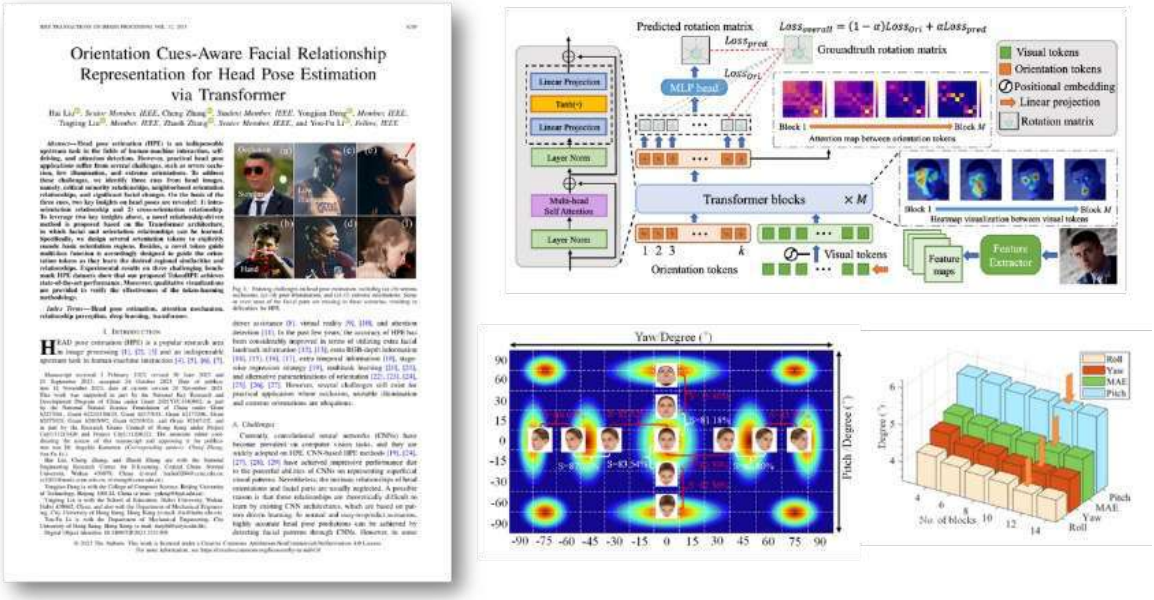

Figure 3 Transformer-based Head Pose Estimation Method

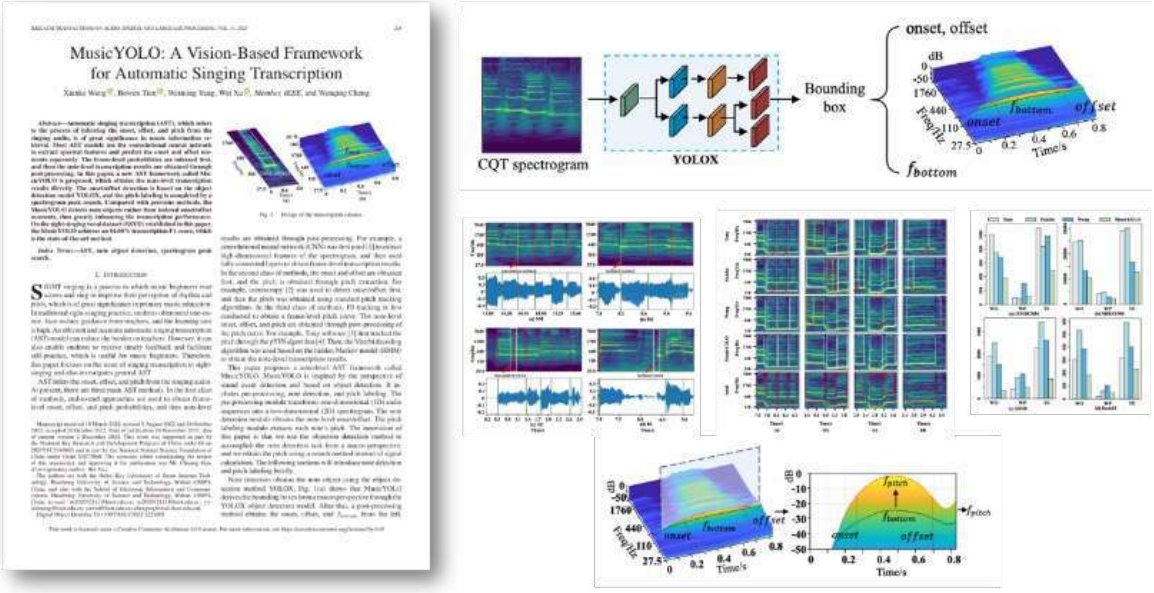

Figure 4 Automatic Transcription and Analysis of Students' Singing Audio

Fourth, the solution has been successfully implemented in 44 pilot regions across 28 provincial-level divisions nationwide, generating three consecutive years of longitudinal developmental data from more than one million primary and secondary school students. On this basis, the project has established the world's first ultra-large-scale foundational database for students' comprehensive quality development. This database covers students in grades 3 to 11 from both urban and rural schools, as well as from regions with varying levels of economic development.

Building on this foundation, the project team applied scientific sampling algorithms and norm development methodologies to construct China's first norm-referenced database for students' comprehensive quality development, as illustrated in Figure 5 This database provides a robust empirical reference system and analytical tool for systematically understanding the status and trends of quality-oriented education in China. At the same time, the team developed a data-mining engine capable of generating comparative, developmental, and factor-based insights, leading to the establishment of a knowledge base for students' comprehensive quality development. Together, these achievements represent a significant milestone in advancing high-quality education development in China.

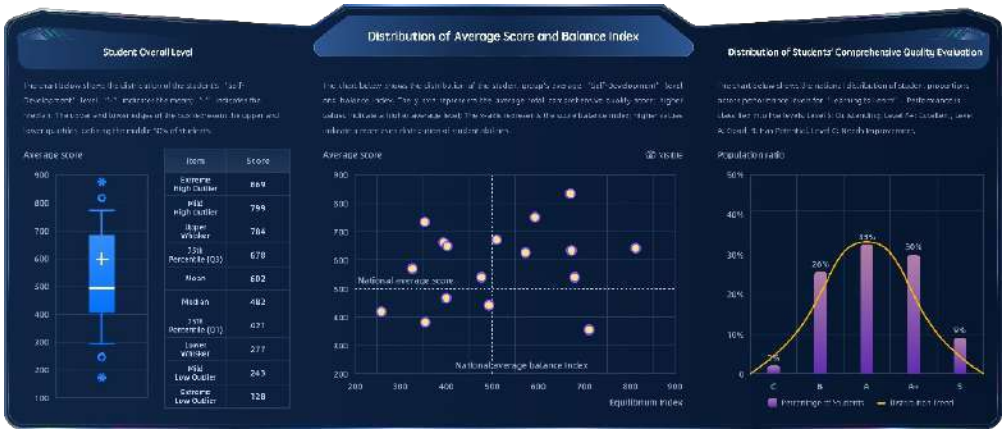

Figure 5 China's first ultra-large-scale dataset and norm-referenced database

3. Platform development and implementation support

To facilitate the efficient implementation and scaling of the solution, as illustrated in Figure 6, the project independently developed the Student Evaluation Enhancing Development Platform (SEED, https://seed.bnu.edu.cn), together with a companion WeChat service account "seed_bnu". Students can conveniently access the platform through computers, tablets, and mobile phones, and participate in assessment activities supported by the new AI-powered evaluation framework.

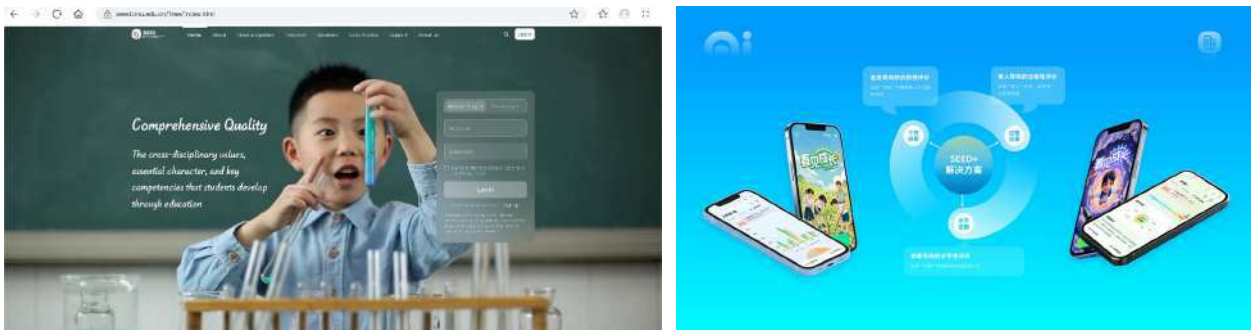

Figure 6 The SEED Platform

The SEED platform has obtained Level 3 certification under China's Multi-Level Protection Scheme (MLPS) and meets the highest information security requirements applicable to platforms of this kind in China. Supported by the robust data storage, computing, and cybersecurity infrastructure of Beijing Normal University's Information Network Center, the platform ensures the secure management of large-scale student data.

Building on this technical foundation, the project has established a multidimensional operational support mechanism to facilitate implementation, service delivery, and continuous improvement.

With regard to ethics and data security, the project strictly adheres to the principles of informed consent and voluntary participation for students and parents, and adopts end-to-end encryption and data de-identification to ensure privacy protection and confidentiality.

In terms of organizational design, the SEED platform enables the deep integration of process-oriented formative assessment and outcome diagnosis, enabling assessment activities to be embedded into routine classroom teaching and fostering a sustainable model of integrated instruction and assessment.

Regarding service support, the project has built a comprehensive support system that combines operational guideline manuals and human customer support, ensuring stable operation under large-scale concurrent assessment conditions.

In terms of feedback and application, the platform automatically generates *Student Comprehensive Development Evaluation Reports* for regions, schools, classes, and individual students (as illustrated in Figure 7). Based on the norm-referenced database and knowledge base, these reports support educational decision-making, instructional improvement, and personalized student development.

Finally, for iterative improvement, the project conducts regular field investigations and consultation meetings to gather feedback from regional authorities, schools, and parents, thereby driving the continuous refinement and upgrading of the solution.

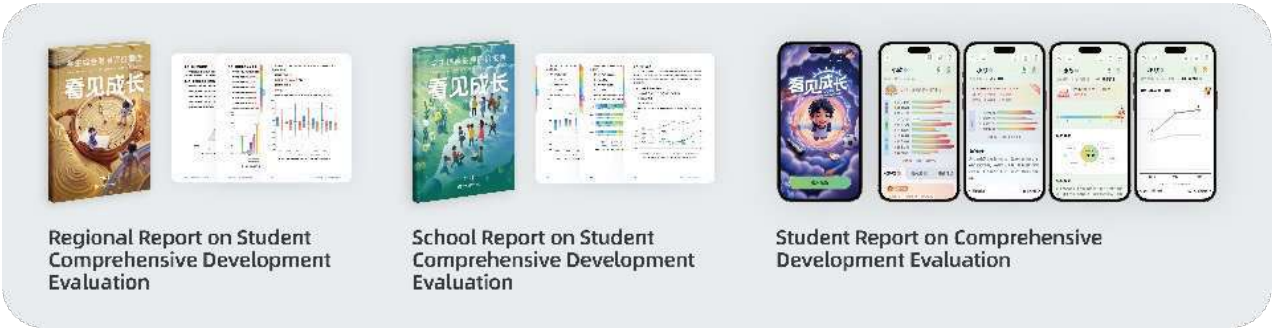

Figure 7 Student Comprehensive Development Evaluation Reports

Case Innovation and Breakthroughs

After three years of sustained research and large-scale implementation, the project has successfully established China's first systematic AI-powered solution for students' comprehensive quality evaluation, with major breakthroughs in four areas: advancing evaluation technologies, uncovering developmental patterns, building feedback systems, and enabling integrated implementation.

1. Developing performance-based assessment through intelligent evaluation technologies

Guided by the theoretical framework, the project developed an AI-supported system of performance-based assessment designed to capture students' comprehensive quality in authentic contexts. By

placing students in interactive and problem-oriented task environments, the system elicits evidence of decision-making, collaboration, communication, and reflection in the course of task completion.

Through embedded, process-oriented, and unobtrusive data collection, students' behavioral processes are systematically captured as key evidence of development. Supported by multimodal data analytics, integrating behavioral, textual, audio and interaction data, the system enables precise and fine-grained diagnosis of students' development levels. In this way, this approach moves beyond static results to reveal developmental characteristics.

Following expert review and multiple rounds of iterative refinement, the project established a comprehensive and scalable system of assessment activities covering students from grades 3 to 11. Large-scale application has shown that this approach is capable of capturing the complexity, contextuality, and developmental nature of student growth.

At the level of practical implementation, the project further promotes the integration of assessment into routine classroom teaching by embedding assessment activities into classroom instruction. Building on these innovations, the project developed the Student Evaluation Enhancing Development Platform (SEED), which provides an integrated infrastructure for large-scale implementation, continuous data collection, and intelligent analysis.

2. Establishing a national database to reveal patterns of student development

Based on scientifically sampled longitudinal data collected over three consecutive years from one million students, the project established China's first national database for students' comprehensive quality development. In both scale and continuity, it ranks among the largest datasets of its kind globally, covering diverse regions, school types, and student populations.

Leveraging this large-scale dataset, the project systematically identified key patterns in student development across China, including national normative references, stage-specific developmental characteristics across different schooling levels, and key factors influencing student growth. By transforming fragmented local data into a unified analytical framework, the database enables scientifically grounded benchmarking across regions, thereby filling a critical gap in the reference system for students' comprehensive quality development.

Furthermore, the database supports in-depth analytical applications through data modeling and trend analysis, providing insights into both individual and group-level development trajectories. It offers a robust empirical foundation for large-scale personalized education, supports the identification of students with high developmental potential, and informs evidence-based regional education policymaking. Overall, the database significantly enhances the scientific rigor, comparability, and practical value of student evaluation in China.

3. Building a multi-level feedback system to support decision-making and student development

Leveraging the SEED platform, the project established an integrated and automated feedback system that generates *Student Comprehensive Development Evaluation Reports* at multiple levels, including regions, schools, classes, and individual students. This system transforms large-scale assessment data into structured, actionable insights, enabling timely and evidence-based feedback across the education system.

The reports provide both cross-sectional comparisons across multiple dimensions of student development and longitudinal tracking of individual growth trajectories. By integrating normative references and data-driven analytics, the system allows users to interpret student performance within

broader developmental benchmarks. Over three consecutive years, the platform has generated more than 12 million student reports, 24,000 school reports, and 1,500 regional reports, demonstrating strong scalability and operational stability.

At the individual level, the reports help students identify their strengths and areas for improvement, supporting goal-setting and self-directed development. At the classroom level, they enable teachers to diagnose learning needs more precisely and implement targeted instructional strategies. At the school level, the reports provide evidence for evaluating educational effectiveness and improving student development. At the regional level, they support the systematic monitoring of quality-oriented education and strengthen data-informed governance.

By linking assessment, feedback, and follow-up action, this system significantly enhances the practical value of evaluation results. It contributes to a shift from fragmented, experience-based decision-making toward a more scientific, transparent, and evidence-based model of educational governance.

4. Promoting integrated implementation and context-sensitive application

Through the integration of indicators, data, and system platforms, the project has effectively embedded advanced evaluation models and technologies into regional education reform practices, forming context-sensitive solutions for students' comprehensive quality evaluation across diverse local contexts.

In regions such as Suzhou Industrial Park (Jiangsu Province), Guilin (Guangxi Zhuang Autonomous Region), and Nanhai District of Foshan (Guangdong Province), process-based developmental data have been systematically integrated with diagnostic assessment data, enabling solutions capable of capturing students' longitudinal growth trajectories and accurately evaluating their current development levels.

In Ningbo and Hangzhou (Zhejiang Province), existing regional indicator systems have been aligned with the new evaluation framework, resulting in locally adapted models that retain national comparability while reflecting regional educational priorities and implementation conditions.

In districts such as Nanshan District of Shenzhen (Guangdong Province) and Dadong District of Shenyang (Liaoning Province), the SEED platform has been integrated into broader regional digital infrastructures, supporting the development of local evaluation ecosystems through integration with education management systems and digital platforms.

These practices demonstrate that AI-powered assessment can be adapted to regions with varying levels of digital readiness and distinct educational traditions. They provide a replicable pathway for scaling students' comprehensive quality evaluation while maintaining both methodological consistency and contextual adaptability.

Promotion Value

The project has generated substantial academic, technical, and policy impacts, demonstrating strong potential for wider dissemination and large-scale application. Building on years of research and implementation, the team has systematically consolidated its findings, published more than 20 papers in leading domestic and international academic journals, and applied for 22 national invention patents and software copyrights. In terms of policy and public impact, recommendation reports derived from the project have been adopted by the Ministry of Education of China, which has also highly recognized the project's contribution to advancing the shift in educational decision-making from experience-based to data-driven approaches. The project has also received extensive coverage from major national media outlets. Together, these achievements have helped establish an AI-powered innovative solution for

students' comprehensive quality evaluation in China, providing valuable insights and practical experience for international educational innovation.

Looking ahead, the project will continue to advance the intelligent transformation of students' comprehensive quality evaluation in China, further strengthening its role in student selection, developmental diagnosis, and educational guidance.

In terms of social impact, the project supports broader education reform by making evaluation more development-oriented, evidence-based, and actionable. At the level of regional governance, the regional *Student Comprehensive Development Evaluation Reports* help shift education management from experience-based to data-driven decision-making, providing robust evidence for policy formulation, resource allocation, and the improvement of student selection mechanisms. At the level of teaching and learning, the project enables intelligent diagnosis of students' developmental status within an integrated model of instruction and assessment. By embedding assessment activities into routine educational practice and leveraging feedback to support more targeted instruction, it helps teachers respond more effectively to students' learning needs while promoting personalized student development. In this way, the project strengthens the role of evaluation in supporting teaching, improving learning, and fostering collaborative student development.

From an economic perspective, the project creates substantial value through an integrated end-to-end solution that brings together theoretical frameworks, assessment tools, analytics technologies, and platform support. This unified approach significantly reduces the costs of redundant development and implementation for regional authorities and schools in students' comprehensive quality evaluation, while also improving implementation efficiency and enhancing the effectiveness of data utilization.

The project outcomes can be widely applied in a range of scenarios, including regional education quality monitoring, school evaluation, and student development guidance, thereby establishing a replicable and scalable intelligent evaluation solution. With strong market prospects and sustained application value, the project demonstrates strong long-term economic potential.

Beyond its national impact, the project carries important global significance. It provides a scalable model for integrating artificial intelligence with educational theory, evaluation practice, and ethical governance to support students' comprehensive quality evaluation in complex educational contexts. Importantly, rather than pursuing technology for its own sake, the project emphasizes alignment with educational goals and student development. In doing so, it offers a Chinese solution to global education transformation, demonstrating how large-scale, data-informed evaluation systems can be effectively designed and implemented in diverse contexts. Its integration of theory, technology, and practice offers valuable insights for advancing digital transformation worldwide.

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Case 3

Welkin "4D" Classroom in the Age of Artificial Intelligence

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Abstract

The United Nations Sustainable Development Goal 4 (SDG4) clearly states the commitment to "ensure inclusive and equitable quality education". However, the world still faces common global challenges, including the shortage of high-quality teachers, the rigid model of the traditional single-teacher classroom, the difficulty of scaling up personalized teaching, and the superficial integration of technology and pedagogy. Taking Shenzhen Welkin School as the practice carrier, this case relies on new-generation information technologies such as artificial intelligence, 5G, big data, and cloud computing to pioneer Welkin "4D" Classroom teaching model, centered on main teaching teachers, auxiliary teaching teachers, field immersion teachers, and AI teaching assistants, and builds a "Headquarters Campus + N participating schools" school community. Over 5 years of practical exploration, 27 primary and secondary schools in Shenzhen have carried out "Co-preparation, Co-research, and Co-teaching" approach. Welkin "4D" Classroom has directly served more than 10,000 students and over 750 teachers, effectively addressing the core challenges of traditional classrooms, and realizing the wide-ranging radiation of high-quality educational resources and large-scale personalized teaching. This model has formed a replicable standardized system.

Keywords: AI+education, Welkin school, "4D" Classroom, Digital transformation, High-quality and balanced education

Case Background

1. Common Challenges in Global Basic Education Classroom Teaching

According to UNESCO's 2024 Global Education Monitoring Report, 250 million children worldwide still lack access to quality basic education, and the shortage of high-quality teachers has become a bottleneck restricting the improvement of global educational equity and quality. At the same time, in the process of promoting the digital transformation of education, countries generally face four common challenges at the classroom teaching level: first, the rigid teaching model that fails to meet students' personalized needs; second, prominent resource barriers that make it difficult for weak schools to obtain stable high-quality classroom teaching resources; third, the superficial integration of technology, falling into the misunderstanding of "having technology but no education"; fourth, the lack of effective paths for teacher development.

2. The Urgent Demand for High-quality and Balanced Basic Education in China

Promoting high-quality and balanced education, so that more children can enjoy fair and quality education at their doorstep, is the consistent value pursuit of the Chinese government. Shenzhen Welkin School is an important part of Experimental Zones for New Teaching and Learning Modes Based on Teaching Reform and Integrated with Information Technology by Ministry of Education, Smart Education Demonstration Zone, and Pilot Zone for Comprehensive Reform of Basic Education for Basic Education.

3. Educational Digitalization as a National Strategy for China's Education Modernization

China has the world's largest basic education system. To achieve a "corner overtaking", digital transformation is a must. China's New Infrastructure, represented by 5G, big data, Welkin computing, and artificial intelligence, has provided the material foundation for the digital transformation of education. The emergence of large language models has also provided a powerful new driving force for classroom teaching reform.

4. Increasingly Prominent Drawbacks of Traditional Classrooms

The traditional classroom model formed in the industrial era can no longer meet the practical needs of talent training in the digital and AI era. First, the "one-size-fits-all" teaching pace fails to take into account personalized differences; second, classrooms are centered on spoon-feeding of knowledge, with a serious lack of cultivation of critical thinking and innovation ability.

This case takes "active welkin-based connectivity" as the core concept, driven by teaching needs, abandons the misunderstanding of instrumental application of technology, and takes AI intelligent teaching assistants as a collaborative subject of classroom teaching, forming a new in-depth collaborative teaching relationship with main teaching teachers, auxiliary teaching teachers and field immersion teachers. In January 2025, "building cloud-based schools" was officially written into the Outline for the Construction of a Strong Country in Education (2024-2035)(Ministry of Education of the People's Republic of China (MEPRC), 2025)

Implementation Process

This case adopts design-based research as the path, carrying out design, research, practice, and iteration simultaneously to promote the construction, creation, and innovation of Welkin "4D" Classroom model.

1. Building an All-Subjects, Multi-Main-Teaching-Teacher, and Live-Interactive Teaching Welkin Classroom

Shenzhen Welkin School was prepared and established with the mission of promoting high-quality and balanced education and building a new teaching model supported by information technology, carrying out exploratory work in advance. 13 weak schools in 10 administrative districts of Shenzhen were selected as participating schools to form a new type of community school with "Headquarters Campus + N participating schools". High-quality main teaching teachers were selected with high standards to undertake the systematic explanation of core knowledge points, the construction of teaching frameworks, the breakthrough of key and difficult points, and the overall control of cross-school classrooms. They focus on the efficient transmission of knowledge and in-depth guidance of thinking, serving as the "core leader" of the classroom. Teachers of each participating school act as auxiliary teaching teachers, who are in the local classrooms, observe students' learning status in real time, carry

out local personalized tutoring, guide classroom interaction, and collect learning feedback, serving as the "local supporter" of the classroom. Main teaching teachers drive auxiliary teaching teachers to carry out regular "Co-preparation, Co-research, and Co-teaching" approach (the "Three Unisons"), and regularly carry out welkin-based multi-teacher teaching model Technically, gigabit optical network and 5G technology are used, following the "cloud-network-edge-end" architecture, connecting welkin classrooms. It realizes real-time interaction between main and auxiliary teaching. We built the "Xiaokun Moxin" digital platform, supporting the digital operation of the community's welkin co-teaching classes.

Figure 1 Map of Second-Cohort 1+N Welkin Community

For example, in a 7th-grade Chinese lesson The Emperor's New Clothes, the main teaching teacher structured the text around the theme of deception, focusing on the fairy tale's core feature of exaggeration to facilitate discussion, sparking students' learning interest. Then, the auxiliary teaching teacher organized 10 minutes of dramatic performance activities in each local class, allowing students to deeply engage with the text. Then, in the sharing session, over a thousand students connected online to exchange ideas. Finally, the main teaching teacher led a detailed discussion of the story's ending, unpacking its deeper implications to help students draw actionable life lessons. The seamless collaboration between the two teachers wove all class activities into a cohesive whole, achieving deep learning co-generated with higher-order thinking.

2. Creating an "Immersive, Boundless" Welkin Classroom

Field immersion teachers carry portable live-streaming equipment to go deep into real social scenarios, introducing real scenes into the welkin class, connecting the inside and outside of the classroom, and linking theory and practice. Through integrated mobile cloud-based equipment, integrated teaching applications such as multi-channel video collection, sound amplification, display and control, live streaming and recording, interactive speaking, and off-campus research are realized. This extends the teaching scene from the classroom to off-campus places such as parks, science museums, museums, enterprises, and research institutes, enabling smooth real-time online interaction between the field site and multiple classrooms. This model realizes the efficient deployment and sharing of high-quality off-campus resources, expanding learning from textbooks to the real world, enabling students to gain immersive learning experience.

Figure 2 A Music Master Class

Take an English reading lesson themed “Water Journey” for example. The main teaching teacher guided students through a little water drop’s journey across the water world, using drama, brainstorming, and situational questions to guide text learning. The lesson walked students through the domestic water usage process, and explained the water cycle from a scientific perspective, helping students understand the value of water resources. Two field immersion teachers were located at the water plant and the sewage treatment plant respectively, enabling cross-region real-time interaction. On-site interviews with staff allowed students to gain first-hand knowledge beyond textbooks, bringing the reading class to life and making it highly engaging. Finally, the lesson integrated the concept of “Lucid waters and lush mountains are invaluable assets”, fully elevating the class’s dimension, breadth, and depth.

3. Innovating AI + Welkin “4D” Classroom

AI teaching assistants are intelligent learning companions and subject-specific agents built on large AI models. Based on students’ daily learning data (such as homework, tests, incorrect responses) and open questions (such as taking photos of problems, direct inquiries), they are responsible for pre-class preview guidance, in-class real-time Q&A, after-class personalized resource recommendations, and whole-process learning analysis, acting as the intelligent enabler of the classroom. Based on subject characteristics and teaching practice, each subject has applied AI teaching assistants into classroom teaching, forming the Welkin “4D” Classroom model together with “main teaching teachers, auxiliary teaching teachers, and field immersion teachers”. Supported by connectivism and constructivist learning theory, the role division and responsibility boundary of the four-in-one classroom are clarified, forming a teaching system with each role focusing on its own strengths and working in coordination.

For example:

- Students can debate with digital humans of characters from classic novels through classroom agents, effectively improving their language expression and logical thinking skills.
- AI generates catchy, custom melodies for ancient Chinese prose, turning texts into songs to help students easily memorize and understand classics.
- AI problem-solving tools deliver step-by-step breakdowns of students’ incorrect responses, clearly presenting the problem-solving process and methods.

• AI geometric analysis tools allow students to drag, rotate, and manipulate geometric shapes to explore their structure, dynamically demonstrating geometric theorems and spatial relationships.

• AI builds an immersive oral English dialogue scenario, correcting pronunciation and grammar in real time, improving students' language application capabilities.

• Scientific inquiry agents coordinate the full process of project-based learning, supporting data collection, project design, and outcome review, comprehensively improving students' comprehensive competencies.

Leveraging the full-dimensional data on teaching, research, student learning, and management accumulated over the long term on Welkin School's digital base, the school has fully integrated and activated the value of data assets. Combining core AI capabilities including large models, intelligent analysis, and adaptive recommendation, it has deeply iterated and upgraded the original mature "Xiaokun Moxin" digital platform, building an integrated, scenario-based, and scalable "digital base + agent platform" AI application cluster, providing precise, efficient, and intelligent support for Welkin "4D" Classroom.

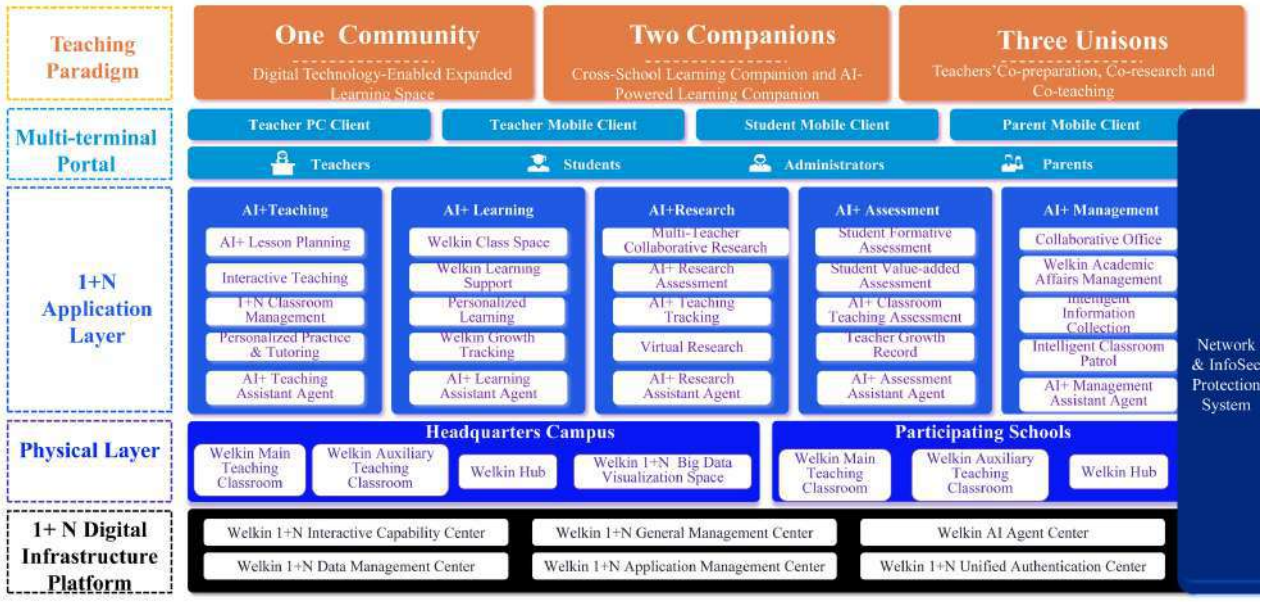

Figure 3 Digital Platform of Welkin School

Innovation Highlights

The four roles of welkin class work in real-time coordination, integrating professional leadership, field immersion teaching, and AI assistance, forming a new teaching pattern, enabling AI to move from a technical tool to deep integration into the full process of education. Leveraging live interaction and AI assistance, the welkin class is extended to high-quality social teaching scenarios, comprehensively promoting educational digital transformation.

1. Element Innovation

AI teaching assistants are established as a new class element, constructing a four-in-one classroom role system of "Main Teaching Teacher + Auxiliary Teaching Teacher + Field Immersion Teacher + AI", highlighting the new collaborative relationship between teachers, machines, and students.

2. Model Innovation

A learning field of "Main Teaching Classroom + Auxiliary Teaching Classroom + Social Scenarios + Virtual Space" is constructed, turning the entire world into a classroom, and creating a virtual-real integrated large teaching field (Gong et al., 2022; Gong, 2023)

3. Technology Innovation

The in-depth integration of artificial intelligence, 5G, big data, cloud computing computes with the whole process of Welkin "4D" Classroom teaching, building a digital platform to support Welkin "4D" Classroom.

4. Mechanism Innovation

A self-sustaining teacher echelon and cross-school collaboration mechanism are established. Relying on the "Headquarters Campus + N participating schools", we built a cross-school and cross-regional collaborative teaching and research mechanism, promoting teachers' professional growth.

Case Outcomes

1. Dual Improvement of Students' Comprehensive Competencies and Academic Performance

As of June 2025, the model has directly benefited over 10,000 students, and indirectly benefited over 40,000 students. Verified by controlled trials commissioned by the Ministry of Education, students in welkin classes saw a 62.3% increase in effective in-class interaction compared to traditional parallel classes, and a 51.2% rise in in-class mastery of core knowledge points. In the 2024 Shenzhen High School Entrance Examination, the subject excellence rate of welkin classes was 45.7% higher than that of traditional parallel classes in the same schools. Furthermore, evaluated under the national "Large-scale Student Cross-Stage Growth Tracking Research" project, welkin class students were rated at the highest level: "Excellence in Comprehensive Development". These students also won numerous awards in national competitions including mathematical modeling and sci-tech innovation, truly realizing the organic combination of large-scale education and personalized training.

2. Leapfrog Development of Teachers' Professional Capabilities

The "4D" collaboration mechanism built a cross-school learning and growth platform for teachers. It directly benefited more than 750 teachers, and indirectly benefited more than 4,000 teachers. Over the past two years, teachers in Welkin School delivered over 100 public lessons at the municipal level or above. A large number of young and mid-career teachers, such as Cheng Yuhe and Lin Qing, won awards in national, provincial, and municipal teaching competitions. 112 auxiliary teaching teachers were promoted to main teaching teachers, and 23 backbone teachers grew into municipal academic leaders. The award rate of welkin class teachers in teaching competitions at or above the district level reached 87%, effectively solving the problem of teacher job burnout and greatly shortening the growth cycle of young teachers.

3. Significant Outcomes in Regional High-quality and Balanced Education

With the resource radiation and model empowerment of Welkin "4D" Classroom, the participating weak schools in Shenzhen saw significant improvements in their school running quality. The school' reputation and appeal to prospective students grew year over year. The first batch of participating schools in Pingshan and Guangming districts successfully transformed into district-level Welkin centre schools, driving 21 schools in their districts to form Welkin communities, realizing the overall improvement of regional education quality, providing a practical path to solve the urban-rural and inter-school education gap.

4. Expanding Official Recognition and International Influence

The practices of Welkin "4D" Classroom were selected as an excellent smart education case by the Ministry of Education in 2022, won the UNESCO Global Smart Education Innovation Practice Award in 2024, and its results were incorporated into UNESCO's 2024 Global Education Monitoring Report (UNESCO, 2024). Xinhua News Agency Integrated Media's live broadcast drew over 1.2 million views. Educational peers from more than 20 countries, including Spain, Italy, Turkey, Serbia, Saudi Arabia, and Sri Lanka, have made special study visits, and some have reached intents to introduce the model to their own regions. In January 2025, "developing cloud-based schools" was officially incorporated into the Outline for the Construction of a Strong Country in Education (2024-2035)(MEPRC, 2025).

5. Continuous Improvement of Academic Outcomes and Resource System

As of June 2025, relying on Welkin "4D" Classroom, 1,297 high-quality digital teaching resources have been generated, and a 2240GB cloud resource library including scenario-based teaching videos and learning analysis data have been built. 4 monographs, 10 papers in CSSCI core journals (including People's Education and China Basic Education) and authoritative media are published, and 9 provincial and municipal teaching research projects are won approval (Gong et al., 2022; Gong, 2025). Also the first *National Guidelines for the Construction of Primary and Secondary Welkin Schools* is released, and Welkin School Professional Committee under China Association for Educational Technology is launched.

Scalability

1. Strong Universality

This model covers the whole process of classroom teaching in all grades and subjects of primary and secondary schools, and can adapt to various classroom types, including regular teaching, experimental teaching, scenario-based teaching, and interdisciplinary project-based learning. It adopts a hierarchical lightweight design, which can adapt to the financial level, infrastructure, and teacher conditions of different regions and school types. It core solves the common global problems of high-quality teacher shortage, unbalanced educational resources, and the difficulty of scaling personalized teaching, which are the core demands of countries around the world, so it has strong universality.

2. Clear Promotion Path

Through Welkin School Professional Committee under China Association for Educational Technology, regions can obtain technical support to locally replicate and adapt Welkin "4D" Classroom model, promoting the implementation.

3. Existing Implementation Cases

Relying on the experience of the "Headquarters Campus + N participating schools" community model, Welkin "4D" Classroom has formed a pattern of "headquarters demonstration, city-wide coverage, regional radiation, and cross-provincial replication":

• In Shenzhen, the model has achieved full large-scale city-wide rollout. The headquarters school has driven 27 participating schools to carry out regular operation. Pingshan District has driven 15 schools, and Guangming District has driven 6 schools.

• In Karamay, Xinjiang Uygur Autonomous Region, the full replication of the model has been officially launched, making it the first city-level large-scale implementation of the model outside Shenzhen. The model has also been implemented in Huanggang City and Wufeng Tujia Autonomous County in Hubei Province.

4. Promotion Suggestions

(1) Establish a mechanism with physical welkin schools as the core traction, to carry out overall planning, unified equipment selection, and standard output. Using the stability, professionalism, and continuity of physical school running, it forms a practical, replicable, and effective Welkin "4D" Classroom model.

(2) Focus on the demand of educational digital transformation, comprehensively build a professional teacher team with strong AI application capabilities and digital teaching literacy, systematically build the four-level teacher training mechanism of "Chief-Main Teaching-Auxiliary Teaching-Reserve", realizing the self-sustaining development and broad radiation of high-quality teachers, to support the replication and promotion of Welkin "4D" Classroom.

Conclusion

Welkin "4D" Classroom is an important achievement of Shenzhen Welkin School in school system innovation, in response to the wave of educational digitalization and artificial intelligence. It is a major innovation in classroom teaching reform in the AI era, exploring a replicable and scalable Chinese experience for global education, and laying a solid foundation for the vision of "building a future-oriented, world-leading Welkin School" (Gong, 2026).

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Case 4

E-Library for Teachers: AI-Enhanced Professional Development for Educators

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Background

The global education sector faces several pressing challenges that the UNESCO IITE E-Library for Teachers directly addresses. First, the rapid advancement of digital technologies, particularly generative AI, has outpaced the capacity of education systems to prepare teachers for their effective and ethical use. Many educators lack foundational AI competencies, creating a digital skills gap that hinders the integration of technology into teaching and learning. Second, the COVID-19 pandemic exposed the fragility of traditional education delivery models and accelerated the need for scalable, resilient, and inclusive distance learning solutions. During school closures, teachers required immediate access to digital tools, pedagogical guidance, and professional development resources - often in multiple languages and adaptable to local contexts. Third, there is a persistent need for human-centered, equitable, and gender-inclusive digital transformation in education, particularly in the Global South, Eastern Europe, and Central Asia, where resources and infrastructure may be limited. Fourth, educators require guidance on the ethical use of AI, data security, and media and information literacy (MIL) to navigate emerging risks such as misinformation, bias, and privacy violations.

The necessity of applying AI and digital technologies to these challenges is clear. AI can enable personalized learning pathways, automate content recommendations, and support multilingual accessibility - making professional development more responsive to individual teacher needs. The implementation objectives of the E-Library are to:

(1) provide a centralized, open-access repository of high-quality digital resources for teacher professional development;
(2) build AI competencies among educators through targeted courses, other types of free resources and allow for networking opportunities and ideas exchange;
(3) promote ethical, human-centered, and inclusive use of AI in education; and
(4) support Member States in achieving SDG 4 by strengthening digital capacity at the classroom level.

Case Implementation Status

The implementation of the UNESCO IITE E-Library for Teachers[1] has progressed through several phases, from demand analysis to technology partnership development and application optimization.

1. Demand Analysis: In the wake of the COVID-19 pandemic, IITE conducted needs assessments across multiple regions[2], including Eastern Europe, Central Asia, and Africa. Surveys and consultations with Member States revealed that teachers urgently required access to free, high-quality digital resources, training on distance learning techniques, and guidance on integrating technology into classroom practice. The pandemic disrupted education for over 1.5 billion learners globally[3], and teachers were often unprepared for the sudden shift to online and distance learning. IITE's response was to mobilize global education and technology partners for collective action, launching the initiative "Combat COVID-19: Keep learning - Together we are on the move!"[4] This initiative laid the groundwork for the E-Library by identifying priority content areas: digital tools, online pedagogy, assessment techniques, well-being education, and, increasingly, AI in education.

2. Technology Research and Development: The E-Library for Teachers was developed in strategic partnership with *NetDragon Websoft Holdings Limited* (hereinafter: *NetDragon*)[5], a global leader in digital education technology with expertise in AI, online learning platforms, and content management systems, and launched in 2022. NetDragon's technical capabilities enabled IITE to build a multilingual, scalable, and user-friendly platform that could host diverse resource types, including online courses, video lectures, analytical reports, policy briefs, and teaching guides.

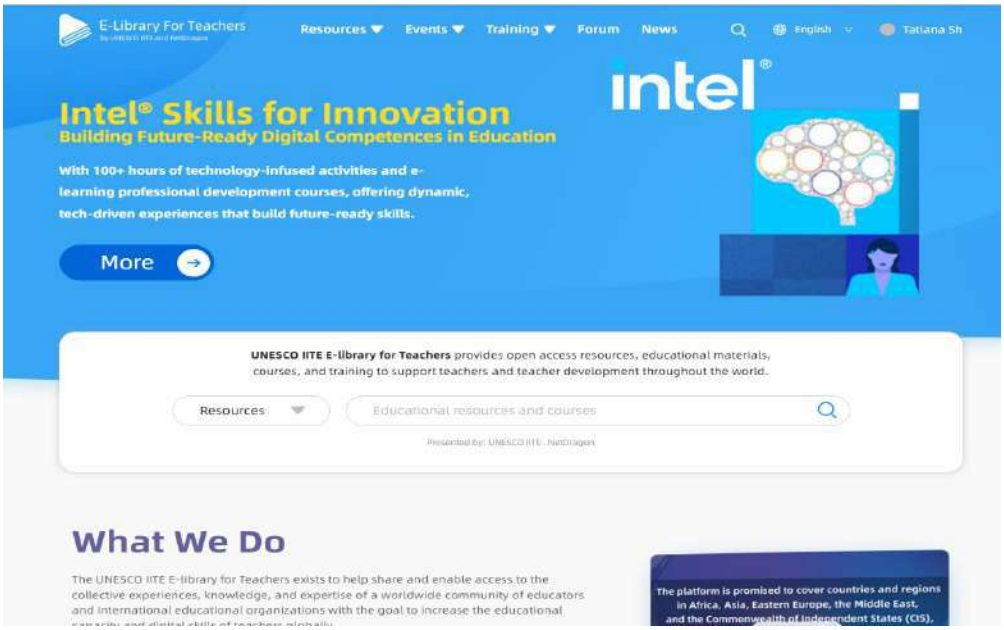

Figure 1 E-Library front page

[1] https://elibrary.iite.unesco.org/#/
[2] https://unesdoc.unesco.org/ark:/48223/pf0000379380
[3] https://www.un.org/en/academic-impact/covid-19-and-higher-education-ensuring-inclusive-continuity-education-through-global
[4] Combat COVID-19: Keep learning. Together we are on the move! – UNESCO IITE
[5] https://www.netdragon.com/content/2023-06-21/20230621024007064.shtml

A separate initiative launched in 2025 is “AI In Education: The Future Is Now”[6] which consists in a number of expert-authored videos which aim to provide educators with guidance on AI's role in teaching and learning. In May 2026 the second video series, focusing on hands-on demonstrations of AI tools for inclusive education, will be released.

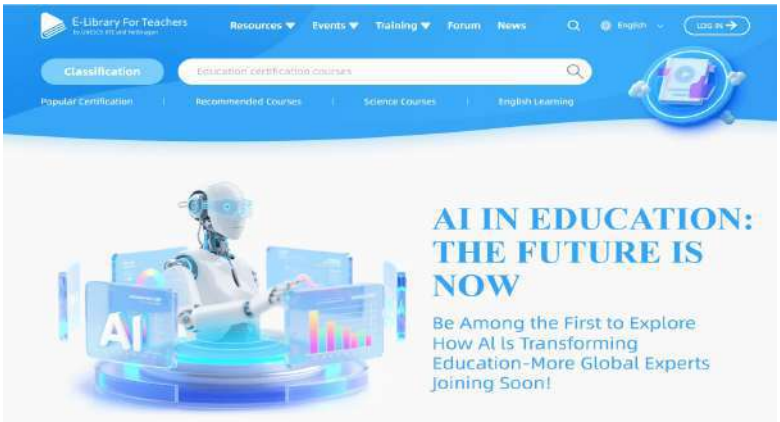

Figure 2 “AI in Education: The Future is Now” landing page

A special feature of the platform is its E-Teach Forum[7] for professional networking, ideas exchange and looking for collaboration opportunities (requires authorization). The platform supports open access and is designed to be interoperable with other UNESCO digital initiatives. While currently the platform does not have an explicit AI focus, possible avenues for its incorporation into the platform include automated keyword extraction and classification for content, automated content summarization of resources and key takeaways, recommendation system based on a teacher's subject, language, and experience level and an AI-powered tutoring chatbot with multilingual support.

3. Personalized Customization and Localization: Recognizing that teachers have diverse linguistic, cultural, and contextual needs, IITE prioritized multilingualism and localization. The E-Library offers resources in English, Russian, Chinese and Arabic relevant to its target regions; the E-Teach Forum currently has threads in English and Arabic languages.

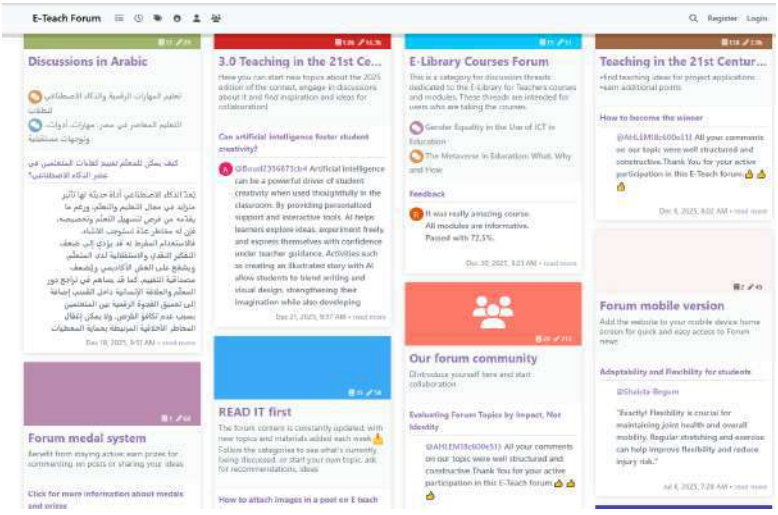

Figure 3 E-Teach Forum, integral part of E-Library for Teachers

[6] https://elibrary.iite.unesco.org/#/AIExperts

[7] https://elibrary-forum.sdpsg.101.com/?lang=en-US

4. Application Optimization: IITE continuously expanded and refined the E-Library's content based on user feedback and emerging priorities. Between 2024-2026, the Institute and NetDragon added 34 new online courses to the e-library which included courses developed by the University of Belgrade in Serbia and Intel® Skills for Innovation Initiative (SFI), focusing on AI competencies, lesson planning, programming in Python, and digital pedagogy. These courses were developed with partners (for instance, Asia e University (Malaysia), University of Belgrade (Serbia), Intel Skills for Innovation, Christ Deemed to Be University (India) and others) and designed for self-paced, asynchronous learning, making them accessible to teachers with limited time or internet connectivity. A number of courses and other resources in Arabic and Chinese are awaiting the upload.

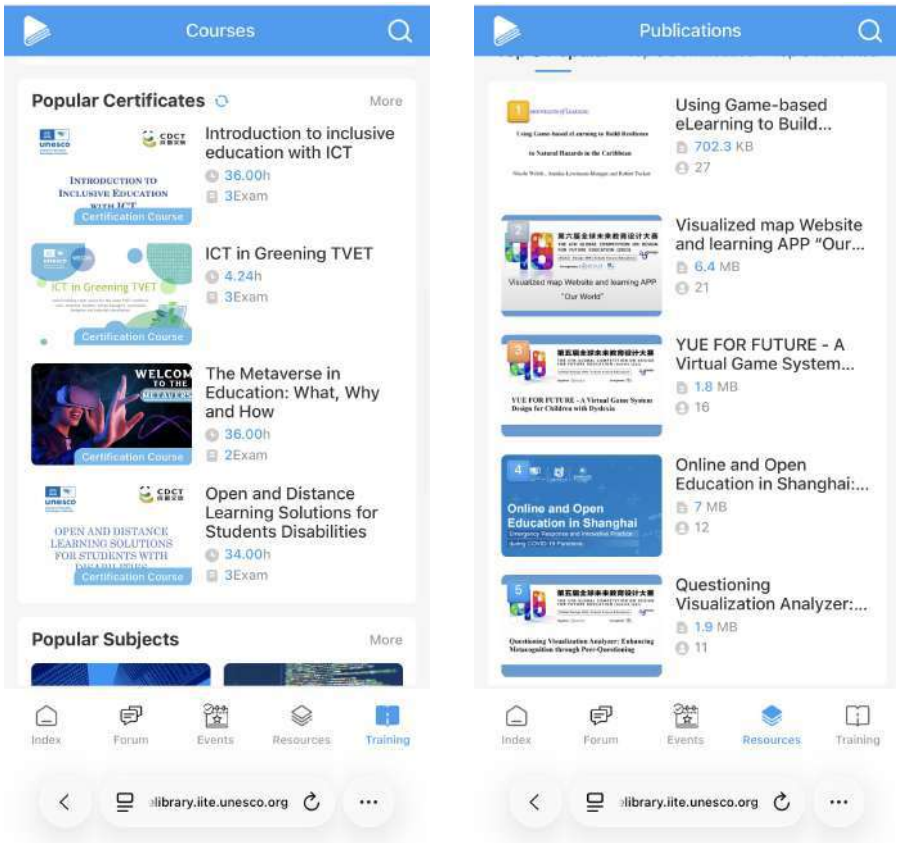

Figure 4 E-Library Courses and Publications

5. Integration with Broader Capacity-Building Initiatives: The E-Library does not operate in isolation. It is integrated into IITE's flagship webinar series "Harnessing Technologies to Transform Education," which covers themes such as AI ethics, data security, transformation of teaching through AI, green TVET, and AI competencies. Webinars are offered in English and Russian. These resources address both teacher professional development and broader societal digital inclusion goals. E-Library's regional partners (e.g., in Serbia, Russia and Egypt) provide onsite / hybrid trainings to local educators (e.g., over 60 Egyptian teachers were trained on the use of AI for education in November-December 2025). Currently, there is also currently discussed also an ambitious initiative to use the E-Library for Teachers and its capabilities for needs of UNESCO Associated School Network (UNESCO ASPnet) which encompasses almost 10,000 schools across 167 countries[8] as an information, networking and collaboration hub for the ASPnet teachers.

[8] https://elibrary.iite.unesco.org/wjtcontestnew?lang=en-US&auth=#4ff341fd-d73e-482f-8911-c854d691fb17/20

6. International Competitions and Engagement: To motivate teachers and students to develop AI competencies and digital skills, IITE co-organized several international competitions, including the Huawei ICT Regional Competition, the BNU-IITE Global Competition on Design for Future Education. Most importantly, the platform hosts its own IITE-NetDragon "Teaching in the 21st Century" competition (three annual contests, 2023 - 2025). Resources and success stories from these competitions are shared via the E-Library[9], creating a feedback loop of best practices. E-Teach Forum (integral part of the E-Library) serves as a discussion platform not only for the competitions' participants but also for those who take the online courses and is willing to discuss the newly acquired knowledge and share experience.

Figure 5 Winners of the Teaching in the 21st Century Competition - 2025 in Beijing (China)

7. Partnership and Governance: IITE's Governing Board, consisting of 11 members representing all regional groups with gender balance, provides oversight and strategic guidance. IITE strengthened its global collaboration network, partnering with the Global Smart Education Network, the Global MOOC and Online Education Alliance, the Global Network for Digital Lifelong Learning, and others. Donor partners include the public sector, charitable foundations, and technology companies.

Case Innovation and Breakthroughs

1. Main Innovation Content: The primary innovation of the E-Library for Teachers lies in its integration of AI competencies and ethical AI principles into teacher professional development at a global scale. Unlike traditional resource repositories that simply aggregate content, the E-Library is part of a strategic ecosystem designed to transform teaching practice. Key innovations include:

(a) Multilingual, localized content that serves diverse regions, including Africa, the Middle East, Eastern Europe, and Central Asia, reducing language barriers to professional development;

(b) AI-focused course offerings that build teacher competencies in generative AI, basic programming, media and information literacy, and more;

(c) Cross-sectoral content that addresses not only digital pedagogy but also gender equity, well-being and inclusion - recognizing that effective teaching in the digital era requires holistic support;

(d) Open access and sustainability ensuring that low-resource settings are not excluded.

[9] https://www.unesco.org/en/aspnet

2. Technology Breakthrough Content: The technological breakthroughs associated with the E-Library are about the creation of a comprehensive capacity-building ecosystem. Key technological achievements include:

(a) *Creating a Holistic ICT and AI Hub*: It functions as a centralized "hub" that serves four functions simultaneously: a resource center, a training center, a communication center, and a networking center for teachers worldwide;

(b) *Scalable online course delivery*: The E-Library uses a cloud-based infrastructure that supports asynchronous learning, allowing thousands of educators to access courses simultaneously without performance degradation. The technical level of this case is industry-leading for a UN category 1 institute, as it combines public sector mission-driven goals (IITE) with private sector technological expertise (NetDragon). The significance for educational informatization and digital transformation is profound: it provides a replicable model for how international organizations can partner with technology companies to build AI-enhanced professional development platforms that are ethical, inclusive, and scalable;

(c) An upcoming feature of E-Library will be *the AI Content Factory* - a scalable, cost-efficient platform for culturally adaptive content production created by NetDragon. It transforms educators' tacit knowledge into structured data and enables instant production of culturally- and age-appropriate teaching materials for further use in the classroom. AI Content Factory's dual-cycle quality control mechanism integrates real-time teacher feedback and expert reviews, ensuring both accuracy and continuous improvement.

These breakthroughs combine to form a scalable model for enhancing teacher capacity and, consequently, the quality of education on a global scale.

3. Application Practice Breakthrough Content: The platform directly supports educators in target countries of Serbia, Tunisia, Ghana, Egypt, Russia, and Thailand through open-access digital resources and training. It actively engages ministries, with a core objective to boost the ICT and AI competencies of around 100,000 teachers worldwide, directly contributing to SDG 4.

The breakthroughs in application practice lie in

(a) *integration of AI competencies into teacher training*: The E-Library's 34 new online courses represent a shift from basic digital literacy to advanced AI competencies, preparing teachers for the generative AI era, and

(b) *gender-equitable and inclusive approaches*: The publication of the online course on "Gender Equality in Use of ICT and AI in Education" is a breakthrough in applying a gender lens to AI in education - a rare focus among international development initiatives.

The value for domestic basic education, particularly in low- and middle-income countries, is that the E-Library provides a low-cost, scalable model for teacher professional development that can be adapted to local languages and contexts, without requiring massive infrastructure investment.

4. Intellectual Property Status: The intellectual property (IP) ownership and distribution for the E-Library for Teachers is managed as follows:

(a) UNESCO IITE retains ownership of the core platform and the educational content developed directly by IITE staff or partners or through its regular programme budget;

(b) NetDragon, as the technology partner, holds IP rights to underlying software, algorithms, and proprietary code, while licensing these to IITE for the purposes of the E-Library;

(c) Voluntary contributions and partner-developed content: Courses and resources developed with donor partners or third-party organizations are subject to separate IP agreements, typically allowing IITE to host and distribute the content freely for non-commercial educational purposes;
(d) Open access policy: Consistent with UNESCO's mandate, resources on the E-Library are made available as open educational resources (OER), meaning they can be freely accessed, adapted, and redistributed for educational purposes, with appropriate attribution. The IITE brand and the E-Library name are protected as UNESCO property. The IP framework supports the Institute's mission of equitable access while respecting partner contributions.

Promotion Value and Risks

1. Application Prospects and Achievements: The E-Library for Teachers has already achieved significant scale: its repositories have 40+ online courses, over 400 multilingual resources on AI, greening education, vocational skills, and other SDG4 related topics; 54 open tools for digital teaching and remote learning and over 450 real-world best practices from 20+ countries (the results of Teachers' competitions). Its most active audience resides in South Asia and Middle East (Pakistan, India, Egypt)
The operation and management model is a decentralized, partnership-based approach: IITE provides the core platform and curates content, while regional partners (e.g., ministries of education, universities, NGOs) select the locally-relevant content, create the resources, or adapt and deliver training locally. The model is highly scalable: the platform's cloud-based infrastructure can accommodate unlimited users, and new courses can be added with marginal cost. Large-scale promotion is feasible through UNESCO's network of Member States, category 2 institutes, and Associated Schools.
2. Social and Economic Value: Socially, the E-Library democratizes access to quality teacher professional development, reducing inequalities between high-resource and low-resource education systems. By providing free, multilingual, open-access resources, it supports inclusive education, gender equity, and digital inclusion for persons with disabilities. The AI-focused courses prepare teachers for the future of work, enhancing students' digital competencies and economic opportunities. Economically, the E-Library reduces the cost of teacher training for Member States, as resources are freely available and can be adapted locally without expensive licensing fees.
3. Demonstration and Leading Role: The E-Library serves as a global model for how international organizations can leverage AI and public-private partnerships to transform teacher professional development. Its emphasis on ethical, human-centered AI - rather than technology for technology's sake - provides a replicable framework for other UN agencies, governments, and NGOs.
4. Potential Risks:
(a) *Ethical risks*: There is a risk of data privacy violations if user data is not properly secured. Mitigation: IITE's adherence to UNESCO's AI ethics recommendations, data security guidelines, and transparency in partnership agreements.
(b) *Sustainability risks*: The E-Library depends on project-based funding. Core resources from UNESCO and the host country (Russian Federation) are essential but limited. If funding decreases, content updates and technical maintenance could suffer. Mitigation: IITE's proactive diversification of donors and partnerships.

Case 5

Singapore's Adaptive Learning System (ALS) in Student Learning Space

Chia Hai Siang

Ministry of Education, Singapore

Background

Singapore's Student Learning Space (SLS) is a national learning platform rolled out to all primary to pre-university students since 2018. The SLS serves to transform the learning experiences of Singaporean students through the purposeful use of technology, including the use of Artificial Intelligence in Education (AIED) (MOE, 2026b).

One of SLS's AIED features is its Adaptive Learning System (ALS), which was piloted in 2022 and released in 2023. At its heart, the ALS is a traditional Intelligent Tutoring System (ITS) which uses machine learning to recommend personalised learning pathways to students. The ALS is designed to be used for all subjects and levels.

ALS uses Bayesian Knowledge Tracing (BKT) and Knowledge Space Theory (KST) to model student mastery within and across concepts/skills. Over time, this student modelling improves through optimisation of parameters such as guess, slip, learn and prior knowledge and improve the accuracy of their probability estimates.

The ALS's Domain Model, which describes the relationships between the concepts within a subject via concept maps, is initially built up by curriculum experts from the Ministry of Education (MOE) according to Singapore's national curriculum and subsequently refined over time through statistical analysis of learner data (Goldin et al, 2016).

ALS's Tutor Model, which sets out suitable instructional strategies for each concept, is made up of banks of expert-crafted lesson activities and assessment items. For students mastering a concept, all adaptive learning sessions loosely follow the 4 Active Learning Processes described in MOE's EdTech Pedagogical Scaffold (Activate Learning, Promote Thinking and Discussion, Facilitate Demonstration of Learning, and Monitor and Provide Feedback).

This common subject-agnostic structure grounded in learning science ensures that all students will engage in active sense-making, reflection and knowledge creation even as the ALS recommends different activities to each student. These content and item banks are refined over time via student feedback and psychometrics, i.e. Item Response Theory (IRT).

ALS's User Interface (UI) is the final piece that rounds off the 4-component architecture widely used to define ITSs (Fang et al., 2018). As an integrated feature within SLS, the ALS shares similar UI with other non-adaptive lessons/assignments in SLS. This reduces the need for users to have to adjust to different UI and facilitates SLS's seamless transitions between adaptive and non-adaptive experiences (see later).

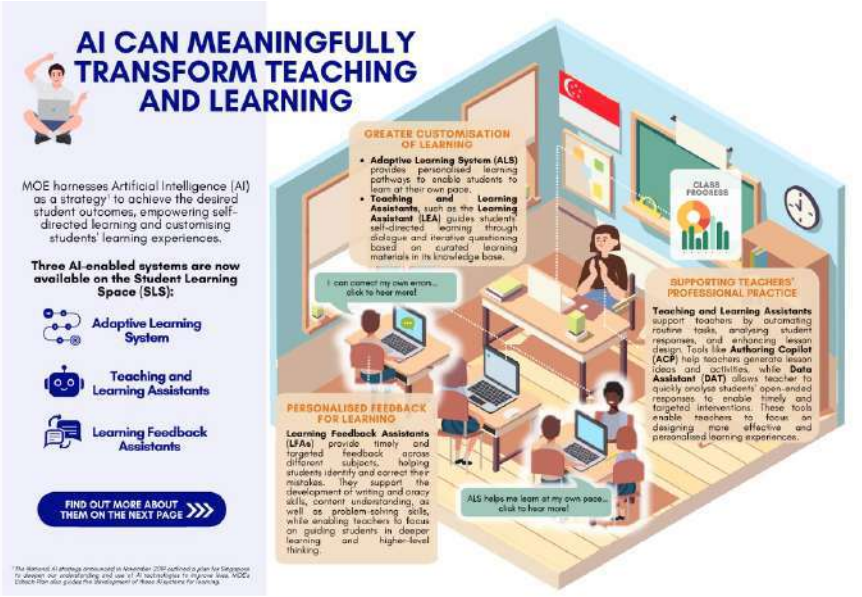

Figure 1 Singapore's Student Learning Space, SLS

Case Implementation Status

The ALS is currently implemented for all schools in 2 subjects – Mathematics at Upper Primary and Lower Secondary levels, and Geography at Secondary 3 level. About 150K students currently have access to ALS. There are ongoing pilot explorations to expand ALS to other subjects/levels as well as domains such as 21st Century Competencies and Digital Literacy/Technological Skills (DLTS). Some schools have also developed their own ALS instances (see later).

Case Innovation and Breakthroughs

Two main characteristics make SLS's ALS unique – its intentional design for use by teachers within class instruction and synergy with other AIED features.

1. Intentional ALS design for teacher use within class instruction

ALS addresses the problem of ALS adoption and teacher resistance (Létourneau, 2025) through its design. Like most ITSs, ALS primarily supports student self-learning, since one of its major affordances is its ability to recommend the next appropriate concept for students based on their mastery (what we consider as "between-concept" or macro-adaptivity). However, using ITSs in this way means teachers lose their traditional ability to control/constrain the topic/concept being covered by their students during classroom instruction; many teachers struggle to manage classes with every student going through individualized/unique content, process and pace at the same time. Consequently, ITS-mediated self-study is often kept distinct, and supplementary to in-class instruction.

To solve this problem, ALS allows teachers to create adaptive sections within non-adaptive lesson modules. Students can follow content common to the whole class or a group for certain portions of a lesson, before transiting on to personalised/adaptive content done as individual seatwork. In this way, teachers can continue to orchestrate the overall progress of the class, while allowing for segments of self-paced learning or adaptive testing ("within-concept" or micro-adaptivity).

At the same time, since most traditional ITSs recommend pre-existing (e.g. vendor procured) or expert-crafted content and assessment items to students, teachers lack a way to design their own adaptive content and items.

ALS allows schools and teachers to supplement the centralised activity and item banks created by MOE

curriculum officers with their own content and assessment items, accessible only to their own students. Since teacher-designed assessment items are only ever attempted by a small sample of students, collected learning data lacks the statistical power to accurately inform item demand and consequently model mastery. Nevertheless, this affordance provides a means to customise ALS content to meet local needs, improving teacher agency and adoption. Beyond creating content and items, schools can also create their own ALS instances that follow their own domain models. This allows schools to use ALS even when they don't strictly follow MOE's centralised curriculum; schools can add their own concepts/skills to an existing concept map, or use ALS for their own school-based subjects.

2. Synergy with Other AIED features

SLS offers a wide range of other AIED tools (MOE, 2026a) that work synergistically with ALS to provide truly personalised learning experiences (not just pathways).

The rise of generative AI has led to suggestions that LLM-powered adaptive systems might replace ITSs. Borchers and Shou (2025) have demonstrated that frontier models still cannot match the adaptivity of traditional ITS, particularly in their ability to provide differentiated feedback based on student errors and diversity of feedback (i.e. when to correct vs when to question further). Other advantages of traditional ITSs over LLMs include (a) ITS's models are not "black boxes", (b) ITS's recommendations can be derived deterministically (rather than probabilistically), and (c) recommendations can be consistently and coherently shared across students, teachers and other stakeholders across the system. Nevertheless, generative AI offers powerful opportunities for further personalisation and adaptivity at specific points of the learning experience, particularly "within-activity" interactivity, assessment and feedback.

LLMs are used by SLS as student-facing chatbots/tutoring agents (Learning Assistant or LEA) and as Feedback Assistants (FAs). These capabilities supplement ALS's macro- and micro-adaptive recommendations. For example, an expert-prompted LEA instance anchored to a textbook chapter could role-play as a historical figure to teach a student about a historical event. FAs guided by a marking scheme or rubric can give detailed and real-time feedback to student free responses. This means adaptive sessions that are no longer limited to the instructivist pedagogies and close-ended assessments commonly associated with ITSs. At the same time, since task-level personalisation is handled separately by LLMs rather than ALS, this means that concepts/skills in ALS domain models do not need to be overly granular and can remain human-understandable. Compared to the 10K knowledge points in a subject in Squirrel AI for example (Forbes China, 2025), ALS concepts instead number around 1K for each subject and are the same as those used by teachers and students in non-adaptive instruction.

Generative AI is also useful for addressing other challenges of traditional ITS adoption. SLS uses LLMs for lesson authoring through its Authoring Copilot; it can currently generate lesson plans, content, various forms of assessment, rubrics, suggested answers, gamification, images as well as interactives and simulations through vibe-coding, significantly accelerating resource development.

AI generated gamification provides a means to extrinsically motivate students (typically an area of concern for ITSs), while vibe-coded simulations or even games allow stealth assessment to serve as another way to diagnose student mastery. Unlike products such as Khan Academy that use LLMs to generate questions on the fly without expert oversight, SLS uses LLMs to generate content which must first be reviewed manually by human curriculum developers before it is recommended to students, reducing the risk of hallucination and keeping teachers-in-the-loop.

Promotion Value and Risks

An internal MOE study on Primary 5 Maths in 2022 showed students using ALS performed better compared to teacher-led, large group instruction (g=0.3). An upcoming Randomised Control Trial (RCT) will attempt to tease out the effect of micro-adaptivity specifically (i.e. within-concept adaptivity) on student learning, compared to non-adaptive computer-based instruction. The findings from this study will be available by Dec 2026.

Beyond the impact on student learning, ALS offers secondary benefits such as a more accurate and current accurate estimation of students' level of concept mastery, that can lead to better learning regulation and intervention by teachers. Real-time reports on domain and tutor models (i.e. concept map, content quality, item demand and psychometric properties) provided to curriculum developers and teachers can lead to faster and better evidence-based curriculum, content and assessment reviews.

Some future research directions MOE is looking into include comparing the efficacy of proprietary adaptive algorithms promoted by different ITS providers, improving ALS's affective intelligence, facilitating group learning/assessment through ALS, and decomposing performance in multi-concept assessments into individual concept mastery. Findings from these studies will inform ALS's future development.

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Case 6

Mindspark's AI Ecosystem for Personalised Adaptive Learning in Low-Resource Schools at Scale

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Mona Foundation, USA

Summary

Across India and Africa, millions of children attend school every day but learn very little. The cause is well understood: classrooms teach to the grade, not the child, leaving students who have fallen behind to fall further behind with each passing year. For children from tribal communities, low-income households, and marginalised backgrounds, this gap is rarely recovered.

Educational Initiatives (Ei), founded in 2001, set out to solve this problem at scale. Drawing on two decades of large-scale student assessment research and hundreds of millions of data points, Ei built Mindspark, an AI-powered Personalised Adaptive Learning platform that diagnoses each student's actual learning level and constructs a fully individualised learning journey in real time. Every child works at their own level. Every teacher receives AI-generated insights on misconceptions, performance gaps, and targeted remediation plans. The platform runs offline, on basic devices, in nine languages, making it genuinely deployable in the most under-resourced schools in the world.

The evidence is unambiguous. Two independent J-PAL Randomised Controlled Trials, multiple third-party evaluations, and consistent results across geographies confirm that Mindspark delivers up to 5 times more learning than traditional teaching, and an estimated 5 to 15% improvement in lifetime income potential per student. Today, Mindspark operates across 3,700 government schools in 14 Indian states and is expanding in South Africa and Zambia.

Through the Amazon Future Engineer, Ei is bringing structured AI and Computational Thinking education to 40,000 students in tribal and social welfare government schools in India, to students who are first-generation learners with no prior access to computer science education.

Mindspark demonstrates that AI in education is not a privilege for the well-resourced. Designed with equity at its core, it is a scalable, evidence-backed model for opening new futures for the children who need it most.

Background

Across the Global South, millions of children attend school but fail to learn. In India, ASER 2025 reports that over 50% of Class 5 children cannot read a Class 2 text. In South Africa, 81% of Grade 4 students cannot read for meaning (PIRLS 2021) and over 60% of Grade 6 students fail to reach basic maths proficiency. These challenges are driven by a shortage of qualified teachers and worsened in under-resourced, overcrowded, and multi-grade rural classrooms.

The challenge is compounded for the most marginalised. Tribal and first-generation learners, particularly girls, face the steepest barriers. Even where digital infrastructure exists, it is rarely designed for low-resource, multilingual, or low-connectivity environments. And beyond foundational literacy and numeracy, a new gap is emerging: the absence of AI and computational thinking skills that the global economy increasingly demands.

Educational Initiatives (Ei), founded in 2001, was built to address these failures. Through two decades of assessment research and pedagogical innovation, Ei developed Mindspark, an AI-powered Personalised Adaptive Learning platform that diagnoses each student's precise learning level and delivers individualised instruction in real time. Today, Mindspark reaches over 300,000 students across India, with expansion underway in South Africa and Zambia.

Within India, the Amazon Future Engineer program extends this mission further, bringing not just foundational learning, but structured AI and Computational Thinking education to 38,000 to 40,000 students in tribal and social welfare schools across Telangana, 76% of whom are girls.

For the past six years, Mona Foundation, a US based nonprofit founded in 1999 focused on providing access to education to all children and girls empowerment as a key lever of alleviating poverty and sustainable community development, has been a close partner to Educational Initiatives in the implementation of Mindspark in India, South Africa, and Zambia. We are committed to the sustained support of this program as an important tool to collapsing the digital divide currently threatening building a more equitable, prosperous and just communities for all children everywhere.

Implementation

1. Demand Analysis: Understanding the Problem Before Building the Solution

Educational Initiatives (Ei) was founded in 2001 by researchers who spent years observing a troubling pattern: children attended school, teachers taught, but learning did not happen. Through two decades of large-scale student assessments across India, Ei uncovered the root cause. Classrooms were built around the curriculum and the grade, while students were scattered across vastly different actual learning levels. A single Grade 8 classroom could contain students operating anywhere between Grade 2 and Grade 8 in real ability.

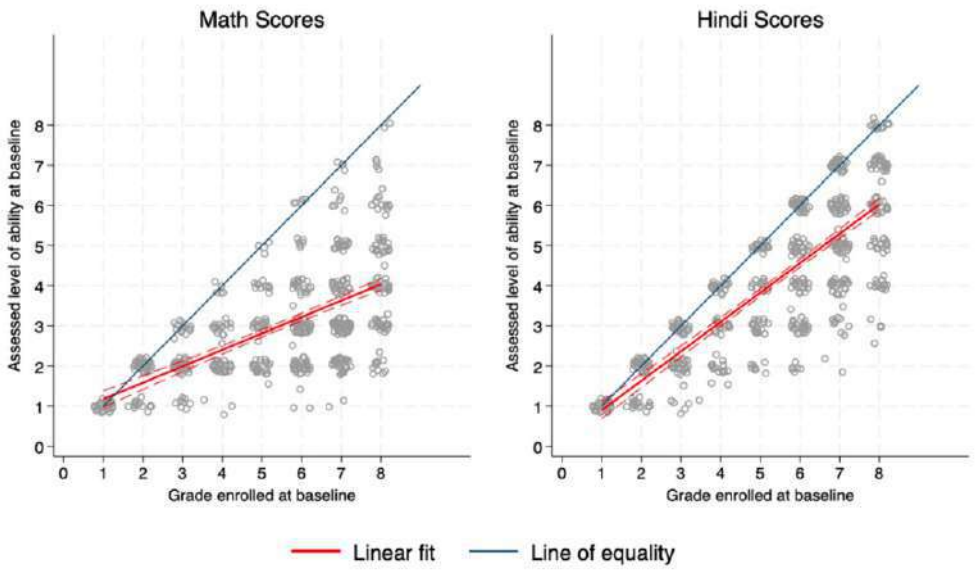

Figure 1 Data from J-PAL's RCT showing the gap between enrolled grade and actual assessed ability in Math and Hindi. The red line (actual performance) falls consistently below the blue line (grade-level expectation), illustrating how far behind students are from where the curriculum assumes they are.

Crucially, Ei's assessments revealed something beyond learning gaps: predictable patterns of student misconceptions. When asked whether 2.3 or 2.27 is larger, many students chose 2.27 because it has more digits, applying whole-number logic to decimals. These recurring error patterns, catalogued across millions of student responses, became the foundation on which Mindspark was built, making it qualitatively different from software that simply delivers curriculum content at pace.

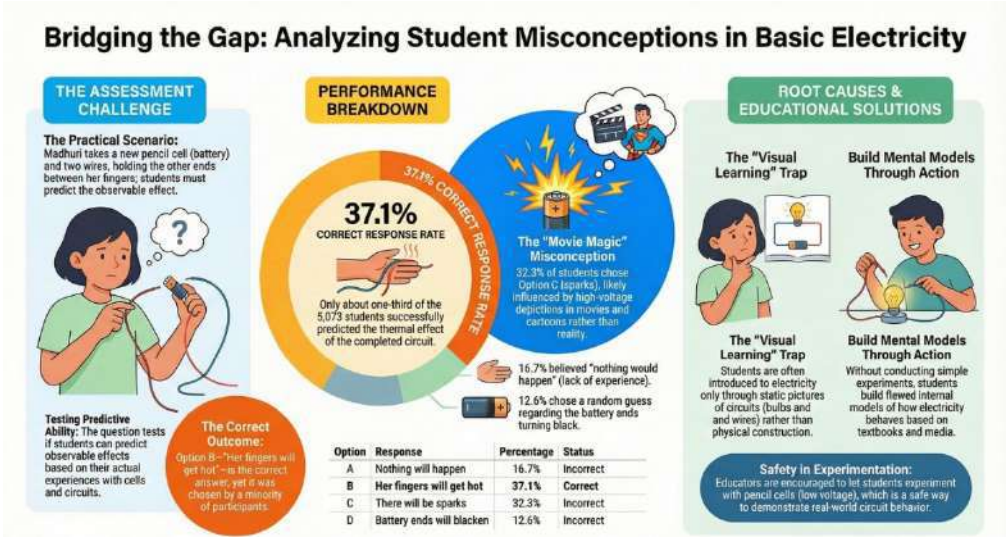

Figure 2 An Ei misconception analysis example from a science assessment, showing how only 37.1% of students answered correctly while the majority clustered around a predictable wrong answer rooted in a specific conceptual misunderstanding. This is the type of data that powers Mindspark's AI diagnostic engine.

2. Technology Research and Development: Building on Evidence

Mindspark launched in 2009, drawing on this assessment-led research. Its AI-enabled adaptive algorithm uses a database of over 45,000 field-tested questions to do two things simultaneously:

identify where each student actually is in their learning, and identify the specific conceptual error driving their mistakes. It then constructs an individualised learning path through interactive animated activities, gamified challenges, and exercises calibrated to the child's actual ability, not their grade.

The adaptation is continuous. An incorrect response triggers a diagnostic branch: if a student gets a fraction multiplication problem wrong, the system tests whether they understand fractions at all, then multiplication, working backwards to find the precise conceptual bottleneck before rebuilding from there. This granular personalisation was made possible only through Ei's expertise in deep pedagogical research and a proprietary dataset built from hundreds of millions of student responses over two decades.

3. Personalised Customisation: How Mindspark Works

Every student begins with a diagnostic assessment that immediately benchmarks their learning level. From that point, every question is selected by the AI based on running performance. For teachers, a parallel layer of AI intelligence operates alongside: a voice-enabled Teacher Co-Pilot answers natural-language queries about class performance, MindBot generates instant insights from live student data, and an automated remediation plan generator identifies recurring conceptual failures and produces targeted teaching plans.

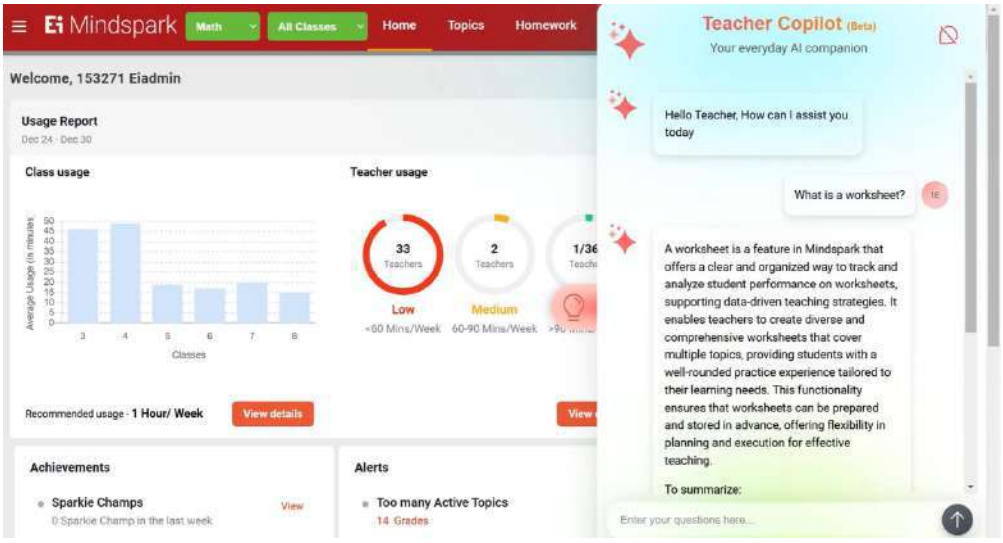

Figure 3 The Mindspark Teacher Co-Pilot interface, showing a teacher dashboard with class usage data alongside an AI assistant responding to the query "What is a worksheet?" The Co-Pilot provides instant, contextual support so teachers can navigate the platform and act on student data without technical training.

Students who are stuck interact with Sparky, an AI Socratic tutor that guides them through problems with questions rather than answers. A Generative AI feature, StoryBuilder, enables students to co-create personalised stories, demonstrably increasing reading engagement and sustained time on platform.

Mindspark runs on smartphones, tablets, laptops, and desktops, is available in nine Indian languages, and functions fully offline. In Africa, implementation partner Edulution deploys Mindspark via offline tablets in under-resourced schools in South Africa and Zambia, with locally hired Learning Assistants supporting delivery and provincial Departments of Education monitoring outcomes at the classroom level.

Figure 4 Students using Mindspark on tablets in classrooms in South Africa and Zambia. The four-panel photo shows children across different school settings engaged with the platform, illustrating how the offline, device-agnostic design enables consistent learning experiences in low-resource African school environments.

4. Implementation Optimisation: Scaling Through Evidence

Mindspark was first deployed in after-school centres in low-income neighbourhoods in Delhi in 2014. A J-PAL Randomised Controlled Trial in 2015 across 619 middle-school students found that those with access to Mindspark scored 0.37 standard deviations higher in math and 0.23 higher in Hindi in just 4.5 months, with equal gains across genders, income levels, and ability levels. When the centre-based model proved financially unviable for low-income families, Ei redesigned the entire delivery model to embed Mindspark within government school timetables.

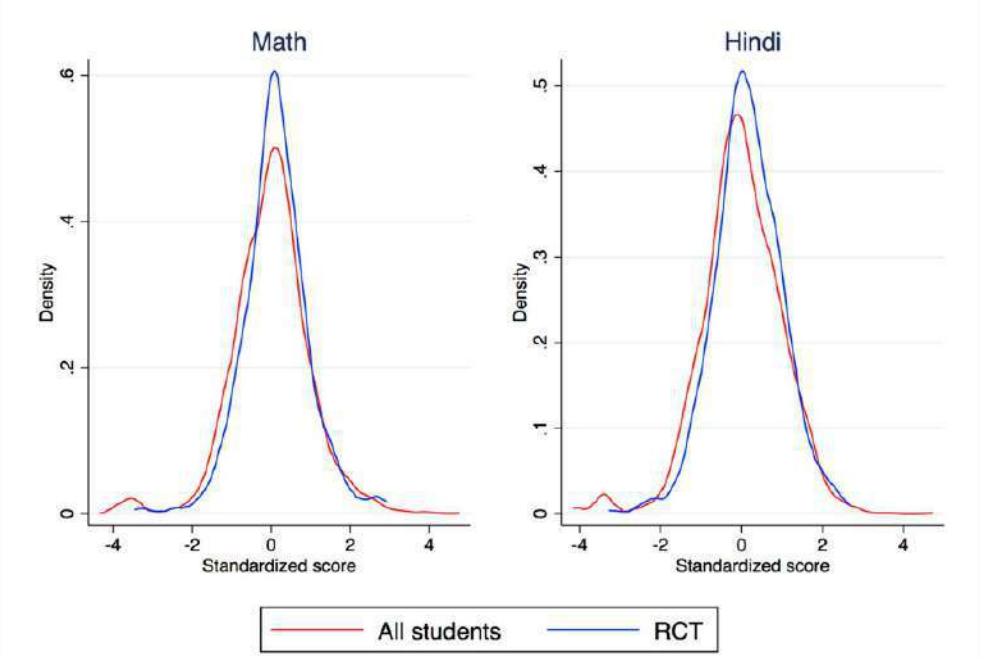

Figure 5 Pre-program achievement comparison from the J-PAL RCT in Delhi, India, showing near-identical baseline distributions between study participants and non-participants in both Math and Hindi. The overlap confirms that learning gains observed after the intervention were attributable to Mindspark, not pre-existing differences between groups.

A second J-PAL RCT in 2017, across 80 schools and 6,500 students in Rajasthan confirmed the in-school model worked: after 18 months, treatment schools showed 0.22 SD gains in math and 0.20 SD in Hindi, with productivity improving by 80% to 100% over business-as-usual, delivering up to four times more learning per rupee, all within existing school hours.

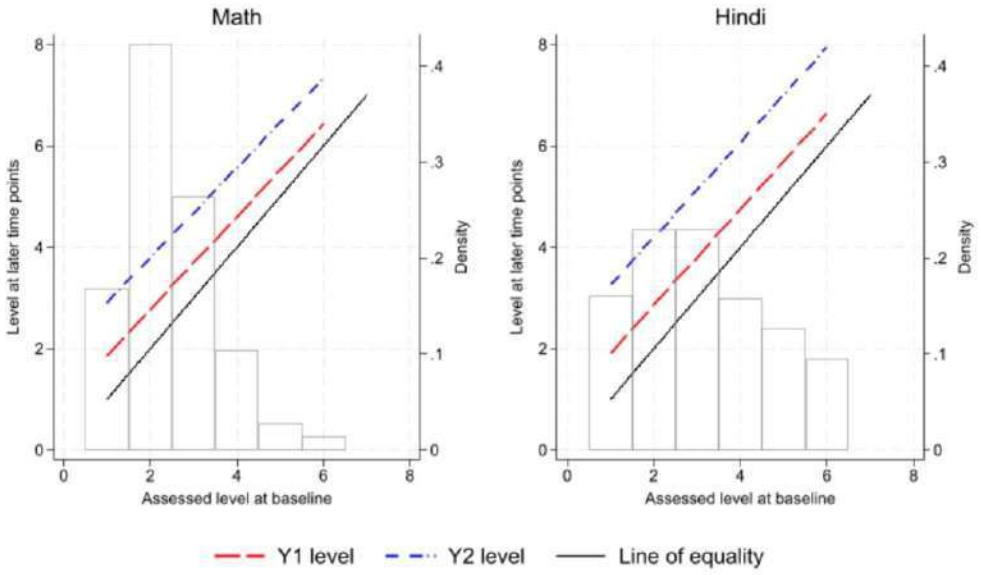

Figure 6 Learning progress in treated schools after two years from the J-PAL RCT in Rajasthan, India. Both Year 1 (red) and Year 2 (blue) learning trajectories in Math and Hindi consistently exceed the baseline, demonstrating that gains were sustained and grew over time rather than representing a one-off effect.

This evidence shaped India's National Education Policy 2020 and government tenders in multiple states. Today, Mindspark reaches over 300,000+ students across India through partnerships with CSR funders, philanthropies and NGOs alongside growing implementation in South Africa and Zambia.

5. The Amazon Future Engineer Programme: Extending the Frontier

Partnering with Amazon Future Engineer, Ei introduced Computational Thinking (CT) as a fourth core subject within Mindspark, the first time such content was embedded within an adaptive platform designed for low-resource government schools. Students engage through CT Learn, which delivers structured logic puzzles and algorithmic games, and CT Create, an open-ended sandbox where students progress from block-based to text-based coding through creative contexts including art, music, and storytelling. The curriculum covers eight strands spanning Logical Thinking, AI Foundations, Data Analysis, Digital Literacy, and Interdisciplinary Projects, aligned to OECD, UNESCO, AI4K12, DigComp 2.2, and India's CBSE frameworks.

Figure 7 The Mindspark CT Learn module interface, showing a student's learning dashboard with topic cards spanning Graph and Charts, Brain Teasers, and logic-based challenges. The honeycomb layout organises learning by strand, allowing students to navigate their personalised CT curriculum across different difficulty levels.

Implementation is teacher-led and sustainable. Over 500 ICT instructors received a 10-hour onboarding programme requiring no prior Computer Science expertise. The programme runs within existing school timetables, functions offline, and continuously tracks student progress through Mindspark's diagnostic engine. It currently reaches 38,000 to 40,000 students across 110 government residential schools in 26 districts of Telangana, 76% of whom are girls from tribal and marginalised communities.

Figure 8 Students in a Telangana, India's government residential school working independently on Mindspark during a scheduled lab session.

Case Innovation and Breakthroughs

Mindspark's foundational innovation is replacing grade-based instruction with ability-based learning. Every child works at their actual level, with every question, activity, and challenge individually calibrated by the AI in real time. This transforms the teacher's role from content deliverer to targeted intervention specialist, supported by AI-generated performance summaries, misconception reports, and automated remediation plans.

The more distinctive innovation is Mindspark AI and Digital Thinking, which redefines what CS education looks like for the AI era. A direct comparison with standard coding platforms reveals how fundamentally different the approach is:

How Mindspark AI & Digital Thinking compares to standard coding platforms

FEATURE	STANDARD CODING PLATFORMS	MINDSPARK AI & DIGITAL THINKING
Project Utility	ISOLATED Students build "calculators" they never use again. CS stays disconnected from the rest of their schoolwork.	INTERDISCIPLINARY Students build *actual usable tools* — pendulums, graphers, simulations — connected directly to Math and Science.
Coding Paradigm	SYNTAX-HEAVY 20+ hours on manual syntax memorisation. Ignores the reality that AI now writes most code.	AI-ASSISTED "Hybrid Coding" — students architect the logic; AI handles the syntax. Reflects how coding works in the real world.
Teacher Visibility	BLACK BOX Teacher sees only the final output. No insight into whether a student struggled, copied, or guessed.	PLAYBACK MODE Teacher can replay a student's *entire coding process* step by step to diagnose exactly where thinking broke down.
Grading	BINARY "Did it run?" No ability to assess quality of thinking, elegance of solution, or depth of understanding.	AI + HUMAN LOOP AI provides instant partial grading and flags concerns. Teacher acts as final validator — speed combined with judgment.
Content Format	PASSIVE Outdated instructional videos. Passive consumption that loses student attention quickly.	ACTIVE LEARNING Fully interactive, text-light, and vernacular-ready. No watching — only doing. Every screen requires a student response.
Adaptivity	STATIC One-size-fits-all lesson plans. High achievers plateau; struggling students fall further behind and disengage.	FULLY ADAPTIVE Personalises the path based on *how* each student thinks — reading error patterns, response speed, and reasoning style.

Figure 9 Comparison with standard coding platforms and Mindspark AI & Digital Thinking

The curriculum is structured around eight progressive strands, building from logic games and digital literacy in primary grades, through data visualisation and AI foundations in middle school, to interdisciplinary projects and AI-assisted coding at the secondary level.

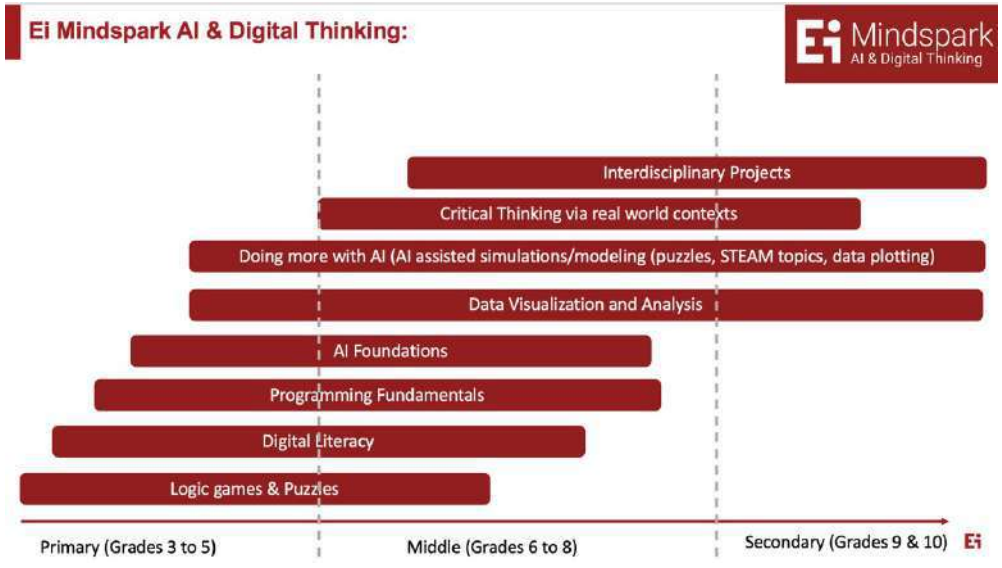

Figure 10 The Mindspark AI and Digital Thinking curriculum progression across Grades 3 to 10, organised by developmental stage.

Technology Breakthrough

Mindspark's core technological advance is an AI system built on error pattern analysis rather than content delivery logic. Drawing on two decades of Ei's assessment research and hundreds of millions of student response data points, the platform identifies not just what a child gets wrong, but the specific thinking pattern behind the error, a level of pedagogical intelligence that general AI tutoring tools have not replicated at a comparable scale in low-resource, multilingual contexts.

Articulate is a speaking evaluation AI that assesses narrative oral communication in real time with automated scoring and feedback across vocabulary range, grammatical accuracy, fluency, pronunciation, and clarity of organisation. This is a skill almost entirely absent from EdTech solutions serving low-resource schools.

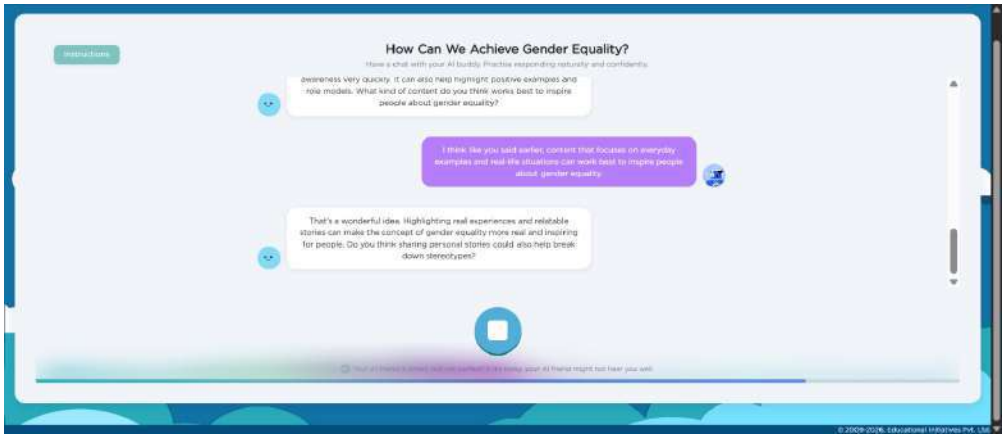

Figure 11 Articulate's AI conversational practice interface, showing a student engaged in a discussion about gender equality with an AI buddy. The student types responses and receives guided follow-up questions that encourage deeper thinking, practising both spoken English and critical reasoning simultaneously.

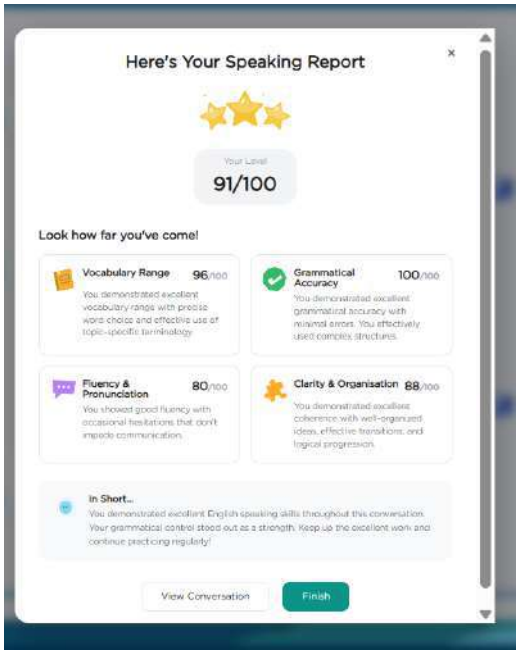

Figure 12 Articulate's speaking report interface showing a student's overall score. The report provides personalised written feedback for each dimension, giving students and teachers actionable insight into oral communication skills that most platforms do not measure at all.

StoryBuilder lets children co-create personalised stories through structured choices and has measurably increased reading engagement, time on platform, and questions attempted.

Within the AI and DT curriculum, additional breakthroughs include:

Prompt2Poster — a Generative AI module where students iteratively refine text prompts to co-create visual outputs, building genuine prompt engineering skills.

AI-Powered Socratic Hints — students are guided through challenges with questions rather than answers, reinforcing reasoning over recall.

Playback Mode — teachers can replay a student's entire coding process to diagnose logic gaps, replacing the black-box "did it run?" model of other platforms.

Hackathon and Project Gallery — students build real, usable tools, including pendulums, graphers, and simulations that connect directly to their Math and Science learning.

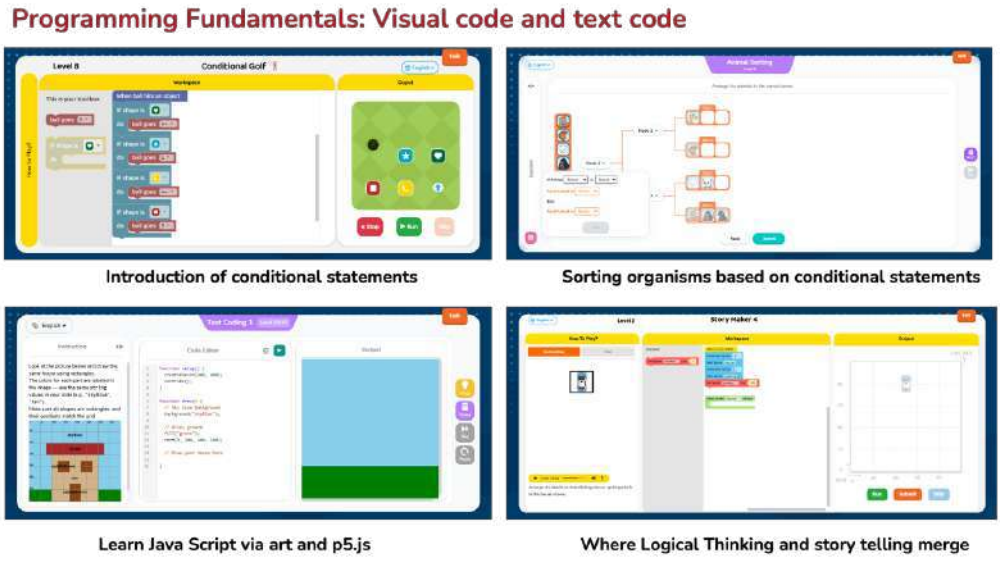

Figure 13 Articulate's speaking report interface showing a student's overall score. The report provides personalised written feedback for each dimension, giving students and teachers actionable insight into oral communication skills that most platforms do not measure at all.

For the EdTech sector, the significance is clear: Mindspark demonstrates that sophisticated AI-powered learning is deliverable fully offline, on basic devices, in nine regional languages, in some of the most under-resourced schools in the world. This repositions AI in education from a premium feature available in well-connected urban schools to a foundational infrastructure for equitable learning everywhere.

Application Practice Breakthrough

The most significant breakthrough in application practice is the proof that personalised adaptive learning can move from experimental efficacy to systemic public education policy, and that AI and computational thinking education can reach students who have historically been excluded from it entirely.

Two independent J-PAL RCTs produced consistent learning gains across different geographies, delivery models, and student populations, directly influencing India's National Education Policy 2020 and triggering government tenders in multiple states.

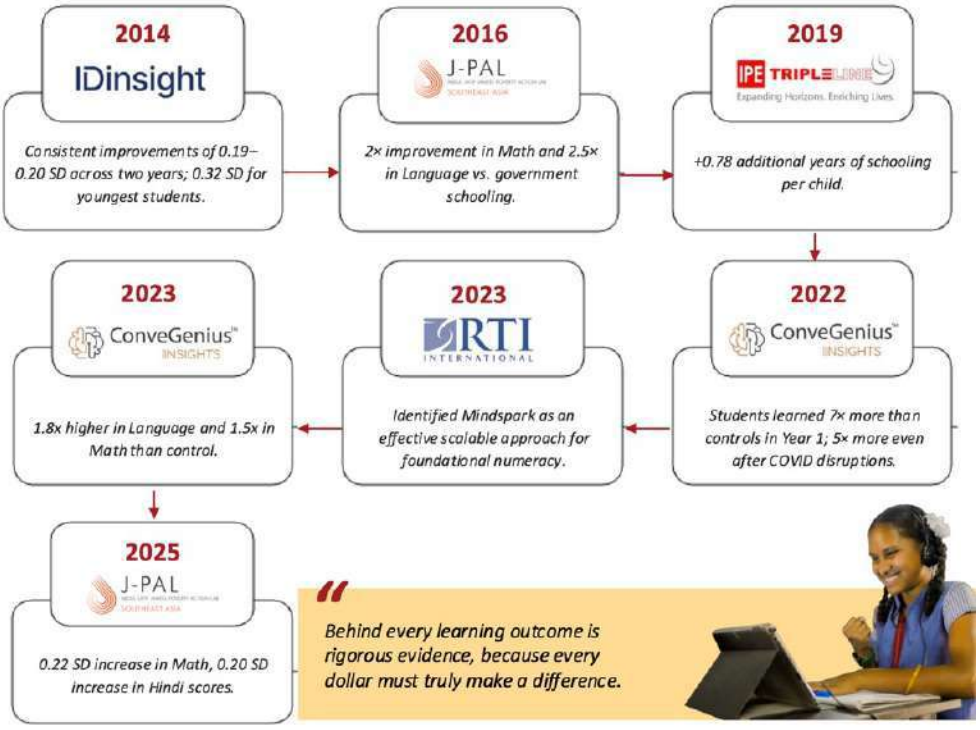

Figure 14 A timeline of six independent evaluations of Mindspark from 2014 to 2025, conducted by IDInsight, J-PAL, IPE Triple Line, ConveGenius Insights, and RTI International.

Through the Amazon Future Engineer programme, structured AI and Digital Thinking education has reached 40,000+ students across tribal and social welfare government schools in Telangana, most of whom are first-generation learners in districts where CS education had no prior presence.

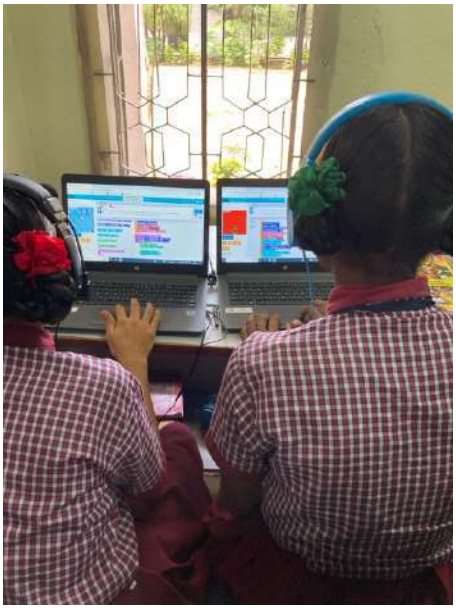

Figure 15 Two girls in the Amazon Future Engineer programme working side by side on a block-based coding session.

This demonstrates that the digital divide is a curriculum, pedagogy, and equity problem, and that AI, when the implementation model is designed from the ground up for the contexts that need it most, can close it.

Scope, Value and Potential Risks

1. Scope of Mindspark

Mindspark is already operating at a meaningful scale. As of 2024-25, the platform runs across 3,700 government schools in 14 Indian states, serving over 300,000 students. In Africa, active implementations in South Africa and Zambia are growing toward a target of 3 million students by 2030, in partnership with provincial Departments of Education. Mindspark impacts ~20000 learners in rural parts of Mpumalanga, KwaZulu Natal, Gauteng in South Africa and ~6000 learners in Rural parts of Zambia.

The operation model is designed for replication. It can run offline, is teacher-led, and costs under USD 2 per student per year at the state scale. Critically, Ei has made its in-school implementation protocols publicly available, a rare commitment in the EdTech sector, which has already enabled other PAL providers to adapt them across additional states.

Also, Mindspark has established a model that the broader EdTech sector is now following. It was the first learning software in India to undergo rigorous independent evaluation, and its evidence base directly shaped the National Education Policy 2020 and government procurement decisions in multiple states. The Rajasthan RCT implementation protocols have since been adopted by other PAL providers, demonstrating the programme's role as a sector-wide reference point.

Internationally, the programme has been recognised by HundrED, UNESCO, the World Bank, Harvard Business School, Stanford Social Innovation Review, and The Economist as a leading global example of personalised learning at scale in low-resource contexts.

For the Global South specifically, Mindspark demonstrates that sophisticated AI in education does not require high connectivity, expensive devices, or elite school conditions. This is a proof point that other countries, education ministries, and technology partners can build on directly.

2. Social and Economic Value

Mindspark's social value is rooted in equity. Learning gains are consistent across gender, income level, and initial ability. Critically, the weakest students, those who make virtually no progress under regular schooling, gain the most.

The economic case is equally strong. IPE Triple Line's independent evaluation found that Mindspark delivers 0.78 additional years of schooling per child and 5 to 15% higher lifetime income potential. At scale, it delivers up to four times more learning per rupee compared to traditional teaching.

For the Amazon Future Engineer cohort specifically, the programme creates structured pathways into STEM careers for tribal and first-generation learners in communities that had no prior access to computer science education, 76% of whom are girls.

3. Potential Risks

Government procurement favours cheap over effective. Policies in India push schools toward free software and the lowest-cost hardware. This makes it structurally difficult to fund high-quality adaptive platforms. Cheap devices break within two years. There is a need for improving efforts to ensure the

longevity of devices while putting in place stringent checks to ensure that these remain in working condition. The label "adaptive learning" is also widely misused in the market, creating confusion that makes evidence-backed solutions harder to distinguish from superficial ones..

Teacher adoption remains fragile where institutional buy-in is weak. When teachers carry heavy administrative loads, PAL sessions are the first thing dropped. Genuine government ownership of the programme, not just compliance, is essential to sustainability.

as AI features deepen, so do obligations around child data. Mindspark currently constrains student AI interactions to predefined choices, encrypts all data, and never uses it commercially. Maintaining that standard as the programme scales requires active governance, not just policy documents.

Appendix

1. Mindspark Awards:

Year	Award / Recognition	Awarding Institution
2017	UNESCO ICT in Education Prize — recognised for harnessing technology to improve learning outcomes in government schools	UNESCO
2017	WISE Awards Finalist	Qatar Foundation / World Innovation Summit for Education
2018	Finalist, UNESCO Prize for Innovation in Education	UNESCO
2018	Featured in the Annual Meetings Plenary address as a global example of AI improving learning at low cost	World Bank Group
2018	Case study published: "Improving Educational Outcomes in India"	Harvard Business School
2018	Selected as one of the world's top education innovations for proven impact and scalability	HundrED Global Collection
2018	Featured as "innovations that work" in the Goalkeepers report tracking SDG progress	Bill and Melinda Gates Foundation
2019	Finalist, King Hamad Bin Isa Al-Khalifa Prize for the use of ICT in Education	UNESCO
2020	Finalist, King Hamad Bin Isa Al-Khalifa Prize for leveraging AI and ML in Education	UNESCO
2023	Winner, Mahatma Award for CSR Excellence in Education	Mahatma Foundation
2023	Selected for global Numeracy at Scale study as an effective scalable approach for foundational numeracy	RTI International
2025	Shortlisted, Global EdTech Prize	Global EdTech Prize
2025	Winner, Nexus of Good Annual Award	Nexus of Good Foundation
2025-26	Selected for 100x Cohort to accelerate Ei's mission	Impact Accelerator, London School of Economics
2026	Case study published again: "Improving Educational Outcomes in India"	Harvard Business School

2. Third-Party Evaluations:

- **Independent Academic Research**

a.J-PAL Delhi RCT (2015–2016) Conducted by Professors Karthik Muralidharan (UC San Diego / J-PAL Co-Chair), Abhijeet Singh (Stockholm School of Economics), and Alejandro Ganimian (NYU Steinhardt). Published in the American Economic Review (2019). 619 students across 5 government schools in Delhi. Students using Mindspark scored 0.37 SD higher in math and 0.23 SD higher in Hindi in 4.5 months — more than twice the learning gains of the control group. Source: Muralidharan, Singh and Ganimian (2019), American Economic Review, 109(4):1426–60

b.J-PAL Rajasthan RCT (2017–2020) Second independent RCT led by Professors Muralidharan and Singh across 80 government schools and 6,500 students. Published 2025. Results: 0.22 SD gains in math and 0.20 SD in Hindi after 18 months. Middle school productivity improved 80–100% over business-as-usual. Cost-effectiveness: up to 4x more learning per rupee than traditional teaching. Source: Muralidharan and Singh (2025), J-PAL Southeast Asia

"Mindspark delivered some of the largest experimental treatment effects ever documented in public middle schools at scale." — Prof. Karthik Muralidharan, Co-Chair, J-PAL

- **Expert Opinions**

a."One of the interventions tried in Rajasthan — Mindspark — has proved effective with science and math learning for kids. It identifies the stage at which the child is and takes them to the next level through a personalised learning journey." — Prof. Abhijit Banerjee, Nobel Prize Laureate in Economics, MIT; Co-Chair, Global Education Evidence Advisory Panel (GEEAP)

b."The progress made in Language and Maths by Mindspark pupils was greater than in almost any study of education — and for a fraction of the cost of attending a government-run school." — The Economist, July 2017

c.The World Bank Group President Jim Yong Kim cited Mindspark by name at the 2018 Annual Meetings Plenary in Bali as a global example of data-driven personalised learning delivering results at a fraction of the cost of traditional schooling.

- **Additional Independent Evaluations**

IDInsight (2014) Evaluation across two consecutive years (2011–12 and 2012–13) in private schools. Consistent improvements of 0.19–0.20 SD across both years; 0.32 SD for the youngest students. Near-identical results across years demonstrated programme reliability. Source: IDInsight, published evaluation report

ConveGenius Insights (2022) 1,329 Grade 3 students across 55 intervention and 54 control schools. Students learned 7x more than controls in Year 1, and 5x more even after COVID disruptions. Delivered under a results-based financing model, confirming scalability under performance accountability. Source: ConveGenius Insights Study, 2022

RTI International (2023) examined six large-scale numeracy programmes worldwide. Identified Mindspark as an effective, scalable approach for foundational numeracy, specifically citing its

adaptive level-based progression as a core pedagogical strength. *Source: RTI International Numeracy at Scale global study, 2023*

IPE Triple Line (2019) Long-term economic impact modelling based on multiple studies. Findings: +0.78 additional years of schooling per child; 5–15% higher lifetime income potential for Mindspark users. *Source: IPE Triple Line Evaluation, 2019*

- **Teacher Survey Data**

The 2017 RCT in Rajasthan included a structured teacher opinion survey administered two years into the programme. Results across 141 teachers in treatment schools:

99% of teachers reported Mindspark was useful

88% said student learning had improved substantially

76% said students understood concepts better *Source: Muralidharan and Singh (2025), Table 10 — Teacher Opinions on Mindspark Usefulness*

- **Government and Policy Recognition**

India's Ministry of Human Resource Development cited Mindspark in its ICT in Schools Policy revision and PAL Implementation Guidebook. Mindspark was subsequently referenced in India's National Education Policy 2020, the first time a specific EdTech platform was cited in national education policy, a form of institutional endorsement representing the highest level of public-sector validation available in the Indian education system. *Source: Ministry of HRD, Government of India; National Education Policy 2020*

- **Media and Public Evaluation**

Mindspark has been positively reviewed or featured in: *The Economist* (cover story, July 2017 and March 2020), *Stanford Social Innovation Review*, twice in *Harvard Business School* (case study), *World Economic Forum*, *Hechinger Report*, and *KPMG* ("Enhancing the Quality of Education in India by 2030").

3. Case-related images, videos, and other materials.

Amazon Future Engineer Program Video: https://www.youtube.com/watch?v=w4QxTCyvCd8

Karthik Murlidharan Ted talk where he mentions Mindspark: Why Spending Smarter Beats Bigger Budgets | Karthik Muralidharan | TED

Karthik on Mindspark effectiveness: Karthik M on Ei Mindspark's Effectiveness

Ei-Mindspark South Africa CSR Project (by PLT & Halls)

Ei Mindspark - Personalised Learning for Every Child

User Voices Video Links

Mindspark for Out-of-School-Children: The Case Study of Babulal Nayak - Mindspark for Out-of-School-Children: The Case Study of Babulal Nayak

Mindspark in Government Schools: Case Study of Mohammad Shayar - Mindspark in Government Schools: Case Study of Mohammad Shayar

Mindspark in Government Schools: A Teacher Case Study - https://www.youtube.com/watch?v=pEsqz588BVE&list=PLOMi4M57IR5pycfo67odIajpIJxR66tel&index=4

Thabang's Journey with MindSpark and Mona Foundation in South Africa

Case 7

An Integrated Suite of Free AI Apps for Higher Education: Strengthening Access to Education and Training

Maxim Jean Louis

Contact North | Contact Nord's AI Innovation & Development Lab, Ontario, Canada

Overview and Early Adoption of the AI App Suite

This initiative reflects Contact North | Contact Nord's continuing effort to explore how emerging technologies can expand access to education and training for people living in small, rural, northern, and remote communities across Ontario. Artificial intelligence (AI) is beginning to influence how colleges, universities and Indigenous Institutes support teaching and learning. Many available AI systems remain costly, proprietary, or dependent on infrastructure that numerous institutions do not possess. In response, Contact North | Contact Nord's AI Innovation & Development Lab developed an integrated suite of AI apps that includes AI Tutor Pro, AI Teaching Assistant Pro, AI Pathfinder Pro, and AI Trades Explorer Pro. These apps support learners in their studies, assist educators in course preparation, and help people explore education and training pathways. Since their introduction, the apps have generated more than 3.2 million interactions from nearly 350,000 users around the world.

Figure 1 AI apps developed by Contact North | Contact Nord's AI Innovation & Development Lab

The Public Mandate of Contact North | Contact Nord

Contact North | Contact Nord helps people living in Ontario, especially those in small, rural, northern, and remote areas, access the online education and training they need to get or retain a job, earn a promotion, or advance their career without having to leave their communities. The organization works with publicly funded colleges, universities, Indigenous Institutes, and other training providers to help people across Ontario participate in education and training without having to leave their local communities.

Contact North | Contact Nord receives core funding from the Government of Ontario, Canada to support its mandate of expanding access to education and training through technology enabled learning. In 2026, the organization marks 40 years of helping people across Ontario access education and training without leaving their communities. Contact North | Contact Nord serves more than 1,600 communities across more than one million square kilometres of Ontario, including many small, rural, northern, and remote communities.

Over four decades, Contact North | Contact Nord has worked directly with learners, educators, and institutions across the province, gaining practical insight into the barriers that can limit access to education and training. The work undertaken by Contact North | Contact Nord's AI Innovation & Development Lab grows directly from this experience.

The Role of the AI Innovation & Development Lab at Contact North | Contact Nord

Contact North | Contact Nord's AI Innovation & Development Lab was established with a focused mandate to develop, enhance, and sustain an integrated suite of free AI apps designed to support access to education and training. The Lab concentrates on the continuous improvement of these apps to ensure they remain practical, accessible, and useful for learners, educators, and institutions.

In support of this work, the Lab undertakes experimentation, prototyping, testing, and evaluation related to the design and functionality of the AI apps. These activities are conducted specifically to refine and strengthen the apps and to ensure they respond effectively to the needs of learners and educators.

The Lab builds on Contact North | Contact Nord's more than 40 years of experience supporting distance and online learning across Ontario. Drawing on this experience, the Lab develops tools that address the needs of people seeking access to education and training, particularly those living in small, rural, northern, and remote communities across the province.

The Lab's principal initiative is the ongoing development and improvement of the four AI apps. This integrated suite of applications supports academic learning, instructional development, academic pathway discovery, and exploration of skilled trades careers. The apps operate through standard web browsers, require minimal technical infrastructure, and are made available at no cost.

In addition to maintaining and enhancing the applications, the Lab makes these apps available to publicly funded colleges, universities, Indigenous Institutes, and other training providers in Ontario, across Canada, and to institutions globally so learners and educators can access practical AI tools without licensing barriers.

The development and ongoing refinement of the apps is supported by a small interdisciplinary team.

Dr. Ron Owston – Research Associate, AI in Higher Education, Contact North | Contact Nord, and Professor Emeritus, York University.

Dr. Owston's responsibilities include creating the conceptual approach to the apps and testing their design and implementation.

Michael La Riviere – Enterprise Web Architect, Contact North | Contact Nord

Michael leads the development and implementation of AI-powered solutions that support teaching, learning, and access to higher education.

Rick Sleaver – Director, Recruitment Marketing, Communications & Data Analytics, Contact North | Contact Nord

Rick supports the team with marketing and communication tools to promote the availability of the apps.

Their expertise has contributed to the design, testing, and ongoing improvement of the AI apps and helps ensure the apps respond to real needs within education and training environments.

Challenges Facing Higher Education in Supporting Learners and Faculty

Higher education institutions are currently facing a combination of pressures. Faculty workloads continue to grow while demand for learner support is increasing. Many learners do not have easy access to advising, tutoring, or career guidance. These challenges are especially visible in regions where learners live far from post-secondary campuses, including rural, northern, and remote communities.

In recent years, the rapid emergence of generative artificial intelligence has created new possibilities for supporting teaching and learning. However, many available systems require costly licenses or technical infrastructure that is beyond the reach of numerous institutions.

At Contact North | Contact Nord, the potential of artificial intelligence was viewed as an opportunity to explore practical ways to address long standing gaps in access to education and training.

Growing Interest in Artificial Intelligence in Higher Education

Colleges and universities around the world are examining how artificial intelligence might support teaching and learning. At the same time many educators are concerned about cost, infrastructure requirements, and the long-term implications of relying entirely on commercial technology providers.

The experience emerging from Contact North | Contact Nord's AI Innovation & Development Lab suggests that publicly supported education organizations can also play a direct role in shaping how artificial intelligence is introduced in higher education. By focusing on practical tools that expand access to education and training, institutions can ensure that new technologies strengthen learning opportunities rather than deepen existing inequalities.

Development of an Integrated Suite of AI Apps

Contact North | Contact Nord's AI Innovation & Development Lab undertook the development of apps designed specifically for educational use. The result was an integrated suite of AI apps intended to support both learners and educators.

The suite includes four apps:

- AI Tutor Pro provides assistance for learners studying a wide range of subjects and programs.

- AI Teaching Assistant Pro supports educators with course design, instructional planning, and feedback preparation.
- AI Pathfinder Pro helps learners explore academic programs and potential career directions.
- AI Trades Explorer Pro helps people living in Ontario who are interested in skilled trades understand the education and training pathways required.

Development of an Integrated Suite of AI Apps

To support awareness and adoption, Contact North | Contact Nord has hosted a series of free, public webinars demonstrating the capabilities and potential uses of the AI App Suite for learners, educators, and institutions. These webinars provide practical demonstrations of the apps and illustrate how they can support teaching, learning, and exploration of education and training pathways.

Webinars Delivered

- AI Institute: How to Teach with AI Tutor Pro and AI Teaching Assistant Pro (Second offering)
  - December 10, 2025
  - Registrations: 717
- AI Institute: How to Teach with AI Tutor Pro and AI Teaching Assistant Pro
  - April 29, 2025
  - Registrations: 515
- How Faculty and Instructors Can Reduce Their Workload and Save Time with AI Teaching Assistant Pro (Second offering)
  - December 10, 2024
  - Registrations: 427
- How to Help Your Students Use AI Pathfinder Pro and AI Trades Explorer Pro to Find Personalized Education and Training Pathways Leading to a Rewarding Job, a Promotion, or a Career
  - November 19, 2024
  - Registrations: 103
- How to Enhance Student Engagement and Success with AI Tutor Pro (Second offering)
  - October 29, 2024
  - Registrations: 349
- How Faculty and Instructors Can Reduce Their Workload and Save Time with AI Teaching Assistant Pro
  - August 27, 2024
  - Registrations: 700
- How to Enhance Student Engagement and Success with AI Tutor Pro
  - May 9, 2024
  - Registrations: 528

Institutions Featuring the AI Apps

Several institutions are featuring Contact North | Contact Nord's AI apps within their learning resources, academic support services, or student success initiatives.

A sample of institutions currently highlighting one or more of the apps include:

- Brigham Young University - Idaho
- Brock University
- Fanshawe College
- George Brown College
- Humber College
- Lakehead University
- MacEwan University
- McMaster University
- Queen's University
- San Diego State University
- Seneca Polytechnic
- Sheridan College
- Thompson Rivers University
- Toronto Metropolitan University
- University of Ottawa
- University of Toronto
- Western University

These institutions are making the apps available to support learners and educators in exploring how artificial intelligence can complement teaching, learning, and academic planning.

Design Principles of the AI App Suite

The development of the AI App Suite was guided by several principles.

Open access

All tools are available online without cost and without registration requirements.

Simplicity

The AI apps function through standard web browsers and do not require specialized infrastructure.

Multilingual availability

The apps are available in 29 languages.

Responsible use of artificial intelligence

The apps are designed to support learning rather than monitor learners. They do not monetize personal data and they are not used to automate high stakes assessment.

Equity

The apps reflect Contact North | Contact Nord's commitment to expanding access to education and training for people living in communities across Ontario.

Implementation and Early Adoption of the AI App Suite

The integrated suite of apps was developed over a two-year period by a small interdisciplinary team within Contact North | Contact Nord's AI Innovation & Development Lab. Development involved early prototyping, internal testing, public release, and continuing improvements informed by user engagement. The development and refinement of these apps have benefited from ongoing dialogue with educators, institutions, and partner organizations interested in expanding access to education and training for the public good. Public colleges, universities, Indigenous Institutes, and other training providers in Ontario have been invited to explore the use of these tools. Here is an example of how one of these tools can be used in practice. A learner in Northern Ontario who lives approximately 400 kilometres from the nearest post-secondary campus was studying business administration and used AI Tutor Pro to review accounting concepts while preparing for an exam. Within minutes the app generated explanations, practice problems, and step-by-step guidance. The learner later reported that the interaction helped clarify concepts that had been difficult to understand during independent study. This type of support reflects the broader objective of using artificial intelligence to strengthen access to education and training for learners who study far from major campuses.

What Distinguishes the AI App Initiative

Several characteristics distinguish the integrated suite of apps developed by Contact North | Contact Nord's AI Innovation & Development Lab. The initiative provides a coordinated set of apps that support learning, teaching, advising, and career exploration. The apps were developed within a publicly funded education organization rather than by a commercial technology vendor. Because the apps are freely accessible through a web browser and require no infrastructure, educators and learners in many regions are able to experiment with them. The initiative illustrates how artificial intelligence can be introduced in ways that respect privacy, academic integrity, and the public mission of education.

Implications for Higher Education Institutions

The integrated suite of apps developed by Contact North | Contact Nord's AI Innovation & Development Lab illustrates how advanced educational technology can be developed within a publicly funded organization in practical and cost-conscious ways. By reducing cost barriers and minimizing infrastructure requirements, the apps allow educators and learners to explore the use of artificial intelligence in accessible and practical ways. The initiative demonstrates how a publicly funded

organization can translate its mission of expanding access to education and training into practical artificial intelligence apps that benefit learners and educators across Ontario and are attracting interest from institutions globally. Organizations and institutions that choose to use or adapt these tools are responsible for ensuring that their use aligns with their own regulatory, educational, and legal frameworks.

A Public Sector Model for Strengthening Access to Education and Training

In 2026, Contact North | Contact Nord marks its 40th year of helping people across Ontario access education and training without leaving their communities. The work of Contact North | Contact Nord's AI Innovation & Development Lab extends this mission into the emerging era of artificial intelligence. The experience gained through this initiative suggests that publicly funded education organizations can play an important role in shaping how artificial intelligence is introduced in higher education. By focusing on practical apps that expand access to education and training, institutions can ensure that new technologies strengthen learning opportunities for diverse communities. As artificial intelligence becomes embedded within education systems, the central question will not be whether AI is used, but how it is designed and governed. The experience of Contact North | Contact Nord suggests that public institutions can play a leading role in ensuring that AI strengthens access, equity, and opportunity in higher education worldwide.

Case 8

Bridging Global Standards (HSK) and Local Curricula (VCE Chinese): The "Mandarin x Mind AI Platform" for Chinese Language Education in Australia

Bei WANG

Lyrebird Education Chinese Language Learning and Testing Centre, Australia

Background

Chinese language education in Australia has reached considerable scale, with approximately 180,000 K–12 learners nationwide, nearly 120,000 in Victoria—the most developed state for Chinese teaching. Yet behind this scale lies a deep structural imbalance: only about 4,000 Year 12 students sit for Chinese examinations nationally, with fewer than 400 being non-background learners—a 94% attrition rate (Orton, 2016).

This crisis stems from three systemic challenges. First, extreme student diversity (non-background, heritage, and native speakers) makes differentiated instruction extraordinarily difficult. Second, Australia has a national curriculum but each state operates its own senior secondary examination system (e.g., VCE, HSC, QCE), resulting in fragmented curriculum alignment. Third, over 97% of Chinese teachers are first-language speakers who, while linguistically proficient, often lack systematic training in Australian pedagogical contexts.

At the classroom level, teachers face three acute pain points:

- preparing multiple lesson tiers for mixed-ability classes;
- being unable to use vast HSK-aligned digital resources developed in China due to curriculum misalignment;
- working in isolation—many schools have only one Chinese teacher—making it impossible to systematise individual expertise or repurpose external resources.

The fundamental problem is clear: standards exist, resources exist, but the bridge connecting them to Australian classrooms does not. This project was conceived to build precisely such a bridge.

Case Implementation Status

The “Mandarin × Mind AI Platform” International Chinese Intelligent Teaching and Research Platform (https://www.mxmind.ai) was originally developed by the HSK Shanghai Learning and Testing Centre under the academic guidance of the Fudan-Hanban Innovation Base, with teachers from Fudan University, The Chinese University of Hong Kong, Beijing Language and Culture University, and East China Normal University already participating in its use. Building upon this HSK-based platform, the Lyrebird Education Chinese Language Learning and Testing Centre (Australia) initiated a joint research collaboration to localise the platform for the Australian context, specifically the Victorian Certificate of Education (VCE) Chinese curriculum.

The project proceeded in four phases.

Phase 1: Atomic-level standard mapping (January–June 2025).
We deconstructed HSK 3.0 (Levels 1–9) and the VCE Chinese study designs (Second Language and Second Language Advanced streams) into atomic units—each vocabulary item, grammatical structure, and text function tagged with its originating standard. Through expert annotation and semi-supervised learning, we established a bidirectional mapping matrix. For example, the HSK Level 4 word yingxiang (influence) was simultaneously mapped to the VCE theme “Global and contemporary society” and the text type “Persuasive writing.”

Phase 2: Standard-aware AI generation engine development (July–October 2025).
The core innovation was embedding the mapping matrix as a constraint layer within the large language model. When a teacher selects a teaching scenario—for instance, “VCE theme: Living in a Chinese-speaking community, text type: Persuasive writing, target HSK Level 4”—the system automatically invokes the corresponding vocabulary whitelist and grammatical boundaries, ensuring that generated content does not exceed the specified levels.
Key functions include:

- **One click lesson generation:** Input a topic or upload materials; the system outputs a complete lesson package (reading passage with pinyin, graded text, vocabulary, grammar explanations, theme relevant images, audio narration, and exercises).
- **Text difficulty adaptation:** Upgrade or downgrade the linguistic complexity of any existing text while preserving cultural content and VCE theme relevance.
- **Dual system output:** The same content can be displayed from either HSK or VCE perspectives.

Figure 1 One Click Lesson Generation.

Phase 3: Teacher pilot and iterative refinement (October 2025 – March 2026)

A closed pilot was launched with Chinese language teachers in Victoria and across Australia. A total of 92 trial accounts were distributed in four batches: 20 accounts in the first two batches (targeting Victorian core teachers), 52 in the third batch, and 20 in the fourth batch. The third batch accounts were all activated within 48 hours. As of March 2026, the activation rate reached 100%, with teacher distribution as follows: Victoria (46), Queensland (18), Tasmania (2), New South Wales (1), and overseas (5). Each teacher received 1,500 initial credits (sufficient to generate 3–5 complete lesson packages). Feedback was collected through in app surveys, weekly Zoom Q&A sessions, and a mid term online briefing, with weekly iterations to refine generation speed, exercise types, and image styles.

Phase 4: Expansion from VCE to national and interstate curricula (March 2026 onward).

Positive pilot responses quickly generated cross state interest, with teachers from Queensland, Tasmania, the Northern Territory, New South Wales, and South Australia requesting access and adaptations for their own state systems. In response, we established a joint working group composed of frontline teachers from multiple states and scholars from the University of Melbourne and Monash University. The group's core task is to extend the mapping from VCE to the Australian Curriculum: Languages and to other state senior secondary syllabi. Full alignment is scheduled for completion by the end of 2026.

Next steps

Two further developments are underway. First, we are adapting the platform for classroom use, developing student side functionality to support online exercises and assessments while ensuring compliance with Australia's complex regulations on intellectual property, student data privacy, and child protection. Second, in response to teacher demand for richer cultural content, we are partnering with Chinese cultural education organisations to localise digital cultural resources—using AI to adjust language complexity, restructure teaching hours, and adapt classroom activities—thereby creating a new digital pathway for Chinese cultural resources to enter mainstream Australian classrooms.

Case Innovation and Breakthroughs

1. Main Innovation Content

The platform introduces five interconnected innovations that fundamentally change how Chinese language materials are aligned, generated, and shared.

Innovation 1: Atomic level standard mapping.

For the first time, HSK 3.0 and the VCE Chinese curriculum have been aligned at the granular level of individual vocabulary items, grammatical structures, themes, and text types. This bidirectional mapping matrix transforms what was previously a "hidden curriculum"—dependent on individual teacher expertise—into an explicit, machine readable system rule.

Innovation 2: Standard aware AI generation.

Unlike generic large language models (e.g., ChatGPT) that frequently generate out of syllabus content ("hallucinations"), our platform embeds the mapping matrix as a constraint layer within the generation engine. The output is thus guaranteed to simultaneously satisfy HSK level boundaries and VCE thematic and textual requirements, eliminating the need for teachers to manually vet materials for standard compliance.

Innovation 3: Resource activation.

China has invested heavily in HSK aligned digital resources—textbooks, graded readers, digital courseware, test banks—that have remained largely inaccessible to Australian teachers due to misalignment with local curricula. Through the mapping matrix, the platform automatically adds VCE and Australian Curriculum metadata to any HSK tagged resource and dynamically adjusts linguistic difficulty, transforming a vast existing resource stock into immediately usable classroom materials.

Innovation 4: Teacher co creation and sharing ecosystem.

The platform's embedded "Teacher Sharing Circle" addresses the isolation that afflicts Australian Chinese teachers—many of whom are the only Chinese teacher in their school. Teachers can upload their own adapted lessons, download and rate peer resources, and collaboratively refine materials. This mechanism transforms fragmented individual efforts into collective, cumulative expertise.

Innovation 5: Human AI collaboration.

The platform's design philosophy is "AI does the repetitive, structural work; teachers do the creative, human work." All generated content is presented as a draft to be reviewed, modified, and finalised. By automating alignment, adaptation, and exercise generation, the platform frees teachers to focus on classroom interaction, personalised instruction, and cultural dialogue.

2. Technology Breakthrough Content

The key technological breakthrough lies in **embedding a structured standard mapping matrix as a generative constraint layer within a large language model**. This is not simple prompt engineering but a fundamental architectural choice that ensures all generated outputs are pedagogically safe and curriculum compliant. The approach is language-agnostic and curriculum-agnostic, meaning it can be applied to any subject where global competence frameworks need to be aligned with local curricula.

3. Application Practice Breakthrough Content

In application terms, **the breakthrough is the transformation of a structural system-level problem—the misalignment between global standards and local curricula—into a practical, teacher-facing tool.** Pilot results demonstrate that what previously required 3–5 hours of manual preparation can now be accomplished in 5–8 minutes, with 92% of generated content rated as doubly aligned (HSK and VCE). Moreover, the teacher sharing circle has already accumulated dozens of co created lesson packages, forming a cross state professional learning network—a direct response to the isolation that has long plagued the field.

4. Intellectual Property Status

The core "Mandarin × Mind AI Platform" platform, including the HSK based generative engine and foundational technology, is owned by the HSK Shanghai Learning and Testing Centre. The Australian localisation layer—including the HSK–VCE/Australian Curriculum mapping matrices, the constraint layer configurations, and all localised user interface adaptations—is jointly owned by the Shanghai centre and Lyrebird Education under a collaborative research agreement.

Promotion Value and Risks

1. Application Prospects and Achievements

The platform has demonstrated strong adoption: 92 teacher accounts fully activated within weeks, spanning five Australian states. The 5–8 minutes lesson generation time (down from 3–5 hours) and 98% positive feedback on workload reduction indicate high practical value. From its VCE starting point, the platform is now expanding to the Australian Curriculum and other state systems—a natural extension given its modular architecture.

Globally, the model is transferable to any country with a formal Chinese curriculum (e.g., AP Chinese in the US, GCSE Chinese in the UK). Adaptation would require only decomposing the local curriculum into atomic units and mapping them to HSK—a process estimated to take less than three months.

2. Social and Economic Value

Socially, the platform addresses the crisis of non background student attrition by providing teachers with tools to sustain learner engagement through differentiated, level appropriate materials. Economically, it repurposes China's substantial prior investment in HSK resources, avoiding duplicative content development and substantially reducing teacher workload—an efficiency gain with significant resource implications for school systems.

3. Demonstrative and Leading Role

This case demonstrates how AI can operationalise curriculum alignment at scale, transforming high level policy goals into daily classroom reality without imposing additional burdens on teachers. It offers a replicable model for integrating global standards with local curricula across educational systems.

4. Potential Risks

Technical risks: The generative engine may occasionally produce outputs with minor inaccuracies in cultural nuance or stylistic register. Mitigation includes ongoing model fine tuning based on teacher feedback and maintaining the teacher as the final decision maker.

Ethical risks: Over reliance on AI could potentially reduce teacher autonomy or homogenise instruction. The platform's design—with teachers reviewing, modifying, and supplementing all generated content—explicitly guards against this. Data privacy and child protection risks are being addressed through compliance with Australian regulations, including student data management protocols and parental consent frameworks, which will be fully implemented before the platform is deployed in schools with student facing features.

Other Relevant Information

1. Case Award Status

Mandarin × Mind AI Platform has been awarded the "Gold Medal Teaching Tool" title in the 2025 ChinesePlus Global Gold Medal Projects.

2. Third-Party Evaluation

User evaluations (excerpts):

"I have been teaching VCE Chinese for 12 years. This is the first time I can take a current social issue story and, with one click, make it suitable for my Second Language Advanced class without worrying about out of syllabus vocabulary."

— VCE teacher, Melbourne public secondary school

"The standard mapping is a game changer. I no longer have to guess which HSK words are permitted in which VCE task. The system does it for me."

— Senior Chinese teacher, Queensland private school

"The Teacher Sharing Circle makes me feel I am no longer fighting alone. Seeing how others adapt the same text inspires me."

— Chinese teacher, New South Wales secondary school

These evaluations were collected through in app surveys and Zoom debriefing sessions during the pilot period (February–March 2026). Additional expert review is being conducted by the joint working group comprising frontline teachers from multiple states and scholars from the University of Melbourne and Monash University.

Case 9

Tutor, Not Solver: Designing a Guardrailed AI Assistant for Learning in Higher Education

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Background

Generative AI has rapidly become a de facto “shadow tutor” for students in higher education, particularly in high-enrollment gateway courses where questions peak outside office hours (Kasneci et al., 2023). At the same time, instructors and teaching assistants (TAs) face two simultaneous pressures: rising volumes of repetitive support needs, such as logistics queries, debugging confusion, rubric clarification, and regrade requests, and growing concern that unrestricted AI use can short-circuit productive struggle and undermine academic integrity (Cotton et al., 2024; Yan et al., 2023).

At Purdue University, these tensions became concrete. TAs observed that heavy reliance on generic AI tools such as ChatGPT was inflating homework scores above 95% while exam performance declined, indicating that students were bypassing meaningful engagement with course material. Students pasted TA advice directly into ChatGPT rather than processing it themselves and skipped critical instructions such as file-naming conventions for autograders. Generic public chatbots are not course-aligned, may produce ungrounded answers, and can too easily output complete solutions, creating both a credibility gap and an integrity gap.

PeteChat was conceived as a principled third path between outright prohibition and uncritical acceptance. The course-level chatbot tutor project bridges (a) technology to learning by shaping LLM capabilities into tutoring behaviors such as hints, questions, and strategy rehearsal; (b) instructional design theory to practice by embedding self-regulated learning (SRL) scaffolds inside AI-mediated dialogue; and (c) research to policy by building privacy, academic-integrity, and instructor-accountability commitments into system design, not only into a syllabus statement. The project is supported by Purdue University's Innovation Hub Funding Program: Teaching and Learning in an AI-Rich Environment, developed in collaboration with the Center for Instructional Excellence, Purdue Libraries, and the Rosen Center for Advanced Computing (RCAC).

Case Implementation Status

PeteChat was developed through a design-based research (DBR) approach (Anderson & Shattuck, 2012), with iterative cycles of design, deployment, evaluation, and redesign across four phases in authentic classroom settings. Each semester of pilot use constituted a design cycle in which data on PeteChat's performance and user experiences were collected and applied to improve the next version.

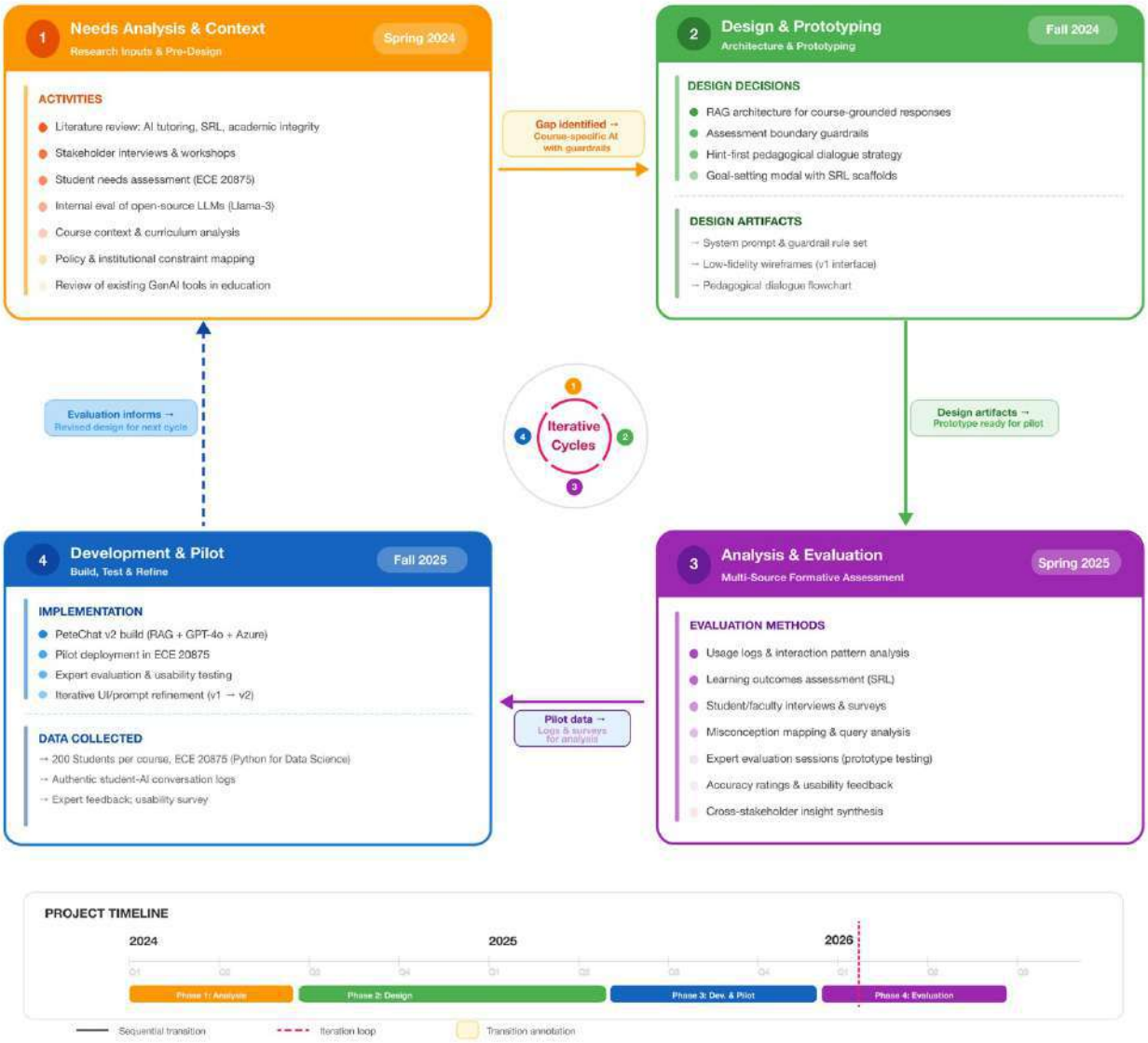

Figure 1 Design-Based Research (DBR) cycle guiding the development of PeteChat, illustrating iterative loops of design, enactment in authentic courses, multi-source analysis, and redesign.

Phase 1: Foundation and Baseline Tutor (Summer–Fall 2024)

Development began with a thorough needs analysis: interviews and workshops with students, faculty, and administrators surfaced key requirements. Students expressed frustration with generic AI answers for course-specific questions and desired explanations over direct solutions. Faculty hypothesized that

access to student AI query data could help preempt misconceptions. A dataset of approximately 1,000 instruction-style question-and-answer exemplars in Alpaca format was assembled from syllabi, lecture notes, prior exams, and discussion-board exchanges (with faculty permission). An open-source LLM from the Llama-3 family was fine-tuned using parameter-efficient LoRA/QLoRA techniques on Purdue's Gilbreth GPU cluster. A retrieval-augmented generation (RAG) layer was added to ground responses in verified course sources.

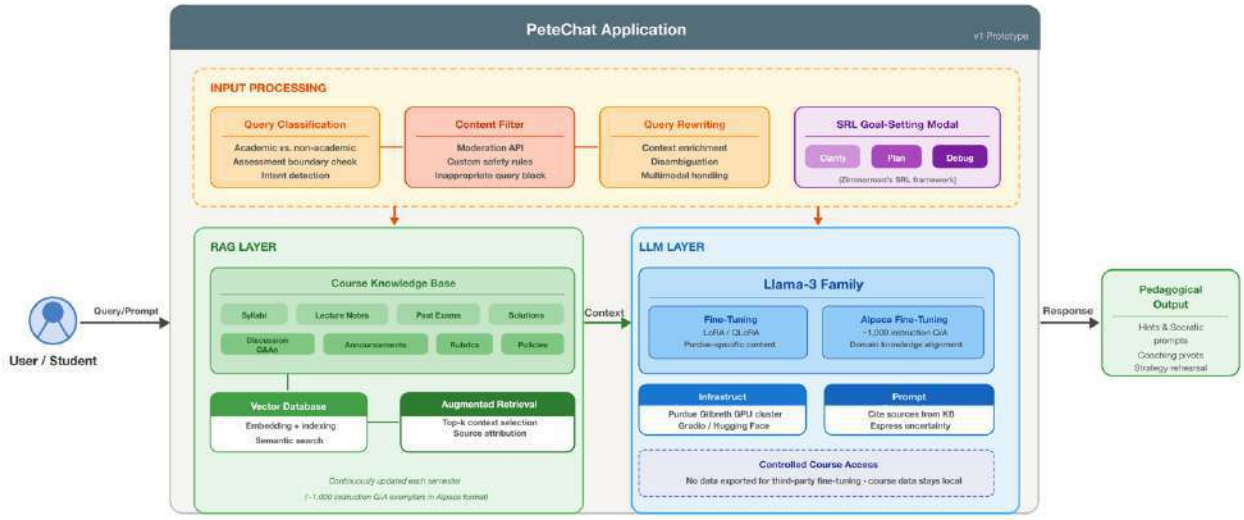

Figure 2 System architecture of PeteChat. A RAG layer grounds answers in vetted course sources while fine-tuning aligns response style and solution methods with instructor expectations.

Phase 2: First Large-Scale Deployment — ECE 20875 (Fall 2024–Spring 2025)

PeteChat was deployed via Gradio/Hugging Face to undergraduates in ECE 20875 (Python, regression, clustering, classification, and neural networks). This marked the first large-scale test and provided the richest evidence of authentic student engagement. Following deployment, formative evaluation sessions were conducted under IRB-approved protocols with four expert stakeholders: two ECE 20875 TAs, one software developer, and one UX/UI specialist. Sessions lasted 30 to 45 minutes each, combining think-aloud tasks on the live prototype with semi-structured interviews.

Key findings were organized across three stakeholder groups. Student-oriented findings revealed that heavy ChatGPT use was inflating homework scores while exam performance dropped. TAs identified regrade requests without justification as a major workload burden. UX feedback highlighted onboarding gaps—users did not know what to ask, the sidebar was closed by default, and high-contrast styling reduced readability. The low-fidelity mockups below (Figure 3) illustrate the before-and-after of interface redesign informed by these findings.

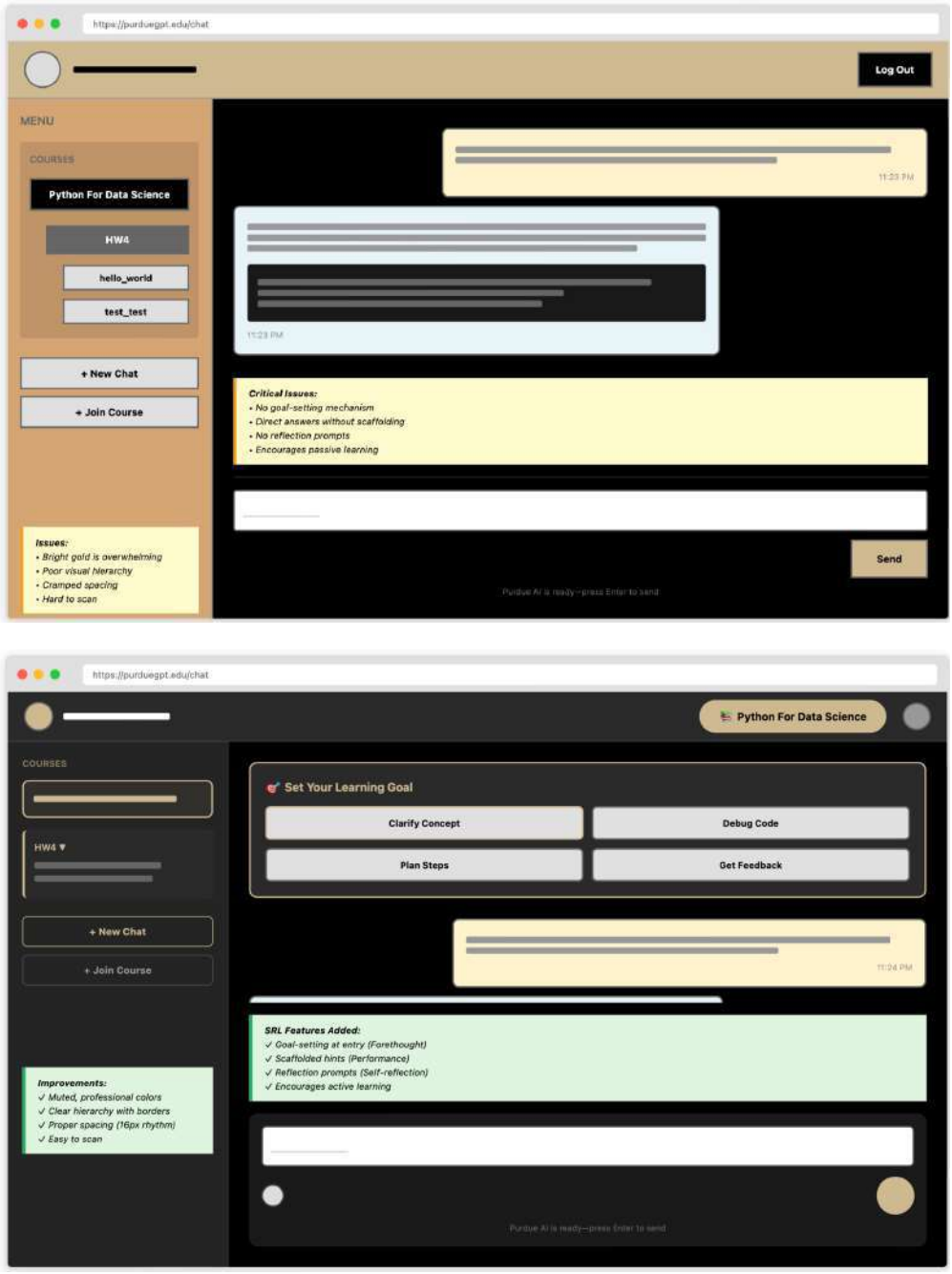

Figure 3 Low-fidelity interface mockups of PeteChat. Top: initial design identifying critical issues (no goal-setting, direct answers, passive learning, poor visual hierarchy). Bottom: revised design with SRL features added (goal-setting at entry, scaffolded hints, reflection prompts, muted professional colors, clear hierarchy).

Phase 3: Direct Preference Optimization (Spring–Summer 2025)

Drawing on extensive preference data collected during Phase 2, the team applied Direct Preference Optimization (DPO) to better align the model's style and scaffolding strategies with what Purdue students found most helpful and trustworthy. Iterative tuning noticeably strengthened the clarity, conciseness, and pedagogical consistency of PeteChat's responses.

Phase 4: Broader Campus Integration (Spring 2026)

A preference-aligned version of PeteChat was extended to additional large undergraduate Python programming and data science courses, marking the transition from course-specific innovation to broader campus-level integration. This phase also expands the instructor dashboard to support multi-course configuration.

Case Innovation and Breakthroughs

1. Main Innovation Content

PeteChat advances the state of practice in three interconnected ways. First, it introduces an assessment-aware guardrail architecture that detects when a student query involves an active assignment and automatically shifts to a hint-first, integrity-preserving response mode—refusing direct solutions, surfacing academic-integrity banners, and redirecting students toward conceptual reasoning or human support. Figure 4 illustrates the conceptual interaction model for this guardrail flow.

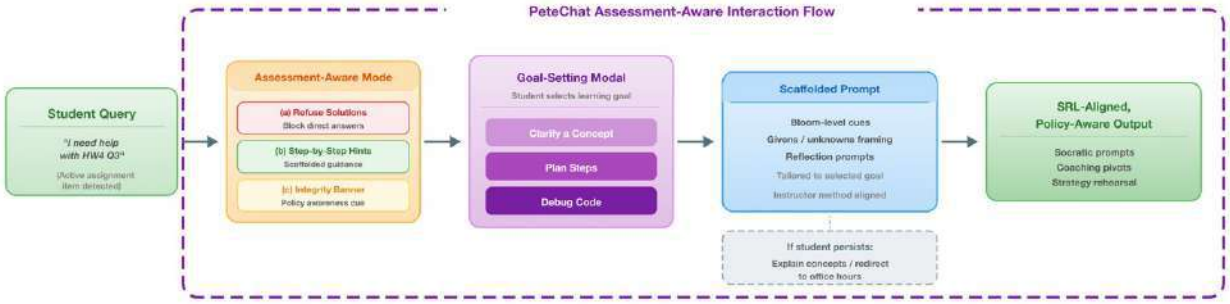

Figure 4 Conceptual interaction model showing how student prompts are routed through assessment checks: active-assignment queries activate hint-first responses and academic-integrity banners, while non-assessment queries receive direct, course-grounded assistance.

Second, PeteChat operationalizes SRL theory within AI-mediated dialogue. Abstract constructs (goal-setting, self-monitoring, judgment of learning, and reflection) are instantiated as concrete dialogue features: goal-setting prompt templates at session entry, reverse prompting sequences, judgment-of-learning (JOL) micro-checks, and rubric-anchored regrade explanation flows. Figure 5 illustrates the full pedagogical dialogue flow.

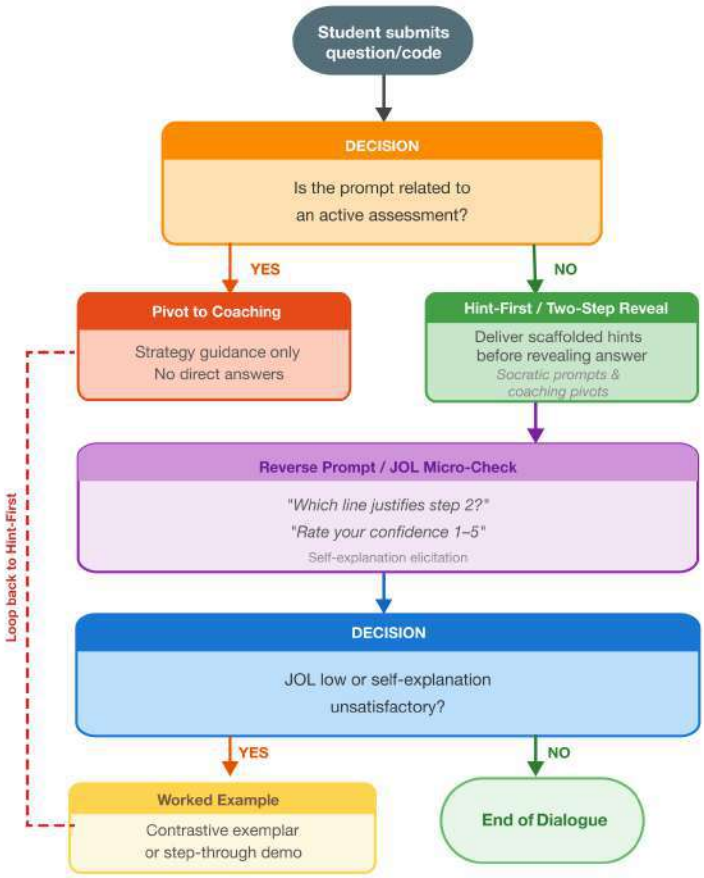

Figure 5 Pedagogical dialogue flow illustrating how student prompts are routed through assessment checks, coaching pivots, hint-first responses, reverse prompting, and judgment-of-learning (JOL) micro-checks to support scaffolded learning rather than direct answer provision.

Third, the project demonstrates that an institutionally hosted, locally fine-tuned AI can outperform generic public tools on dimensions that matter most in educational contexts: accuracy relative to course content, alignment with instructor pedagogical intent, data privacy, and trustworthiness. Eight design principles emerged: (a) Tutor, not solver—default to hinting and scaffolding; (b) Align to the course: ground responses in instructor-provided materials with provenance; (c) Respect academic integrity: include guardrails and reminders; (d) Reduce TA overhead: automate regrade explanations and logistics handling; (e) Design for clarity and momentum: contextual onboarding and readable visual outputs; (f) Flexible control for staff: instructor configuration without coding; (g) Trust through transparency: show sources and acknowledge uncertainty; (h) Just in time or 24/7 support: offer study plans and mock quizzes scoped to available time.

2. Technology Breakthrough Content

PeteChat's technical architecture combines several advances. Parameter-efficient LoRA/QLoRA fine-tuning on Purdue's Gilbreth GPU cluster makes institutional LLM customization computationally feasible without full model retraining. The RAG pipeline dynamically retrieves from a continuously updated knowledge base (syllabi, rubrics, lectures, homeworks, discussions and exams) with freshness timestamps displayed inline, addressing the fixed training-cutoff limitation inherent to all LLMs. A DPO

alignment stage calibrates response style to student preferences. Provenance citations in every AI response allow students and instructors to trace the source of each answer, building institutional trust. The system also incorporates multimodal RAG and query rewriting, identified as technical strengths in the Phase 2 formative evaluation.

3. Application Practice Breakthrough

Eight evidence-based design decisions define PeteChat's feature set: (D1) homework guardrails activating hint-first, integrity-preserving response modes for active assessments; (D2) logistics responses delivered with freshness timestamps and "verify on syllabus/Piazza" disclaimers; (D3) debugging support framed as error-message explanation and Socratic prompting rather than code patching; (D4) study planner and mock quiz generator scoped to available time and upcoming exam content; (D5) regrade helper flow requiring students to articulate their reasoning from rubric criteria before escalating to a TA; (D6) default-open sidebar with course-organized "Try asking..." prompt cards generated from syllabus metadata; (D7) visual redesign favoring balanced contrast ratios and tabular or stepwise outputs; and (D8) instructor dashboard supporting drag-and-drop content uploads, per-course tone configuration, and alignment audit metrics.

4. Intellectual Property Status

PeteChat is an institutional research project developed at Purdue University with support from the Innovation Hub Funding Program. The system architecture, training data pipeline, and design documentation are owned by Purdue University. The design case manuscript is under preparation for peer-reviewed publication, with a presentation accepted at the AECT International Convention 2026 (Chicago), Design and Development Division (Submission ID 751). All student interaction data are stored exclusively on Purdue systems under IRB-approved protocols.

Promotion Value and Risks

1. Application Prospects and Current Achievements

PeteChat has been piloted in ECE 20875 at Purdue University, serving hundreds of undergraduate students per semester, with Phase 4 extending deployment to additional courses in Spring 2026. The project has been considered for presentation at the AECT International Convention 2026 in Chicago (peer recognition of the work's contribution to educational technology design). The eight transferable design principles and eight evidence-based design decisions are structured as actionable guidance for institutions worldwide. The open-architecture DBR methodology provides a replicable template for iterative AI tool development in live educational settings.

2. Social and Economic Value

PeteChat addresses a significant equity challenge in higher education: unequal access to timely, high-quality academic support. By providing 24/7 course-aware assistance, it extends instructional support beyond office hours and TA availability, particularly valuable for students in large gateway courses. The academic-integrity guardrails actively work against the erosion of genuine learning that unconstrained AI use risks producing. TA workload reduction features, such as automated regrade explanation flows, logistics query handling, and consistent responses to repeat questions, redirect human expertise toward higher-value instructional interactions. The locally hosted, open-architecture design also addresses data privacy concerns that deter institutional adoption of third-party AI tools.

3. Demonstration and Leading Role

As a documented design case following DBR methodology, PeteChat offers a replicable model for universities worldwide. By sharing both successful strategies and the tensions and trade-offs encountered, this design case contributes design precedents (Boling, 2010) that practitioners and researchers can build upon without repeating costly trial-and-error cycles. The design decisions and principles are transferable across disciplines, course types, and institutional contexts.

4. Potential Risks

Four risks warrant attention. First, a technical risk: LLM hallucination cannot be fully eliminated; the RAG grounding layer, inline provenance citations, and uncertainty-expression prompting mitigate this. Second, a scalability risk: LoRA/QLoRA and RCAC infrastructure collaboration make institutional hosting feasible. Third, a pedagogical risk: overly restrictive guardrails may reduce perceived usefulness; continuous calibration through instructor configuration and usage analytics addresses this. Fourth, an ethical and privacy risk: all data remain on Purdue systems, interaction logs are anonymized, and the project operates under IRB-approved protocols.

Other Relevant Information

1. Case Award Status

The PeteChat design case has been considered for presentation at the AECT International Convention 2026 (Association for Educational Communications and Technology), Chicago, USA, Design and Development Division (Submission ID 751, concurrent session). This is peer-reviewed by the leading international association for educational technology, which constitutes external recognition of the work's scholarly and practical contribution. The project is funded by Purdue University's Innovation Hub Funding Program: Teaching and Learning in an AI-Rich Environment. The design case manuscript is in preparation for peer-reviewed journal publication.

2. Third-Party Evaluation

Formative evaluation was conducted with four expert stakeholders under IRB-approved protocols (Purdue University IRB). All participants provided informed consent; audio recordings were transcribed, anonymized, and stored on Purdue systems. TAs endorsed the regrade helper flow and assessment-aware guardrails as solutions to authentic workload and integrity problems. The UX specialist validated the redesigned onboarding experience and visual clarity improvements. The developer confirmed the technical feasibility of the RAG-plus-fine-tuning architecture and identified query rewriting and multimodal RAG as particular strengths. Large-scale student interaction data from Phase 2 (ECE 20875, Spring 2025) and Phase 4 (Spring 2026) will form the empirical base for forthcoming summative evaluation comparing PeteChat users with non-users on exam performance, SRL measures, and interaction log analysis.

3. Supporting Materials and Contact

AECT 2026 abstract: Li, B., Tan, L., Zakharov, W., Acton, C., & Qiu, Q.(2026, October). A design case of PeteChat: Designing AI tutors that teach students how to think, not what to answer. Presentation accepted at the AECT International Convention 2026, Chicago, IL, USA.

Design case manuscript in preparation: Li, B., Tan, L., Zakharov, W., Acton, C., & Qiu, Q. (in preparation). Tutor, not solver: Designing a guardrailed AI assistant for learning in higher education. Supporting materials available from: Belle Li, Purdue University College of Education (li4808@purdue.edu).

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Case 10

The ALECSO Charter on Artificial Intelligence Ethics: A Regional Governance Framework for Responsible AI in Education

Mohamed JEMNI

Arab League Educational, Cultural and Scientific Organization (ALECSO), Tunisia

Background

The Arab world, in its pursuit of digital transformation, faces significant challenges in integrating Artificial Intelligence (AI) within education. Key pain points include a pronounced technology and knowledge gap, characterized by inadequate digital infrastructure and a shortage of specialized human resources. This is compounded by a lack of clear legal and regulatory frameworks for AI, leading to concerns over data privacy, algorithmic bias, and accountability.

Furthermore, there is a critical need to balance technological innovation with the preservation of rich Arab cultural identity and Islamic values. Social and cultural concerns arise from the potential for generative AI to produce content misaligned with local norms or to impact the labor market. The absence of robust national strategies and weak investment in scientific research risk relegating Arab nations to being consumers rather than developers of AI technology.

To address these challenges, the Arab League Educational, Cultural and Scientific Organization (ALECSO) developed the ALECSO Charter on Artificial Intelligence Ethics as a regional ethical and policy reference to guide the responsible use of AI in education, culture, and science. The Charter was conceived not as a purely theoretical statement, but as a practical framework to help Arab countries and institutions align AI adoption with principles of human dignity, justice, inclusion, transparency, accountability, cultural respect, and sustainable development.

The Charter responds to a pressing regional need. Without clear ethical guidance, the integration of AI in education may deepen inequalities, reproduce bias, weaken trust, and introduce systems that are linguistically or culturally inappropriate.

At the same time, if guided responsibly, AI can support more equitable access to learning, strengthen educational quality, empower teachers, improve institutional efficiency, and stimulate innovation in Arabic digital content and educational technology. The ALECSO Charter was therefore designed to help transform AI from a disruptive external force into a responsible enabler of educational progress in the Arab world.

The best-practice value of this case lies in its effort to translate widely recognized international AI ethics principles into a regionally grounded Arab framework. It offers a model of how global debates on AI governance can be adapted to the needs of multilingual, culturally rich, and institutionally diverse societies. In this sense, the Charter is both a regional policy innovation and a contribution to the broader international discussion on responsible AI in education.

Case Implementation Status

The implementation of the principles outlined in the ALECSO Charter (https://www.alecso.org/publications/uploads/2025/08/etic.pdf) is conceptualized as a strategic, multi-phased process, moving from foundational analysis to practical application and continuous evaluation.

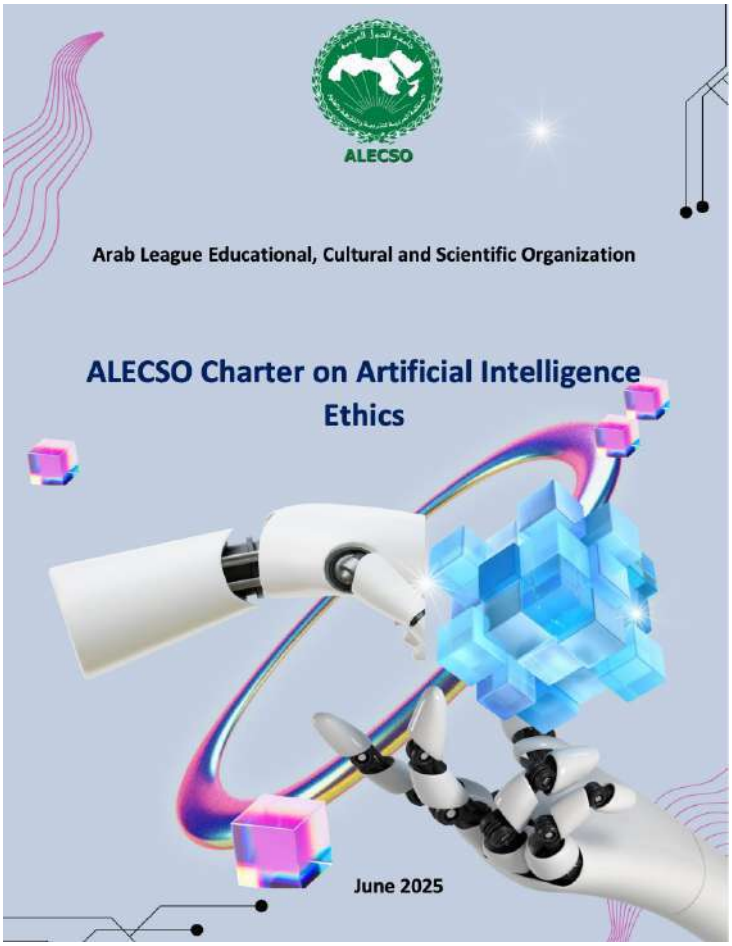

Figure 1 ALECSO Charter on Artificial Intelligence Ethics

1. Demand Analysis and Stakeholder Engagement:

The foundational step involved a comprehensive analysis of the unique challenges facing the Arab world. This included identifying the technology gap, the lack of cohesive policies, economic constraints, and social-cultural concerns specific to the region. A key part of this analysis was recognizing the dual impact AI could have on education—as a tool for personalized learning and a potential source of bias if not properly governed. To ensure the charter's relevance, ALECSO engaged a wide range of stakeholders. This included AI developers, ethicists, legal professionals, government representatives, and industry leaders from across Arab countries. The "founding committee," composed of experts like Dr. Maledh Marrakchi and Prof. Dr. Ashraf Darwish, held both in-person meetings at ALECSO headquarters in Tunis and virtual roundtables to review existing international and Arab regulations, ensuring the charter was aligned with both global best practices and local cultural specificities.

2. Technology Development and Research:

The charter itself acts as a blueprint for research and development. A core aspect of its implementation is encouraging the development of AI technologies that are linguistically and culturally competent. This is most evident in the push for advancements in Arabic Natural Language Processing (NLP). The charter calls for supporting research and development to create AI models that can accurately process the Arabic language, understand its nuanced dialects, and preserve its authenticity. This is a critical technological development, as many global AI models are primarily trained on English data, leading to biases and inaccuracies in Arabic contexts.

3. Application Optimization and Guideline Development:

The charter translates high-level ethical principles into concrete, sector-specific implementation guidelines. For education, this optimization takes the form of actionable directives:

- **For Justice and Non-Discrimination:** It mandates that educational AI systems be designed with non-discriminatory algorithms, trained on diverse data to ensure all students, including those with special needs, are treated fairly.
- **For Transparency and Explainability:** It requires that AI systems used for grading or personalized learning are transparent. Students, teachers, and stakeholders must understand how decisions are made and be able to identify any limitations or biases.
- **For Human Oversight:** A critical guideline is the insistence that decisions regarding a student's educational or academic path should never be left solely to an AI system. This ensures that human judgment and autonomy remain central to education.
- **For Integrity:** The charter explicitly advises against using generative AI in writing refereed scientific research, university dissertations, and other academic publications to uphold academic integrity and prevent plagiarism.

4. Application Optimization through Governance and Monitoring:

The charter's implementation is not a one-time event but a continuous cycle. It establishes a framework for ongoing monitoring and evaluation. This includes developing indicators to measure compliance with ethical frameworks and encouraging governments to adopt the charter's policies by amending local laws. A dedicated mechanism is proposed to monitor the rapidly evolving AI landscape, ensuring the charter remains relevant and can be updated to address new challenges. This proactive, cyclical approach—moving from analysis to development to application to monitoring—is designed to create a sustainable and responsible AI ecosystem in Arab education. The ultimate optimization is the

move from abstract principles to a living framework that adapts to technological change while safeguarding cultural and human values.

Case Innovation and Breakthroughs

The ALECSO Charter on AI Ethics represents a pioneering and comprehensive framework, marked by significant innovations and breakthroughs in how the Arab world approaches AI in education.

1. Main Innovation Content:

The primary innovation is the charter's holistic and culturally-rooted approach to AI ethics. Unlike generic global frameworks, it meticulously integrates the preservation of Arab cultural identity and Islamic values into every aspect of AI governance. This is not merely a token mention but a core operational principle. For educational models, the charter mandates that AI must be used to improve the quality of education while simultaneously protecting students from cultural or value-based orientations that conflict with their heritage. It innovates by defining the role of AI as an aid to human decision-making, not a replacement.

This is a critical pedagogical shift, ensuring that technology empowers teachers and supports students without eroding the human-centric nature of education. Furthermore, the charter's structure—providing specific implementation guidelines for education, culture, and science under each principle—is a significant innovation. This ensures that broad ethical concepts like "transparency" or "accountability" are translated into actionable, context-specific practices for teachers, administrators, and EdTech developers.

2. Technology Breakthrough Content:

The charter identifies and champions a key technological breakthrough: the development of robust Arabic Natural Language Processing (NLP) and the pursuit of AI technological sovereignty. By emphasizing the need for AI models that can understand nuanced Arabic dialects and cultural expressions without distortion, the charter addresses a fundamental flaw in existing global AI systems. This push for localized AI models is a strategic technological breakthrough. Its significance for educational informatization is profound. It enables the creation of personalized learning tools, intelligent tutoring systems, and educational content that are linguistically accurate and culturally relevant, moving beyond mere translation of foreign content. The charter's advocacy for open-source AI models and regional collaboration to achieve technological sovereignty represents a high-level strategic stance. It aims to reduce dependence on foreign technologies, ensuring that the data, values, and developmental goals of Arab nations remain central to the AI tools used in their schools and universities. This positions the Arab world as a potential developer of AI solutions, not just a consumer.

3. Application Practice Breakthrough Content:

The charter achieves a breakthrough in application practice by establishing a clear, principled foundation for regulating AI in education where none previously existed at a unified Arab level. It provides the first common ethical language and framework for member states. The breakthrough lies in its scope: it covers the entire AI system lifecycle, from design to disposal, ensuring ethical considerations are embedded from the outset. For basic education, the charter's implementation would lead to concrete changes in practice. For instance, it mandates that educational content generated by AI must be scientifically verified, non-misleading, and consistent with national curricula. It requires that AI tools used for assessment be transparent and auditable, allowing for appeals and

corrections. Most importantly, it breaks new ground by explicitly stating that a student's educational path cannot be decided by AI alone, enshrining human oversight and teacher autonomy as non-negotiable. This protects students from potentially biased or flawed automated decisions, fostering a safer, fairer, and more trustworthy learning environment.

4. Intellectual Property Status:

The intellectual property of the charter itself is explicitly stated: "All rights reserved to the Organization" (ALECSO). The document's creation is a collective work, with ALECSO holding the copyright. The text, including its translation from Arabic by the Arab Center for Arabization, Translation, Authorship and Publication (Damascus), is owned by ALECSO.

The charter acknowledges and incorporates references to the intellectual property of others, such as the principles and guidelines of UNESCO, the OECD, and the EU, as well as the national AI strategies and charters of individual Arab countries like Jordan, Saudi Arabia, Egypt, the UAE, Libya, and Palestine. These are used as foundational sources, with ALECSO building upon them to create a unified, regionally-specific framework. The charter also establishes principles for protecting the intellectual property rights of innovations resulting from scientific research in AI and for data used to train AI systems, ensuring that new IP generated within the Arab world under this framework is also safeguarded.

Promotion Value and Risks

1. Application Prospects and Achievements:

The ALECSO Charter has immense application prospects as the foundational ethical reference for AI in education across 22 Arab League member states. While still in the adoption phase, its current value is in providing a unified framework that guides national policies. Its application scale is potentially pan-Arab, with the charter designed to be the basis for developing local laws, regulations, and curricula. The operational model is one of "soft governance," where ALECSO provides technical and advisory support, and member states are encouraged to adapt the charter's principles to their specific needs, enabling scalable adoption across diverse national contexts.

2. Social and Economic Value:

Socially, the charter protects fundamental rights by ensuring AI is used fairly, transparently, and without discrimination, thereby building public trust in technology. It safeguards cultural identity and Islamic values, ensuring that the adoption of modern technology does not come at the cost of societal cohesion. Economically, by promoting responsible innovation, technological sovereignty, and open-source models, it fosters a homegrown AI industry. This reduces dependence on foreign technology imports, stimulates local research and development, and creates high-skilled jobs. In education, it promises to create a more equitable system, providing personalized learning tools that can help close achievement gaps and better prepare students for a technology-driven economy.

3. Demonstrative and Leading Role:

The charter serves as a powerful demonstrative model for how regional and cultural specificities can be integrated into global AI ethics discourse. It showcases a bottom-up approach where international principles are adapted to local values. Its leading role in basic education lies in establishing a pre-emptive, proactive framework. Instead of reacting to AI's challenges after they arise, the charter provides clear guidelines before widespread implementation. This positions the Arab world as a leader

in ethically conscious AI adoption, offering a model for other culturally rich regions navigating the digital transformation.

4. Potential Risks:

- **Technical Risks:** A key risk is the "technology gap." Without significant investment in infrastructure and skills, the charter's vision may remain aspirational, widening the gap between technologically advanced and less developed member states.
- **Ethical Risks:** There is a risk that the charter could be applied too rigidly, stifling innovation. Conversely, insufficient implementation could lead to non-compliance. The balance between protecting cultural values and allowing for free, critical inquiry in education is a delicate one that requires careful oversight. Finally, a lack of harmonized national laws across member states could lead to inconsistencies and make the effective governance of cross-border AI applications challenging.

Conclusion

The ALECSO Charter on Artificial Intelligence Ethics represents a timely and important regional response to the opportunities and risks of AI in education. Its main contribution lies in providing the Arab region with a coherent ethical and governance framework that is human-centered, culturally grounded, and strategically oriented toward responsible innovation.

As a best-practice case, the Charter is significant not because it claims to have solved all implementation challenges, but because it offers a credible and forward-looking model for guiding AI adoption before problematic uses become normalized. It establishes a common language, a set of guiding principles, and a pathway for future policy and institutional action.

Case 11

AI-driven VR-based Korean Language and Culture Teaching System

Beijing Foreign Studies University, Beijing, China

Background

1. Key issues addressed in the language education field

(1) Lack of real-life situations for language and cultural learning

Traditional language teaching often fails to provide authentic, context-rich environments for practice. Students learn cultural facts and linguistic knowledge from books, without opportunities to apply them in meaningful, real-life interactive scenarios. This hinders the development of pragmatic skills and cultural understanding, limiting learners' ability to engage effectively in real-world cross-cultural contexts.

(2) Lack of cultural immersion

Another problem with traditional language teaching is its insufficient attention to immersive cultural experiences. When learning is confined to the acquisition of factual knowledge, students miss the embodied, affective engagement needed to truly understand a culture, which prevents them from moving beyond stereotypes and developing cross-cultural communication skills.

(3) Lack of immediate feedback on language learning

Without timely corrective feedback during oral practice, learners may fossilize their pronunciation errors and fail to develop conversational accuracy and fluency. This deficiency not only impedes linguistic proficiency but also undermines learners' confidence in authentic communications.

2. Necessity of applying AI technology and implementation objectives

To resolve the above problems, an AI-driven VR-based course design that creates dynamic, scenario-based language learning environments presents a key solution. By leveraging AI and Virtual Reality (VR), instructors can develop interactive simulations, such as cultural rituals that enable students to use language in contexts while receiving real-time feedback, thereby improving both linguistic and cultural competence while supporting the goal of cultivating cross-cultural talents for real-world communication in a globalized world.

- **Implementation objective 1: Enable immersive and practical learning**

Using VR to simulate real-life scenarios (e.g., traditional Korean costume shop visits and cultural sites interactions) allows students to communicate in real contexts. This bridges the gap between knowledge and use.

- **Implementation objective 2: Innovate classroom instruction**

AI-powered tools like speech recognition provide instant, personalized feedback on pronunciation and fluency. This shifts the classroom from a teacher-led model to a student-centered experience, reducing anxiety and promoting proactive learning.

- **Implementation objective 3: Transform assessment and evaluation**

AI analytics support continuous, competency-based assessment by evaluating students' language use and cultural responsiveness during simulated tasks. This moves evaluation beyond exams to focus on learning-oriented assessment and developing students' communicative language competence.

Case Implementation Status

1. Needs analysis for course design

To accurately identify the learning needs of Korean language and culture, a mixed-methods approach, combining questionnaires and interviews, was employed.

Firstly, a structured survey was administered to 25 first-year undergraduate students at a foreign studies university in China, focusing on their preferences for Korean cultural experiences. The results revealed clear trends: Seoul (43%) and Jeju Island (25%) were the most desired destinations, while Korean cuisine (40%) and Jeju Island sightseeing (19%) ranked highest as cultural experiences of interest. These findings indicate that students' cultural cognitive needs are primarily concentrated on modern urban settings and iconic natural landscapes, with a strong exploratory interest in dietary culture. This data provides empirical evidence for prioritizing the development of virtual simulation scenarios.

To further assess students' familiarity with VR technology and its perceived application in the course, semi-structured interviews were conducted with five randomly selected participants. In terms of technological familiarity, only two interviewees (40%) had prior exposure to VR, and their experiences were limited to non-educational contexts. Notably, all interviewees unanimously agreed that integrating VR into the course would significantly enhance learning outcomes. Regarding content application, students expressed a desire to apply the technology to several key modules: (1) visualization of material cultural heritage, such as exploring the inner structures of traditional Korean houses through virtual tours; (2) simulation of social life scenarios, including daily routines, festival customs, and folk activities; (3) hands-on cultural practices, such as virtually replicating the preparation processes of food; and (4) immersive spatial exploration, including virtual walks through typical urban and rural landscapes in Korea.

The above needs analysis collectively highlights a strong student demand for immersive, interactive, and visually enriched learning experiences that can bridge the gap between cultural knowledge and cultural understanding. This analysis underscores the necessity of developing a VR-based teaching system that aligns with learners' preferences and enhances engagement and competency development in Korean language and cultural studies.

2. Technology research and development

(1) System architecture

The system adopts B/S architecture, supporting both web and VR environment. The system includes four layers: storage layer, data processing layer, simulation and generation layer, and application layer.

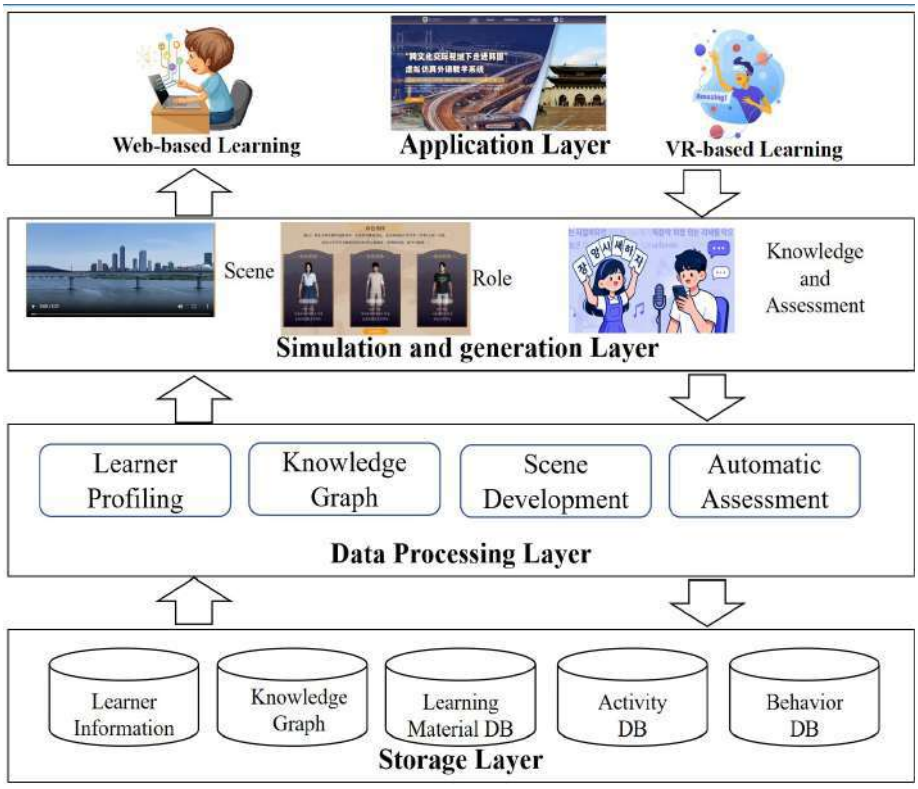

Figure 1 A four-layer architecture of the system

Figure 2 System homepage

In this four-layer architecture, the storage layer serves as the foundational support. It is mainly used to store data related to users and their learning process, including learner information, knowledge graph, learning material database, activity database and behavior database. The data processing layer provides key technologies to support Korean language and culture learning: learner profiling, knowledge graph, scene development and automatic assessment. The simulation and generation layer generated three factors for learners. First, it provides scenarios that support learners' immersive experiences; second, it designs roles that support learners' personalized exploration; finally, it offers learners adaptive and timely feedback with automatic assessment. At last, the application layer mainly provides two types of environments for learners: VR-based learning environment and Web-based learning environment.

(2) Core AI technology applications

Automatic assessment: Integrating speech recognition, natural language processing, 3D modeling, and VR panoramic technologies, the immersive Korean language and culture learning platform enables human-computer dialogue and role-playing in authentic cultural contexts. The system delivers real-time and adaptive feedback on learners' performance in four dimensions: pronunciation and intonation, linguistic accuracy, fluency, and communicative competence.

Figure 3 AI technology application: 3D modeling

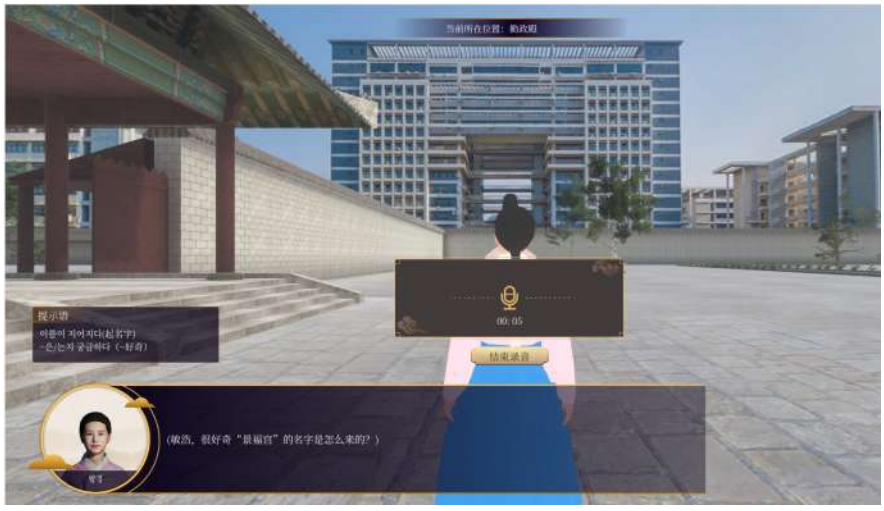

Figure 4 AI technology application: speech recognition

Role-based interaction and task-driven learning (learner profiling and knowledge graph): The system analyzed learners' learning data and conducted learner profiling to get the learners' learning state and role. Based on the role, the system could generate learning tasks based on the learners' state and the knowledge graph, such as "game-based task packages" and "Sino-Korean cultural comparison and exploration", which record operation data in real time and generate formative evaluations.

Figure 5 AI technology application: role-based interaction

Figure 6 AI technology application: task-driven learning

Scene development: To support immersive Korean language and culture learning, the system employs scene development technology that integrates 3D modeling, VR panoramic rendering, and culturally grounded instructional design to create authentic virtual environments. Based on these technologies, the real-life communication could be realized which finally enable learners to experience and practice Korean language in context.

(3) Curriculum integration

The system builds four modules and eleven typical scenarios, with the following curriculum integration.

Figure 7 Eleven typical scenarios

Figure 8 Preview of Historical Culture module

Table 1 Course modules

Module	Specific Scenarios	Integrated Courses
Historical Culture	Gwanghwamun, Hanbok Shop, Gyeongbokgung Palace, Kitchen	Survey of the Korean Peninsula; Sino-Korean Cross-Cultural Communication; Korean Cultural Experience
Natural Scenery	Jeju Folk Village, Jeonju Hanok Village	Survey of the Korean Peninsula
Economy and Education	Multinational Enterprise Interview, Front Gate of Seoul National University, Outside/Inside of Kyujanggak	Workplace Culture and Etiquette in Korean Enterprises; Comprehensive Skill Training Program; Survey of the Korean Peninsula
Time-Space Travel	Time Travel to Dengzhou Street in the Tang Dynasty	Chinese Culture in Korean; History of Sino-Korean Cultural Exchanges

Taking the “Multinational Enterprise Interview” scenario as an example, students need to complete five steps: task trigger → knowledge learning → follow-up reading practice → simulated interview → assessment and testing, with the system recording and scoring the whole process.

(4) Implementation steps and timeline

Table 2 Development timeline

Time Period	Core Tasks
Dec 2021 - Mar 2022	Project demonstration and pilot research, clarifying theoretical frameworks (situated learning, experiential learning, embodied cognition theory)
Apr 2022 - Dec 2022	Phase I of system development: Completion of the Historical Culture module
Jan 2023 - Jun 2023	Pilot teaching at BFSU, collecting feedback
Jul 2023 - Oct 2023	System optimization and Phase II development: Adding scenarios such as multinational enterprises and Kyujanggak
Nov 2023 - Dec 2023	Inter-school verification at Jiangxi Vocational College of Foreign Studies, with 112 students participating
Jan 2024 - Jun 2024	Effect evaluation
Jun 2024 - Mar 2026	Multi-school application: Sustained application in multiple universities including BFSU and Jilin International Studies University (JISU)

(5) Teaching process design

Based on the embodied cognition theory, a three-stage teaching process of “classroom teaching + language practices on VR system + autonomous learning” is constructed: classroom teaching → role-playing tasks on the platform (with real-time AI feedback) → targeted practice based on evaluation reports.

Case Innovation and Breakthroughs

1. Innovation in education and teaching models

This project introduces significant innovations in educational methodology by systematically integrating VR technologies into language learning curricula. The approach is built on three core areas:

Firstly, it establishes an immersive teaching model that seamlessly blends virtual and real scenarios. By leveraging VR panoramic and 3D simulation technologies, the project constructs typical Korean cultural scenarios spanning historical sites, contemporary urban life, and traditional customs. This enables students to experience cross-temporal and spatial cultural immersion, transporting them directly to environments ranging from the ancient dynasty palaces to modern Seoul without leaving the classroom. This breakthrough effectively addresses the long-standing challenge in language education of providing authentic cultural contexts, moving beyond the limitations of textbook-based learning.

Secondly, the project implements an interactive task-driven learning framework. Through carefully designed game-based task packages combined with AI speech evaluation, students engage in purposeful language practice that strengthens both linguistic output and cross-cultural competence as well as critical thinking abilities. Each scenario incorporates realistic communication challenges, such as negotiating prices in a traditional market or explaining cultural concepts to virtual locals that require application of language skills in culturally appropriate ways. The immediate feedback provided by AI speech evaluation allows students to refine their pronunciation and conversational strategies in real-time, creating a dynamic learning cycle.

Thirdly, a multi-dimensional competency training system forms the foundation of the educational model. The teaching approach focusing on language skills, cross-cultural communication, and digital literacy ensures that students develop not only linguistic proficiency but also the cultural competence and digital skills required for contemporary global citizenship. By systematically addressing these interconnected competencies, the project cultivates compound talents capable of functioning in complex cross-cultural professional environments.

2. Technology breakthrough

This project introduces several key technological innovations that significantly enhance the effectiveness of language and cultural learning. The core breakthrough lies in the integration of multiple advanced technologies, including speech recognition, 3D modeling, natural language processing, and VR panoramic displays. These components work together to create highly immersive and interactive virtual environments where students can practice Korean in realistic scenarios.

A major innovation is the AI-powered speech evaluation system, which uses deep learning algorithms to provide detailed, real-time feedback on pronunciation, tone, rhythm, and fluency. The system continuously collects and analyzes student interaction data, providing both learners and instructors with valuable insights into progress patterns, common difficulties, and optimal learning pathways. Therefore, this learning platform goes beyond simple right-or-wrong judgments by analyzing subtle aspects of speech, helping learners quickly identify and correct errors.

Additionally, the platform incorporates intelligent scenario adaptation, allowing the virtual environments to dynamically adjust based on student performance. This ensures that each learner will get a personalized learning path tailored to their specific needs and progress.

3. Application practice breakthrough

This project achieves significant breakthroughs in educational practice by effectively integrating VR technology into the Korean language curriculum. It addresses the long-standing issue of "emphasizing knowledge over use" by integrating VR experiments with courses such as Korean listening and speaking. Through the innovative teaching approach emphasizing cultural comparison and scenario practice, students are able to apply language and cultural knowledge in authentic contexts, thereby enhancing both language proficiency and communicative competence.

Furthermore, the project fosters a synergistic development of cultural confidence and cross-cultural communication skills. By reconstructing historical scenes of Chinese-Korean cultural exchanges through virtual scenarios, it provides students with an immersive experience of the depth and historical continuity of Chinese and Korean cultures. This process not only strengthens students' cultural identity and confidence but also cultivates their ability to engage in effective and respectful cross-cultural dialogue.

Another key practical innovation is the combination of formative and diagnostic assessment. The system tracks and analyzes students' learning behaviors and outcomes in real-time, providing comprehensive data support for teaching interventions. This enables instructors to offer timely, personalized feedback and guidance, ensuring that each student's learning process is continuously optimized. Through these applied breakthroughs, the project demonstrates a sustainable model for the future of language education.

4. Intellectual property status

The VR teaching system was independently developed by Beijing Foreign Studies University, which holds full intellectual property rights. These rights are supported by multiple technical patents and software copyrights covering core innovations in multi-modal interaction and AI speech evaluation. The system is currently in a trial implementation phase at educational institutions both domestically and internationally, serving as a foundation for further optimization and broader application.

Promotion Value and Risks

1. Application achievements

As of March 2026, this system has been put into large-scale use at three universities: Beijing Foreign Studies University, Jiangxi Vocational College of Foreign Studies, and Jilin International Studies University. It serves as a teaching resource for eight courses, including "Korean Society and Culture" and "Comprehensive Korean", and has been used by a total of 382 students in pilot programs. Research data shows that the immersive learning environment created by the system has effectively boosted students' motivation in language learning and strengthened their cross-cultural understanding.

The system is mainly promoted in the following ways:

- Integration into the Korean language curriculum, with expansion into the core curriculum group of Korean major in universities.
- Presentation of research outcomes at academic conferences such as the annual ChinaCALL conference, along with publication of related papers in core journals.
- Broader implementation through partnerships, aiming to be used in more than 5-8 universities in the next three years, covering over 10,000 students through partnerships with professional networks like the National Consortium of Foreign Language Universities.

2. Social and economic value it brings

This system brings significant social and economic value. It enriches digital teaching resources, improves learning effectiveness, and helps cultivate more practical Korean and cross-cultural talents. As a typical case of AI empowering foreign language teaching, this project can provide a replicable educational product for language-focused universities in China and abroad. By breaking time and space limits, it lowers teaching costs and supports large-scale application. It also drives the development of educational technology, enhances the quality of foreign language education, and offers practical insights for integrating immersive technology into curriculum design and evaluation.

3. The leading role in the education field

The VR foreign language teaching system A Window to Korea is funded by the key project "Research on the Theory and Application of Virtual Simulation Foreign Language Teaching (2022SYLZD011)" under the Double First-Class construction of Beijing Foreign Studies University.

The leading role of this VR system lies in its three key design principles: (1) content organization grounded in cultural comparison, which helps students develop deeper intercultural awareness and a more critical understanding of cultural meanings. (2) student co-creation of instructional design, positioning learners not simply as recipients of information but as active participants in the learning process, as evidenced in the Needs Analysis part, and (3) the construction of immersive and interactive cultural scenarios enabled by VR, allowing learners to experience culturally situated communication in realistic contexts. Such environments strengthen learners' sense of presence, support contextualized language use, and facilitate the integration of linguistic, cultural, and communicative competence.

4. Potential risks

Potential risks in the large-scale application of the system include the following two aspects:

Content and tech updates: the current content and tech might need refreshing in 3–5 years of use. A research team composed of language experts and researchers, Korean professors and technical experts is needed to review and update the system regularly.

Teacher readiness: due to socioeconomic differences, teachers at some partner universities may lack sufficient digital skills to fully leverage the system's advantages and improve their teaching outcome. Therefore, stronger teacher training and support are required to boost results.

By planning ahead for these challenges, we can keep the system sustainable and ensure its wider application.

Other Relevant Information

1. Third-party evaluation

The system has been piloted at 3 universities, involving a total of 382 students (see Table 3). Both quantitative and qualitative data indicate positive feedback from users. Over 90% of students from Jiangxi Vocational College of Foreign Studies affirmed that the system enhanced their learning motivation, deepened cross-cultural understanding and enhanced confidence. Students from BFSU provided Likert-scale ratings averaging above 4.35 for cultural comprehension, confidence building, and anxiety reduction. At JISU, the natural scenery module received an average rating of 4.69, with all evaluation dimensions scoring above 4.60. Post-test results further showed scores exceeding 4.40 in areas such as cross-cultural understanding, sense of presence and learning satisfaction. Students also highlighted practical gains like pronunciation improvement, emotional connection to cultural history,

immersive VR experiences and enhanced cross-cultural communication skills.

Teachers and students at Jiangxi Vocational College of Foreign Studies held very positive feedback of the system, noting it effectively addresses the drawbacks of traditional Korean teaching, such as temporal and spatial limitations and a lack of contextual scenarios. The equally favorable responses from students at BFSU and JISU further corroborate the value of this system for its immersive, interactive and practical benefits in teaching and learning.

Besides, the research team has published substantial academic outcomes, including one monograph and four papers in leading Chinese and Korean (KCI) journals, with completely independent intellectual property rights.

Below is the list of pilot universities and user evaluation data.

As of March 2026, the system has been applied on a large scale in three universities, covering a total of 382 students:

Table 3 Trial data from pilot universities

University	Courses/Samples	Number of Students	Time Period
Jiangxi Vocational College of Foreign Studies	Korean Society and Culture; Comprehensive Korean	112	Nov - Dec 2023
Beijing Foreign Studies University	Chinese Culture in Korean	41	Aug 2023 - Jun 2024
Jilin International Studies University	Survey of the Korean Peninsula; Chinese Culture in Korean; Korean Cultural Experience and other 3 courses	229	May 2025 - Mar 2026
Total	-	382	-

(1) Quantitative data

Jiangxi Vocational College of Foreign Studies (N=112):

- 94.2% agreed that “the system improves learning interest”; 95.0% agreed that “game-based interaction stimulates curiosity”.
- 92.6% agreed that “understanding of Sino-Korean cultures is deepened”; 91.7% agreed that “cultural confidence is enhanced”.
- 90.1% agreed that “speech evaluation boosts expression confidence”; 96.7% gave positive overall evaluations of the system.

Beijing Foreign Studies University (N=23) - Core Indicator Averages (Likert Scale):

- Deepened understanding of similar Sino-Korean cultures: 4.65
- System enhanced cultural confidence: 4.39
- NPC dialogue reduced language anxiety: 4.35

Jilin International Studies University (N=52) - Natural Scenery Module: Overall experience satisfaction: 4.69, with the average score of all dimensions exceeding 4.60.

Jilin International Studies University (N=9) - Post-test Core Data Averages (Likert Scale):

- Mastery of cross-cultural knowledge: 4.40
- Attitude towards cross-cultural learning: 4.40
- Sense of presence: 4.53
- Concentration: 4.56
- Learning motivation and cultural expansion: 4.47
- Exploratory interaction: 4.51
- Learning satisfaction: 4.44

(2) Qualitative feedback

- Jiangxi Vocational College of Foreign Studies: "...effectively solving the drawbacks of traditional Korean teaching such as temporal and spatial limitations and lack of contextual scenarios...highly praised by both teachers and students."
- BFSU Students: "The system's scoring helps me identify pronunciation problems"; "Time-travel dialogue allows me to develop a deeper emotional connection with the history of Sino-Korean exchanges."
- JISU Students: "360° VR videos make me feel as if I am in Jeju Island"; "After the kitchen scenario experience, I can explain the differences in kimchi to Korean friends."

2. Case-related images, videos, books and papers

This part lists the system, along with the monograph and articles published by the academic team based on this system.

The system images, an introductory video in English, and the software copyright certificates are provided as attachments for reference.

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Case 12

EduVision: An AI-Powered First-Person PerspectiveImmersive Multimodal Data Collection, Interaction and Cognitive Empowerment System for Classroom Teaching

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Background

The prevailing "smart classroom" paradigm—built on fixed-camera surveillance and centralized cloud inference—has been widely deployed across China's K–12 system. Yet when evaluated against the TRACE3 instructional analysis model and DP4SET digital pedagogy framework, this approach exposes five structural pain points that undermine authentic teaching:

(1)Epistemological Disconnect: Fixed "God's-eye" cameras cannot link the teacher's gaze to the student being addressed, causing systemic speaker-attribution errors and stripping away the core causal logic of classroom interaction.

(2)Cognitive Overload & Hawthorne Effect: Teachers must repeatedly look away from students to consult physical screens, depleting working memory. Meanwhile, conspicuous monitoring equipment induces surveillance anxiety and the Hawthorne Effect—students perform compliance rather than genuine engagement.

(3)No Private Micro-Intervention Channel: All AI feedback is broadcast publicly (pop-ups, voice prompts), disrupting lesson flow and damaging student dignity. There is no silent, one-to-one delivery pathway.

(4)Device Fragmentation: Smartboards, recording systems, IoT devices, and AI software each demand separate control actions, violating the "Manageable" tenet of the SMART classroom model.

(5)Post-Class Review Bottleneck: Without Agentic AI support, teachers are trapped in the TOTE (Test-Operate-Test-Exit) model—manually scrubbing hours of footage with no causal analysis.

In response, Beijing Normal University developed EduVision—a fully localized, multimodal AI system

anchored in the teacher's first-person perspective (POV). It shifts the paradigm from "objective surveillance" to "subjective POV perception," and from "intrusive public control" to "silent, private micro-intervention."

Case Implementation Status

EduVision has transitioned from R&D to iterative pilot validation in real K–12 classrooms at Beijing Normal University affiliated schools. Built on the DP4SET digital pedagogy framework, the system introduces a "Local Edge Closed-Loop Architecture" requiring zero destructive classroom modifications.

1. Hardware Ecosystem — Five Integrated Modules

The hardware layer achieves full classroom coverage through five plug-and-play components:

M1 — AI Smart Glasses (Teacher Sensing Gateway): Worn naturally by the teacher; captures first-person video, audio, and high-precision gaze-tracking data. Optical waveguide AR display provides real-time cognitive augmentation directly in the teacher's field of view.

M2 — Student Smart Wristbands (Silent Actuators): Purely output-only terminals with LRA vibration motors and micro-OLED emoji screens. Zero biometric sensors are incorporated, physically eliminating surveillance risks while enabling silent 1-on-1 private haptic delivery.

M3 — Teacher Control Ring (Blind-Op Terminal): A discreet ring-style input device that lets the teacher confirm AI decisions, evaluate student answers, and control IoT devices without breaking eye contact or speaking aloud.

M4 — Classroom Edge Computing Box (AI Brain): The local inference server that runs all multimodal AI within the classroom LAN. Implements a strict "burn-after-reading" policy—raw video never leaves this physical node.

M5 — Panoramic Camera (Redundant Auxiliary): Wide-angle auxiliary sensor providing a complementary global view to cross-validate FPV data when the teacher turns to the board or moves around the room.

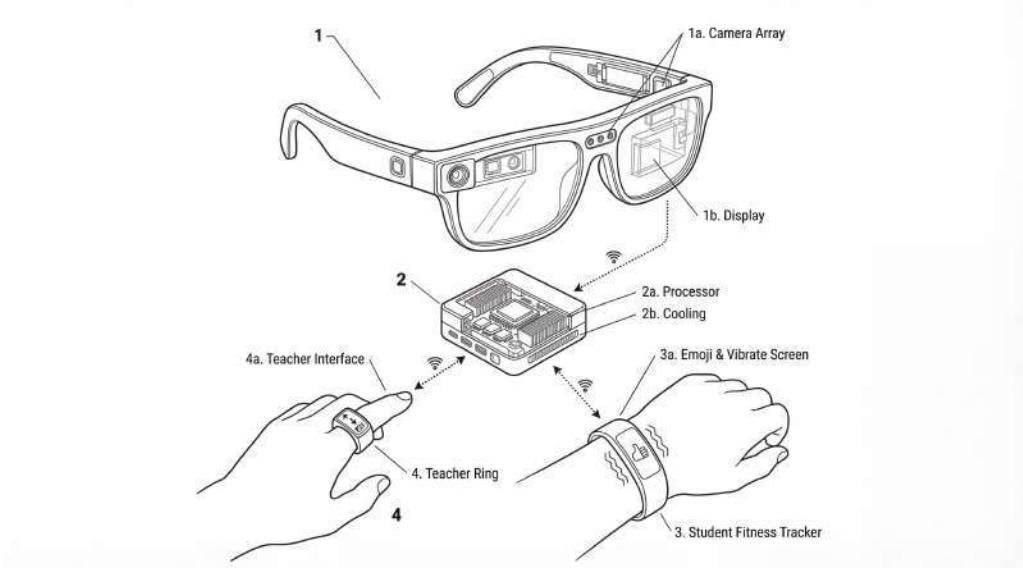

Figure 1 Hardware Module Overview — AI Glasses (M1), Wristbands (M2), Control Ring (M3), Edge Box (M4), Panoramic Camera (M5)

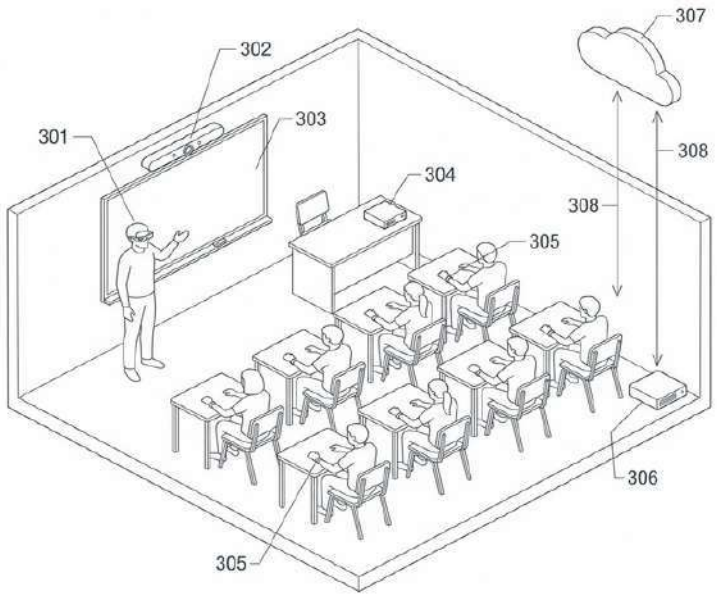

Figure 2 Classroom Deployment Layout — Minimal Infrastructure, Maximum Coverage

2. Software Architecture — Three-Layer Edge-Native Stack

The software stack comprises three layers operating entirely within the Edge Box: (a) Infrastructure Layer — multi-source stream ingestion, time-stamp synchronization, and device lifecycle manageme nt; (b) AI Inference Layer — Visual Perception (gaze tracking, expression analysis, person centering), Speech Understanding (ASR, speaker diarization, TalkFace audio-visual fusion), and Behavior Analysi s (interaction detection, state inference); (c) Application Service Layer — Feedback Decision Engine, AR Rendering Engine, IoT Control Service, and Large-Screen Control Service.

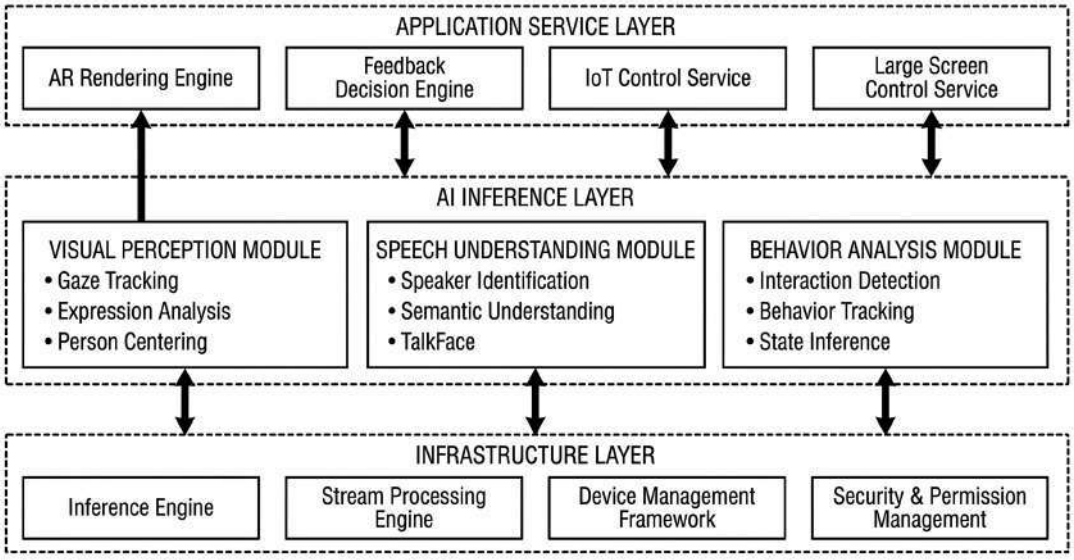

Figure 3 Three-Layer Software Architecture — Infrastructure / AI Inference / Application Service

3. Real-Time Multimodal Processing Pipeline

To guarantee seamless in-class assistance, the pipeline enforces strict end-to-end latency budgets across six stages:

Stage 1 — Glasses Sensing: Raw data ingest streamed over Wi-Fi to the Edge Box.

Stage 2 — Pre-processing: YOLO-based face detection, scene stabilization, audio noise reduction.

Stage 3 — Recognition Analysis: Face-to-StudentID mapping, gaze-target localization, ASR transcription.

Stage 4 — Semantic Understanding: LLM-driven dialogue-role labeling, interaction-event classification, pedagogical intervention recommendation.

Stage 5 — Multi-Path Output: AR overlay rendered on M1 glasses, haptic commands dispatched to target wristbands, IoT/whiteboard signals relayed via the Edge Box gateway.

Stage 6 — Async Event Archiving: Structured EventItem records written to the local timeline store without blocking the real-time chain.

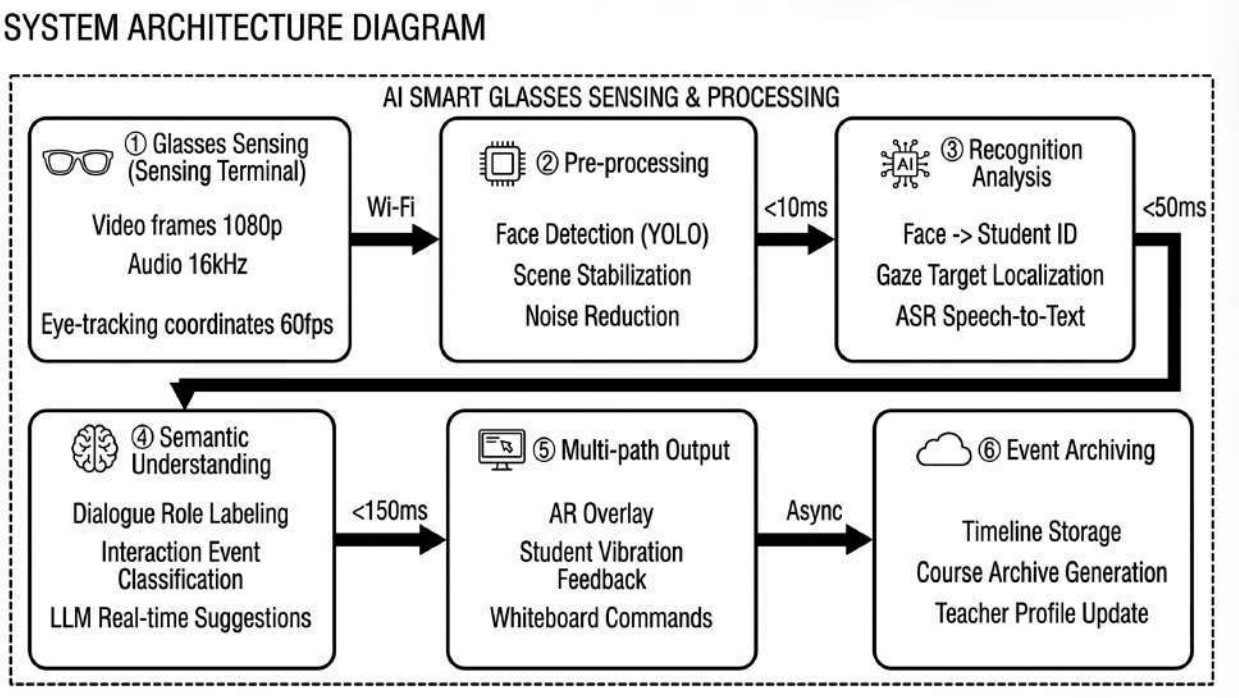

Figure 4 Real-Time Processing Pipeline — Six-Stage Latency-Controlled Dataflow

4. EventItem Ontology — Unified Multimodal Knowledge Graph

EduVision introduces a structured EventItem Ontology as the single intermediate representation for all classroom events. Parallel sensory threads—Speech (ASR + diarization), Gaze (FPV + eye-tracking), and IoT (ring/wristband signals)—are fused through a Combination Analysis Unit that applies Continuous-Time Hidden Markov Models (CT-HMM) for state-sequence modeling and Multivariate Granger Causality (MVGC) for cross-modal causal inference (e.g., "Student gaze-avoidance directly triggers teacher vocal-pitch elevation and follow-up questioning"). Each EventItem is stamped with: <timestamp, actor_ID, target_student_ID, event_type, semantic_payload, confidence>.

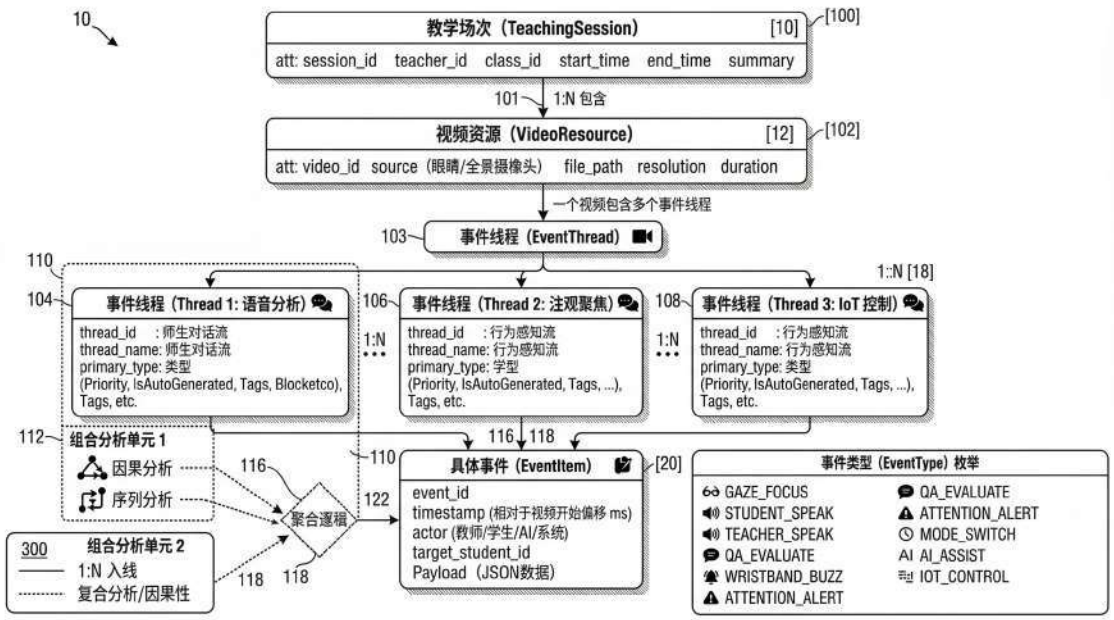

Figure 5 EventItem Data Ontology — Structured Classroom Knowledge Graph

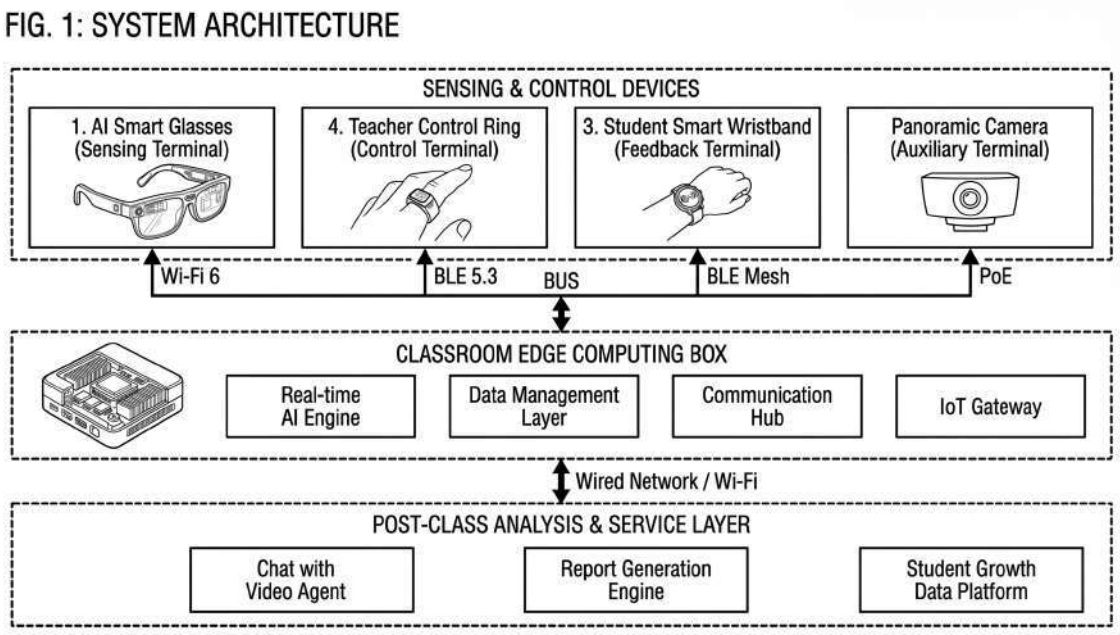

Figure 6 Overall System Architecture — Local Edge Closed-Loop

5. In-Class Interaction Scenarios

Scenario A — Implicit AR Perception (S1–S2): Teacher Li dons M1. Inside the device, the edge box identifies all students via facial recognition, calculates engagement metrics in real time, and displays the names of students requiring focused attention as text prompts within the teacher's field of view.

Scenario B — "Gaze+Control" Private Haptic Loop (S3–S6): The AI flags Student A as disengaged. Teacher Li naturally gazes at Student A for 3s (Gaze Lock). Li clicks M3 (Control Confirm). The Edge Box sends a command (two gentle pulses) via BLE Mesh solely to Student A's wristband (Silent Deliver). Student A self-corrects; no peer or environmental noise is generated. Cooldown: 60s per student.

Scenario C — Dual-Channel Weighted Scoring (S4+S7): Student B answers a trigonometry question. AI scores semantic completeness as Score_AI = 0.55. Simultaneously, Teacher Li pushes M3 joystick upward (Score_Teacher = 1.0). Weighted fusion: Score = 0.4 × 0.55 + 0.6 × 1.0 = 0.82 → "Excellent." Student B receives W-V02 escalating triple-vibration and "+5 Growth Points" on the wristband screen.

6. Post-Class "Chat with Video" — Agentic Reflective Analysis

Post-class, a five-agent architecture (Planner → Retriever → Action → Reflector → Narrator) transforms raw EventItem logs and video into an interactive diagnostic dialogue:

Planner Agent: Parses teacher's natural-language query, decomposes into a coarse-to-fine retrieval plan.

Action Agent: Autonomously controls the video UI—calling VideoSeek() to jump to key timestamps, VideoZoom() to enlarge a student's area, and DrawAnnotation() to overlay bounding boxes and labels.

Reflector Agent: Performs cross-modal consistency verification (e.g., does visual "AU4 frown + AU15 lip-corner pull" align temporally with auditory "increased vocal pitch"?). If evidence is contradictory, it forces the Planner to widen the retrieval window.

Narrator Agent: Synthesises a causal diagnostic report with voice-over, automatically citing video timestamps and annotated frames.

Example — Teacher Li asks: "Why was Zhou Jiu's participation so low today?" The system: jumps to 18:32, zooms in on Zhou's face, detects micro-expressions (AU4 + AU15 → anxiety at 18:30), reports: attention fell from 81% to 51% in the second half vs. 76% in the prior session—and recommends a targeted follow-up plan.

FIG. 2: CHAT WITH VIDEO AGENT SYSTEM ARCHITECTURE

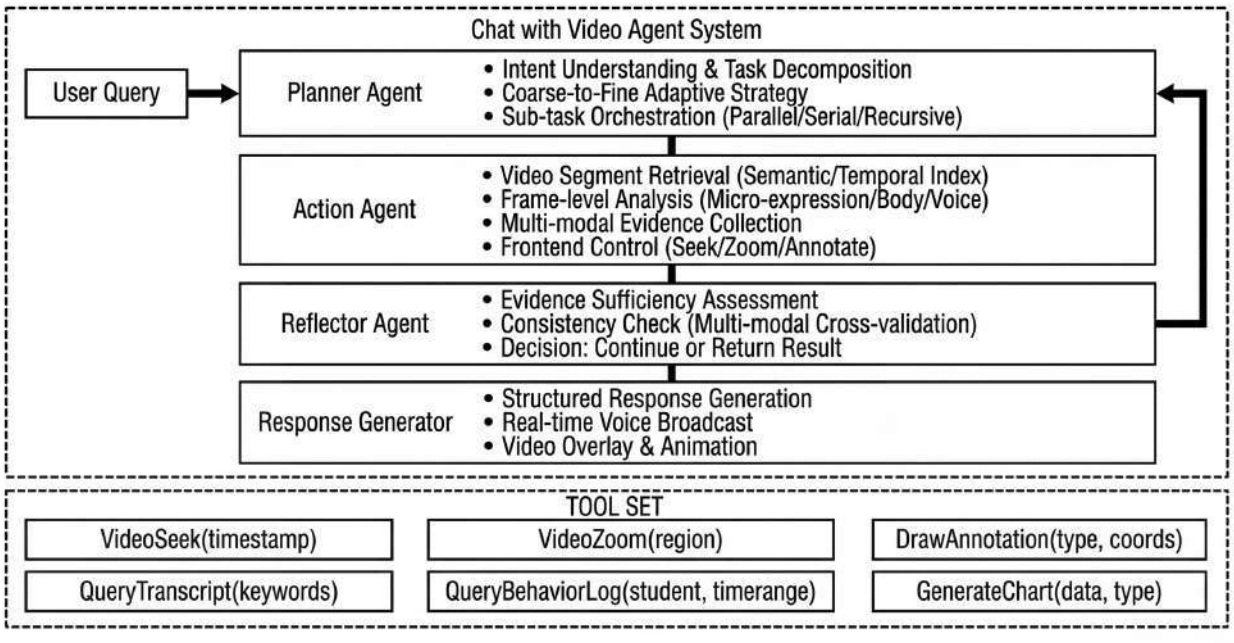

Figure 7 Five-Agent "Chat with Video" Architecture — Planner / Retriever / Action / Reflector / Narrator

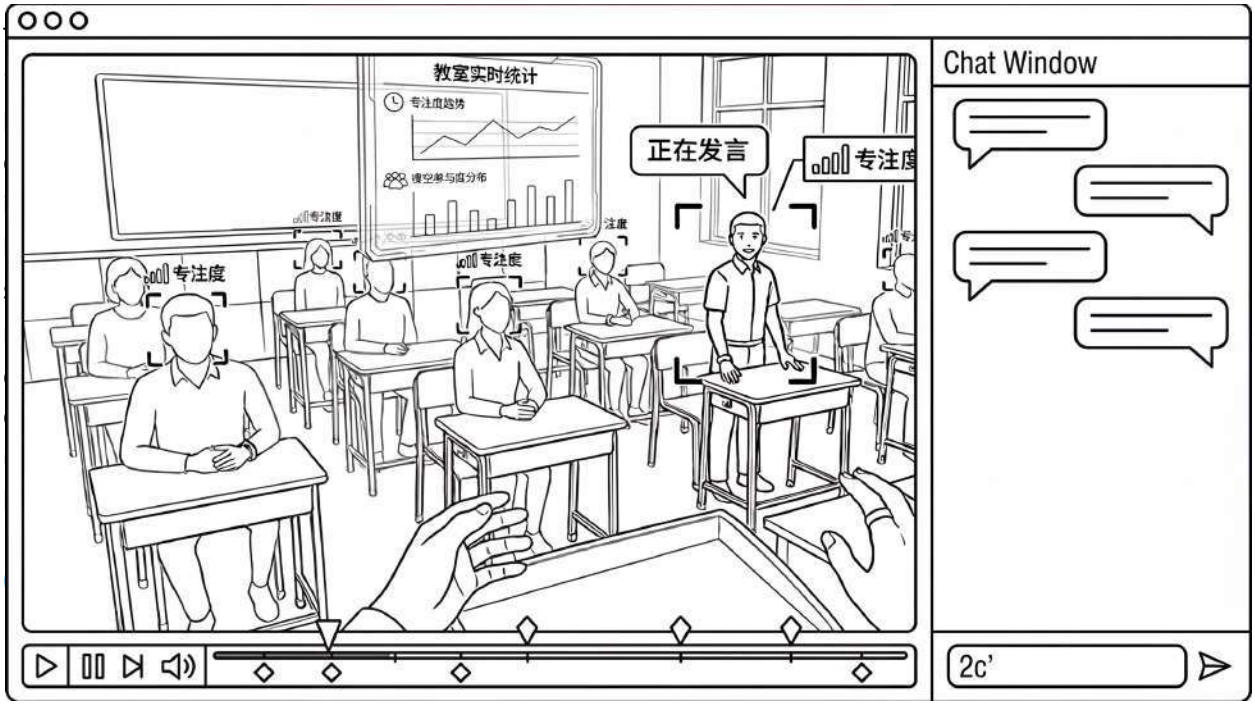

Figure 8 Chat with Video Interface — Autonomous Video Navigation, Annotation, and Causal Diagnosis

Case Innovation and Breakthroughs

1. Core Pedagogical Innovations

Innovation 1 — POV Paradigm Shift: "Gaze-is-focus" replaces "God's-eye surveillance." The teacher's natural gaze becomes the primary data-collection trigger, ensuring frontal, near-field facial capture at the highest-value moment. This fundamentally resolves the epistemological disconnect, advancing classroom reconstruction from "distant recording" to "gaze-enhanced causal attribution."

Innovation 2 — Zero-Intrusion Private Tactile Channel: Student wristbands are equipped with no biosensors, eliminating surveillance anxiety entirely. Teacher attention is mapped directly to silent haptic signals felt only by the target student—"Technology with Warmth" that protects dignity and psychological safety.

Innovation 3 — AI + Teacher Dual-Channel Weighted Evaluation: The $\alpha \cdot Score_AI + \beta \cdot Score_Teacher$ fusion framework (default $\alpha = 0.3$, $\beta = 0.7$) prevents algorithmic over-ruling of teacher judgment. The teacher always retains veto power, embodying the principle: "AI empowers teachers, not replaces them."

Innovation 4 — Agentic Chat with Video (TOTE → PERE): First deployment of an autonomous Agentic UI controller for classroom video analysis. Teachers shift from manual frame-scrubbing (TOTE) to conversational, evidence-based reflection (PERE—Prompt, Explore, Reflect, Evolve).

Innovation 5 — Unified Multimodal IoT Control: A single control ecosystem (M1 + M3 + M4) unifies smartboard, IoT environment, and AI-assistant interactions. Based on Cognitive Load Theory (CLT), this dismantles device fragmentation and returns cognitive bandwidth to deep pedagogical mentoring.

Innovation 6 — 100% Edge AI Privacy Wall: "Burn-after-reading" local architecture. All inference and storage occur within the classroom's physical boundary. Raw audio-visual data never crosses the classroom edge—future-proof compliance with China's PIPL and educational data governance regulations.

2. Technology Breakthroughs

Breakthrough 1 — FPV-Constrained Multimodal Speaker Attribution: Standard audio diarization collapses in K–12 acoustic conditions. EduVision fuses visual TalkFace detection (SyncNet lip-sync from the optimal FPV frontal angle) with speaker diarization (PyAnnote Audio 3.0), tightly constrained by the teacher's real-time gaze vector. The result: a precision attribution pipeline that outputs structured records—"Student X spoke from t_1 to t_2: [transcript]"—with three confidence scores (gaze-hit, lip-sync, combined).

Breakthrough 2 — Reflector Agent Meta-Cognitive Verification: To eliminate AI hallucinations in long-video analysis, the Reflector Agent mimics human metacognition. It cross-validates evidence across modalities and time windows, blocking output if consistency checks fail and iterating until a logically sound causal chain is established.

3. Application Practice Breakthroughs

EduVision achieves three application-level firsts for Chinese basic education: (a) Proof that AI classroom analyze is possible without surveillance infrastructure or cloud dependency; (b) Transformation of post-class teacher reflection from manual search to conversational, AI-narrated causal analysis; (c) A campus-level data governance model where anonymized, de-identified EventItem aggregates feed a Digital Twin dashboard for evidence-based school management, while per-classroom data sovereignty is strictly maintained.

4. Intellectual Property — Five-Patent Portfolio

The project is independently developed by our team, and we plan to apply for relevant patents and publish academic papers in the later stage.

Promotion Value and Risks

1. Application Prospects & Scalability

Eduvision requires only one edge server plus wearable accessories per classroom, reducing hardware BOM to under ¥50,000 per room—comparable to existing smart-classroom installations yet delivering far greater AI depth and data security. The elimination of cloud compute and high-bandwidth uplink costs makes the system viable from top-tier urban schools to resource-constrained rural settings.

2. Social & Economic Value

Socially, EduVision directly supports China's "Double Reduction" (双减) policy by maximising in-class instructional quality, reducing after-school remediation pressure, and advancing inclusive education through dignified, private micro-support. Economically, eliminating cloud dependency removes recurring per-student compute costs. At the macro level, anonymized EventItem data feeds a Campus Digital Twin for cross-classroom pedagogical auditing and IRF (Initiation-Response-Feedback) chain analysis—without ever exposing raw student footage.

3. Demonstration & Leading Role

EduVision establishes the first production-validated reference architecture for teacher-centred, privacy-native AI in Chinese K–12 classrooms. Its "Teacher-First, Privacy-by-Design" blueprint is positioned to shape the next generation of smart-campus (智慧校园) national standards and Ministry of Education AIED procurement guidelines. The Agentic Chat with Video module additionally pioneers a new category of AI-assisted teacher professional development at scale.

4. Risk Identification & Mitigation

Technical Risks: Diarization accuracy may degrade in highly reverberant lecture halls; mitigated by panoramic-camera cross-validation and domain-adaptive model fine-tuning on diverse classroom acoustic profiles.

Pedagogical Risks: AR prompt reliance could atrophy teacher intuition.

Policy Risks: PIPL evolution may impose new requirements; mitigated by the hardware-level "burn-after-reading" architecture that enforces physical data localisation regardless of regulatory changes.

Case 13

Macao Primary and Secondary School Intelligent Learning System and AR Far-Imaging Light Screen Learning Machine

Yi Dai

City University of Macau, Macau, China

Solution Introduction

(1) Function Overview: This solution addresses the dual challenge of educational digitalization and the rising myopia epidemic among youth in Macao. The "Macao Primary and Secondary School Intelligent Learning System" (the System) and "AR Far-Imaging Light Screen Learning Machine" (the Hardware) integrate to create a "Learn as Protection" ecosystem. The hardware utilizes a coaxial catadioptric freeform optical system to project 100-200 inch high-definition virtual images at a perceived distance of 3–6 meters. This fundamentally transforms traditional "near-work" (viewing at 20-50 cm) into a physiological state of "viewing the distance," reducing accommodative demand by over 90% (from ~3.33 D to ~0.03-0.20 D). The software platform, powered by educational big data and Bayesian network algorithms, provides a closed-loop "Test-Diagnosis-Learn-Practice" adaptive learning experience. It captures multi-modal process data—including clickstreams, eye-tracking, and cognitive load indicators—to build "Digital Twin Learners" and provide precise, personalized learning paths.

Figure 1 Macao Primary and Secondary School Intelligent Learning System

(2) Technical Highlights or Innovations:

- Active Visual Intervention: Unlike passive blue-light filters, this solution uses Dynamic Digital Defocus (DDD) technology. It leverages the eye's longitudinal chromatic aberration to induce peripheral myopic defocus, sending biochemical signals to inhibit axial eye growth—the root cause of myopia.
- Advanced Optical Manufacturing: By adopting Nanoimprint Lithography (NIL), the team increased lens production yields from 37% to 82%, significantly lowering the cost of high-precision freeform optics for mass educational use.
- AI Subject Teaching Agents (STA): Utilizing lightweight Small Language Models (SLM) and "reasoning distillation," the system provides professional pedagogical scaffolding for specific subjects (e.g., Macao's JAE exam prep) with a latency under 500 ms and significantly reduced "AI hallucinations".
- Medical-Education Fusion: It achieves a deep integration of smart medical care and smart education, offering medical-grade vision protection during home-based study .

Application Scenarios

(1) Application Environment and Implementation Targets:

Targets: K-12 students, teachers, and parents in the Macao SAR and the Greater Bay Area (GBA).

Environments:

Home-based Learning: A compact desktop terminal for personalized study, requiring only 15-30 cm of physical space to project a 5-meter virtual image.

Smart Classrooms: Integration with campus big data platforms to provide teachers with real-time "learning attention heatmaps" and student academic profiles.

(2) Examples of Typical Application Scenarios

Macao "Four-School Joint Entrance Exam" (JAE) Preparation: At Kwong Tai Middle School, the system was implemented to manage exam prep. It identifies knowledge gaps in Chinese, Math, and English through AI diagnostic tests and generates "personalized improvement schedules." Teachers use the platform’s "High-frequency Error Heatmaps" to conduct targeted remedial teaching.

Cross-Regional Collaborative STEAM Education: In the Hengqin-Macao "Smart Education Technology Experimental School" (e.g., Hengqin First Primary School), the hardware provides immersive virtual science experiments, allowing students to "view" complex ecological data at 6 meters, protecting their vision during high-engagement technology sessions.

Impact and Case Evidence

(1) Implementation Results, Evaluation Data or Practical Experience

Visual Health: Clinical evidence shows that pulse choroidal thickness remains stable during use, with no "choroidal thinning" observed in traditional screen use. Accommodative demand is reduced by over 90%. Learning Efficiency: Implementation in Macao secondary schools resulted in a 15%-20% average improvement in student knowledge transfer and error management efficiency.

User Acceptance: Evaluation via a TAM-based framework (n=160) showed high perceived usefulness (M = 3.94) and strong behavioral intention to use (M = 3.88).

(2) Replicability, Sustainability and Promotion Potential

The solution's modular architecture (Display, Defocus, Control, and Interaction layers) allows for rapid

adaptation to different regional curricula (e.g., Traditional vs. Simplified Chinese). The use of NIL technology ensures a long-term sustainable cost model, keeping terminal prices within 1.8x of high-end tablets while providing 10x the visual protection.

(3) Illustration of a Typical Case

Location: Kwong Tai Middle School, Macao.

Time: January 2025 – Present.

Scale: Comprehensive pilot across core subjects (Math, English, Chinese).

Outcome: Established a data-driven "Home-School Synergy" model where parents receive weekly "Vision Health & Academic Progress Reports" via the "Home-School Connect" module.

(4) Exhibition Materials Conceptual renderings show a compact, sleek desktop AR learning terminal. Technical requirements: Standard power supply, Wi-Fi connectivity. The display will demonstrate a 200-inch virtual "Classroom of the Future" perceived at 6 meters, highlighting real-time AI pedagogical interaction.

Basic Information of the Institution

(1) Institution Introduction

The City University of Macau (CityU Macau), formerly known as the University of East Asia founded in 1981, was renamed in 2011. With strategic development outline of “Rename, Restructure, Transform, Upgrade”, CityU Macau steps forward to develop digital humanities, arts, business, finance, emerging engineering, and social science disciplines to serve society, steering its way to a fully-fledged metropolitan university.

As a leading education provider, the University has been shouldering its social responsibility of “Serving Macao, Integrating into Greater Bay Area” to nurture a wealth of high-caliber professionals that align with its motto of “Virtue, Knowledge, Practice.” In the context of integrated development of higher education in the Guangdong-Hong Kong-Macao Greater Bay Area, CityU Macau will spare no effort to provide intellectual and academic support to promote local and regional development.

CityU Macau is home to nearly 13,000 students, offering nearly 50 Chinese- and English-medium programs with the support of the eleven faculties. CityU Macau is a leading provider of hospitality and tourism management education and is the only one in Macao accredited with the TedQual certification by the United Nations World Tourism Organization (UN Tourism, formally known as “UNWTO”) at all degree levels. This year, the University is ranked 37th in Shanghai Ranking’s Global Ranking of Academic Subjects 2025 in Hospitality and Tourism Management and made its debut in Economics in the 301-400 range.

(2) Experience or Qualifications in the Field of Digital Education

Global Recognition: Its Education field ranked top in Asia and high globally in QS rankings.

Research Strength: Host to 15 research institutes, including the Macao Institute for Global Education Research and Innovation.

Successful Projects: Successfully led multiple Macao Science and Technology Development Fund (FDCT) and FDCT-GDST projects.

The City University of Macau has established a network of "Smart Education Technology Experimental Schools", pioneering the integration of AR/AI in K-12 education.

(1) Application Environment and Implementation Targets:

Targets: K-12 students, teachers, and parents in the Macao SAR and the Greater Bay Area (GBA).

Environments:

Home-based Learning: A compact desktop terminal for personalized study, requiring only 15-30 cm of physical space to project a 5-meter virtual image.

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Case 14

Digital Human Microcourse Platform: "HZPT Solution" for Boosting the Digital Transformation of Vocational Education

Liqiao Dai

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China United Network Communications Group Co., Ltd

Case Background

In the digital transformation of vocational education, the production efficiency and quality of microcourse resources directly determine the effectiveness of teaching reform. The traditional microcourse production mode of "on-camera shooting + post-editing" involves cumbersome process, long cycles, high costs and slow iteration, making it difficult to meet the emerging demands for "lightweight, efficient and regularized" resource development.

Leveraging artificial intelligence and digital human technologies to transform resource production has become the key to solving this problem. However, the practical application of such technologies faces three major challenges: first, teachers have an aversion to "technical complexities", fearing that new tools are too complicated to master; second, there is a lack of user-friendly tools tailored to teaching scenarios, as most commercial tools involve complex operations and high entry barriers; third, inadequate data privacy protection leaves teachers worried about the leakage and misuse of biometric information such as facial featurest and voiceprints, which hinders the technological popularization. How to address these challenges, build a microcourse platform that teachers are "willing to use, able to master and dare to adopt", and achieve "cost reduction, efficiency improvement and quality enhancement" in resource development has become an urgent task to be solved for our college to advance educational digitalization.

Implementation process

(1) Build a Solid Digital Foundation to Underpin Platform Research and Development

The college takes "data-driven development, AI empowerment, and secure and controllable operaton" as the core principles , and systematically advances the construction of digital infrastructure. At the data layer, through the "One Database, One Table" project, the data governance of more than 30 business systems across the college has been completed, and a unified data middle platform has been

built to provide data support for intelligent applications. At the IoT layer, 100% of classroom equipment has been connected to the IoT center, intelligent upgrades of access control, security and other facilities have been completed, forming an intelligent network with full-domain perception and centralized management. At the computing power layer, a domestically-developed server cluster to achieve localized replacement is deployed and a hybrid computing power pool balancing security and flexibility built, delivering a high-efficiency computing environment for AI applications. This digital foundation, featuring "full data integration, full domain IoT coverage and independent and controllable computing power", has laid a solid groundwork for the research and development and large-scale applications of various intelligent solutions.

(2) Develop High-Fidelity Model to Achieve a Zero-Threshold Workflow for Microcourse Production

By integrating digital human and speech recognition technologies, highly realistic digital human avatars and high-quality voice cloning are created. The voice module supports multi-language customization with adjustable speech speed, tone and timbre, boasting a 98% lip-sync accuracy and 96% voice similarity, enabling accurate and natural presentation of teaching content. Teachers can create high-quality microcourses in just three simple steps: "Upload PPT - Edit Commentary - Generate with One-click". This approach completely eliminated the traditional shooting and editing processes, achieving a "zero-threshold" workflow for microcourse production.

(3) Integrate Multi-Modal AI to Realize End-to-End Intelligent Production

The platform integrates 4 major generative AI models, covering all fields of speech, natural language and computer vision. Real-time neural speaker synthesis technology ensures high-quality audio and video generation; large language models enable the intelligent generation of lesson plans, long texts and PPT outlines; neural machine translation, voice cloning and real-time video synthesis technologies are combined to efficiently develop bilingual microcourses. Through multi-modal generative algorithms, end-to-end intelligence in microcourse production is realized, significantly boosting both production efficiency and quality.

(4) Adopt a Hybrid-Cloud Deployment Architecture for Balanced Security and Flexibility

The platform innovatively adopts a hybrid cloud architecture (as shown in Figure 1), with digital human models deployed on-premises to ensure data security and privacy from the source, while cloud-bearing functional modules to enable elastic scaling and data storage, guaranteeing stable, secure and reliable operation. Through the hybrid cloud architecture, the platform has built a safe and efficient technical foundation, strongly supporting r the rapid production of teaching resources.

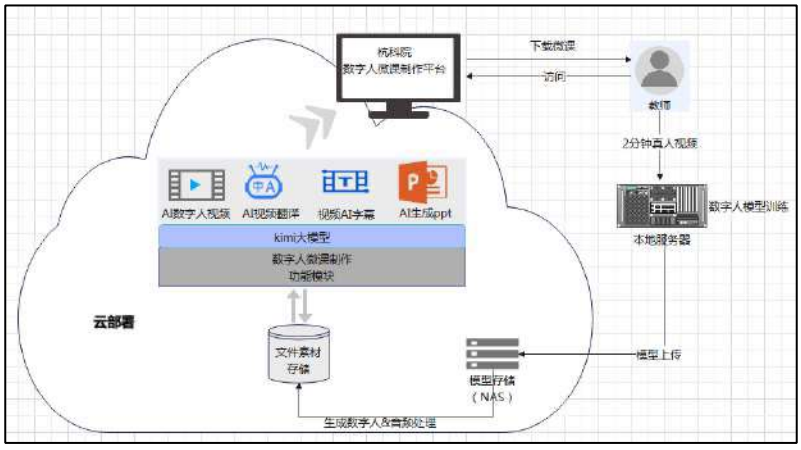

Figure1 Architecture Diagram of the Digital Human Microcourse Production Platform

3. Innovation Highlights

(1) Reshape the Resource Production Paradigm to Build a New Ecosystem for Content Creation

This case breaks the reliance of traditional microcourse production on professional videography teams and expensive hardware, innovatively building a minimalist production paradigm of "Generate on Input". By integrating high-fidelity digital human modeling and multi-modal AI generation technologies, the complex audio-visual production process is encapsulated in the backend, while the frontend offers intuitive operations: "Upload PPT-Edit Commentary-Generate with One Click". This "de-technicalized" design not only alleviates teachers' aversion to technical complexities, but also empowers every teacher to independently develop digital teaching resource. It drives the shift of micro-course production from "elite-led" to "full participation", reconstructing the ecosystem for college-based resources creation.

(2) Establish a Hybrid Cloud Deployment Mechanism to Build a Robust Privacy and Security Firewall

Addressing the risks of sensitive biometric information leakage in digital human technology application, this case is a pioneer in proposing and implementing a security solution based on hybrid cloud architecture. The platform deploys core biometric data such as teachers' facial features and voiceprints and model inference computing power on-premises, achieving "no data leaving the campus, and full privacy protection"; at the same time, cloud resources are used to cope with concurrency pressure, ensuring system flexibility. This mechanism resolves teachers' concerns about "adopting new technologies, and provides a practical technical model for data sovereignty and privacy protection in AI-enabled educational applications.

(3) Empower the Extension of Teaching Time and Space to Open up a New Path for the Globalization of Vocational Education

With the support of digital human technology, the platform breaks the constraints of time and space, supports real-time multilingual translation and cross-cultural scenario adaptation, and provides technical support for the globalization of vocational education. The rapid generation of bilingual microcourses addresses the shortages of overseas teaching resources and language barriers, serving the cultivation of international talents under "Belt and Road" initiative. Meanwhile, the innovative "digital teacher" after-school tutoring model shifts from one-way in-class indoctrination to two-way interaction before and after class, extending the teaching service chain, and promoting student-centered blended teaching reform.

4. Case Outcomes

(1) Expanded Application Scale and Rising User Acceptance

Launched in April 2024, the platform has been widely praised by teachers for its ease of operation and powerful functions. By the end of 2025, more than 60 teachers across the college have created their own digital human avatars, producing a total of more than 8,800 minutes of microcourses, including more than 1,600 minutes of bilingual microcourses. The application coverage has been expanded from individual courses to the entire college, effectively overcoming teachers' "aversion to technical complexities " and driving a shift from "reluctance to use" to "proactive adoption".

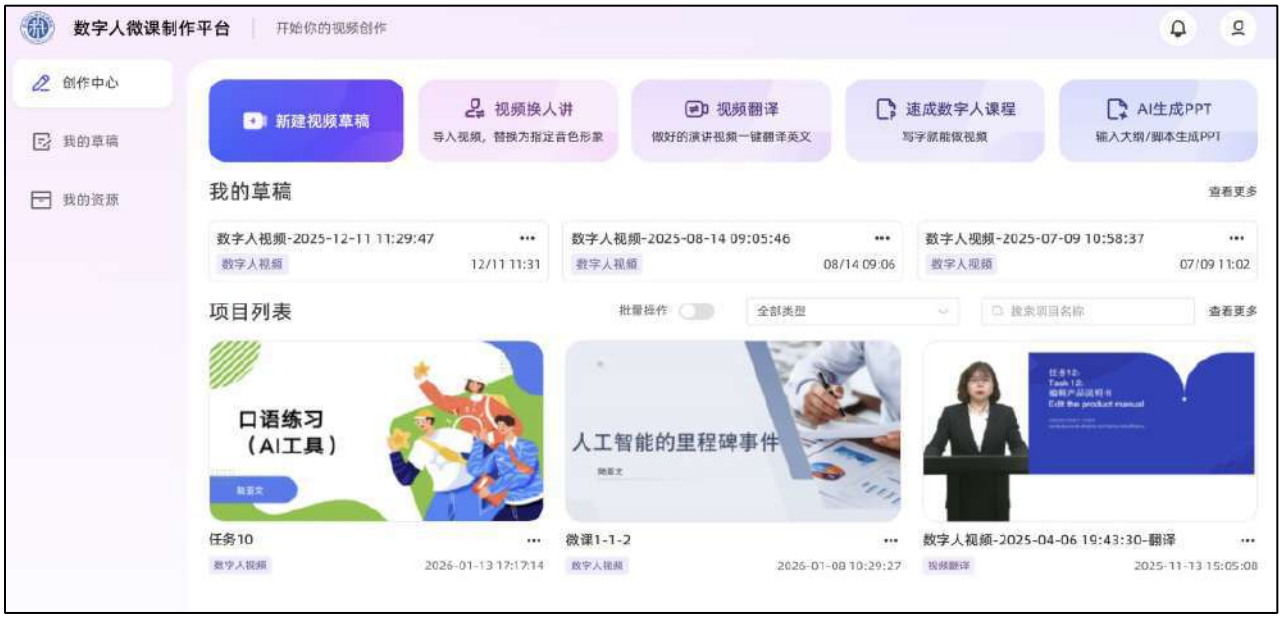

Figure 2 Homepage of the Digital Human Microcourse Production Platform

(2) Substantial Efficiency Gains and Significant Cost Reduction in Resource Development

The application of the platform has brought a revolutionary transformation to the production of teaching resources. Based on the 8,800 minutes of microcourses produced, the traditional production model would have required an investment of approximately 1.06 million RMB; with our platform, the total cost was reduced to about 460,000 RMB, representing a cost reduction of more than 56%. The production cycle for a single microcourse was shortened from the traditional 1-2 weeks to 1-2 hours, achieving an efficiency improvement of more than 80%, completely solving the core pain points of "long cycles and high costs" in the traditional mode, and realizing "lightweight and efficient development of" teaching resources construction.

(3) Improved Resources Quality to Support the Development of High-Level Projects

High-quality microcourse resources produced by digital human technology have been widely applied to various high-level projects at the college, strongly supporting the update of national-level professional teaching resource databases, the development of provincial-level high-quality online open courses and the construction of new forms of digital textbooks. The resource application has been expanded from a single classroom aid to a diversified teaching scenario, effectively supporting the rapid update and personalized supplement of teaching content, and solving the problems of "slow iteration and inflexibility" in the traditional mode.

(4) In-Depth Innovation in Teaching Models to Boost the Internationalization of Education

Digital human microcourses have effectively extended the spatial and temporal boundaries of classroom teaching. For example, Teacher Xuan from School of Early childhood Education used the platform to quickly create "homework feedback microcourses" and push them to students in a timely manner (as shown in Figure 3), effectively making up for the lack of in-class time and individualized guidance. In addition, the development and application of bilingual microcourse resources have provided strong support for the professional learning of South African international students at our college, and reserved high-quality digital teaching resources for serving the "Belt and Road" initiative and the "globalization of vocational education".

Figure 3 Students Viewing "Homework Feedback Microcourses" Rapidly Created via the Platform.

(5) Growing Demonstration Effect and Widespread Social Recognition

With its innovation, effectiveness and replicability, this case has gained extensive recognition from all sectors of society: in 2025, it was named a Typical Case of Zhejiang Provincial Digital Human Education Pilot and featured in the Spring Breeze program on China Education Television, with its report broadcast on CCTV Channel 4; in 2024, it won the first prize in the Education Track and the Third Prize in the National Final of the 2nd "Huacai Cup" Computing Power Innovation Application Competition, as well as the AI Innovation Excellence Award of Smart Universities; and was also featured in the "One AI Class in Zhejiang" program on Zhejiang Education Channel and Zhejiang News Channel. To date, HZPT Solution has been adopted by more than 20 universities, primary and secondary schools inside and outside Zhejiang Province, forming a reproducible and scalable model for digital resource development in education.

5. Scalability

Promotion Path: We have built a dual-track mechanism of "Standard Output + Customized Services". On the one hand, we have developed standardized operation manuals and training courses, and established a closed-loop system of "Testing → Training → Application → Optimization → Popularization" to ensure the content is easy for teachers to understand and master; on the other hand, relying on regional teaching and research communities, we carry out inter-school exchanges and demonstration course displays to share our experience and practices.

Adaptation Solutions: We have designed a hierarchical deployment architecture tailored to different educational institutions. For universities with existing computing power infrastructure, we provide on-premises deployment solutions to ensure absolute data security; for primary and secondary schools with limited resources, we provide lightweight SAAS services that are ready-to-use out of the box. This flexible adaptation strategy not only meets the customized needs of high-end users but also lowers the threshold for the inclusive application of educational digitalization technologies.

Expected Outcomes: The HZPT Solution can help educational institutions break through bottlenecks in resource development and effectively address pain points in curriculum resource construction. It is expected to reduce microcourse production costs by more than 50% and improve production efficiency by more than 80%, and play a significant role in serving the globalization of vocational education and developing high-quality courses. The solution delivers strong social and economic value and has broad application prospects in the education sector.

Case 15

AI-Driven Scenario-Based Transformation in Physical Education: Prioritizing Health Promotion

Shapingba Shuren Jingrui Primary School, Shapingba District, Chongqing, China

Under the dual impetus of building a powerful nation in education and enhancing the physical fitness of adolescents, high-quality school-based physical education is pivotal to the holistic development and lifelong well-being of students, serving as a crucial pathway for fostering virtue and nurturing talents. Adhering to the educational philosophy of "silent nurturing" at Shapingba District's Shuren Jingrui Primary School in Chongqing, the deep integration of digital intelligence technologies with physical education enables tangible perception of physical activities and measurable assessment of outcomes. This approach fosters growth through subtle influence and empowers precisely through technological presence, presenting a multidimensional, school-based practice of AI-empowered "health-first" principles. It offers replicable and scalable practical wisdom for transforming physical education methodologies in the intelligent era.

Background

1. Challenges in Implementing the "Health-First" Concept

(1) Problem pain points

In the domain of basic education in China, while "health-first" represents a policy consensus, its practical implementation confronts a tripartite challenge:

- Traditional physical education teaching relies on teachers' experience-based judgement, and there is a lack of objective data to support students' exercise intensity density, and skill mastery.
- The "one-size-fits-all" approach in physical education evaluation often measures all students with a uniform standard, ignoring individual differences, resulting in the coexistence of "not having enough to eat "and "not being able to digest".

- The disconnection between school and family: School sports and family activities are disconnected, making it difficult to form sustainable healthy behavioral habits.

The underlying causes of the above-mentioned problems lie in the following: First, experiential teaching lacks precise diagnostic tools, making it difficult for teachers to objectively assess the movement quality and exercise load of each student. Second, under the class teaching system, there exists a structural contradiction between large-scale teaching and personalized guidance, and there is a lack of an operational organizational model for teaching students in accordance with their aptitudes. Thirdly, there is a lack of technical means for process evaluation, and students daily movement behaviors and growth trajectories cannot be transformed into data assets that can be retained and analyzed.

(2) Technical necessity

Shuren Jingrui Primary School is located in the urban-rural fringe of Shapingba District, Chongqing. When it was established in 2009, the average age of its teaching staff was less than 25 years old. Under the pressure of being surrounded by schools ,it was “forced to reform”. The school has chosen digitalization as a breakthrough point, using AI technology to make sports perceptible, data verifiable, and evaluation measurable, exploring a systematic path from the concept to practice of “health first”.

The necessity of introducing AI technology is reflected in three aspects:

- Data Diagnosis-Solving the “Invisible ”problem. AI enables automatic collection and immediate feedback of exercise data, converting exercise load and movement quality into visual indicators.
- Teaching Intervention- Addressing “Inaccurate Teaching” Based on data diagnosis, it supports stratified teaching and personalized intervention, achieving “class division according to body type and teaching based on individual aptitude”.
- Evaluation-based Education - Solving the problem of “Incomplete Evaluation” by integrating behavioral data across all scenarios and incorporating it into the growth file, we promote the shift of evaluation from “practicing what is tested ” to practicing for healthy growth.

The practical significance lies in the formation of a low-cost and easy-to-promote school-based practice model of “AI+Sports”,providing a practical sample for basic education schools across the country and even the world to implement the principle of “Health First”.

Case Implementation Status

AI technology empowers the entire scene of sports education.

1. Overall Architecture: AI - CPE Course Implementation System

The school has established an “AI -CPE ” curriculum implementation system, achieving a trinity of contextualization (AI - Curriculum), digitalization and intelligence (AI - Practice), and accompaniment (AI - Evaluation).

Among them, contextualizing the application of AI to deconstruct the core literacy of disciplines and create learning scenarios such as virtual experiments and situational dialogues; Digital intelligence relies on the grouping, intelligent interactive teaching and digital intelligence governance. The accompanying full-process tracking of students’ learning situation data forms a “data portrait + growth narrative ” visual report.

2. Four core scenarios

Scene One: Smart Sports Classroom—From “Experience-based judgment” to “Data - driven”

In the AI motion analysis class, the teacher assists in identify and evaluating students’ movement

processes, and base on the data, provides targeted improvement suggestions. The smart bracelet monitors in real time indicators such as heart rate and exercise density, scientifically controlling the classroom load and ensuring exercise safety. Based on the results of physical form and physical fitness tests, students are divided into classes according to their weak or better performance, achieving “precise teaching”.

Scene Two: Smart Sports Scenario —Making Exercise “Visible”

The school is equipped with low-cost smart playground facilities: counting and shooting machines, smart basketball baskets, long jump carpets, and skipping rope. Students enter the practice system through facial recognition, and the data is collected in real time and synchronously entered into the growth file.

Among them, a low-cost solution of “face recognition + ordinary camera ” is adopted, eliminating the need for wearable devices. The system automatically completes counting, distance measurement, and foul determination, achieving seamless collection and immediate feedback of sports data.

Scene Three: The integrated model of large and small classes

Large classes are uniformly organized for the entire grade, focusing on physical fitness activation and specialized skills to ensure the bottom line and strengthen the foundation, and to make up for the professional limitations of teachers. The small classes implement classified and class - divides, highlighting their strengths and addressing their weaknesses to achieve personalized adaptation.

This way, the problem of “not having enough to eat” and “not being able to digest ” are solved simultaneously, and each students is proficient in at least two sports specialties. Base on the comprehensive score of AI physical fitness, students who have made significant progress will be automatically promoted to higher classes, and those who are temporarily lagging behind will receive compensation training, truly achieving data-driven, dynamic class division, and continuous advancement.

Scene Four: Five- Education robots accompany growth

The “Lan xiaode, Lan xiaozhi, Lan xiaojian, Lan xiaomei, Lan xiaolao ” five-education robots accompany students’ growth, making technology no longer a cold device but an educational partner that is approachable, interactive and guiding. In scenarios such as morning runs, larges breaks, and outdoor practices, students interact with robots through facial recognition. The system automatically records their exercise data and recommends personalized goals for the day.

3. Implementation timeline

Stage	Time	Key tasks	Landmark accomplishments
Basic construction period	2017-2019	High-speed network coverage、Tablet computer equipment 、Digital platform construction	Ensue that each student has access to a mobile learning terminal
Pilot exploration period	2019-2021	Exploration of Mobile Learning Projects	Selected for the UNESCO Mobile learning Best Practices Project
Comprehensive promotion period	2021-2024	Full coverage of smart sports equipment has been achieved, and the large and small class models have taken shape	Comprehensive deployment of AI motion analysis, smart bracelets, and intelligent playgrounds
Period of deepening integration	2024-2026	AI - CPE system is well-developed, The swimming course is make available to all students	Establish a comprehensive school - based practice paradigm integrating AI and sports

Case Innovation and Breakthroughs

The Jingrui Solution for empowering Physical Education with AI

Innovation and operation dimension	Core connotation	Innovative value
Systematic innovation through the coordinated implementation of the “Three Transformations”	Apply AI technology simultaneously to the three dimensions of content implementation and evaluation	Form a closed-loop system rather than a single-point application to achieve a structural transformation in the education model
A low-cost and highly accessible technical route	Adopt a low-cost solution that combines facial recognition technology,ordinary cameras,and smart bracelets	Professional-level data collection achieved through system integration holds significant reference value for developing regions

(Continue)

Innovation and operation dimension	Core connotation	Innovative value
The value leap from data collection to education service	Technology serves precision teaching, safety assurance, and habit formation	Truly achieve that technology serves the purpose of nurturing people, rather than technology for its own sake
The collaborative educational system mechanism involving home, school and society	With digital platforms as the link, each parent has an account	Organizing activities such as family cross-country races and school-themed fun sports meets helps establish a sports camp model centered on schools, reinforced by interconnections ,and encompassing families and communities within its operational scope

Promotion Value and Case Effectiveness

1. Achievements in student development

Indicator	Performance data
The excellent and good rate of physical health	67%
Qualified rate of physical health	99.79%
District-level physical health competition	Won the first prize for 15 consecutive years
Sports competition results	National, municipal and district-level competitions have accumulated nearly a hundred gold medals
Students' breakthrough achievements	Students He Junxi has consecutively broken four records in the Chongqing Youth Swimming Competition and one national record
Popularization of swimming skills	Popularize through the school and ensure everyone masters the skills of self-rescue in water
"Little chubby one" "little bespectacled one"	Effectively contained

2. Teacher development

Type of outcome	Honor and award
Excellent course recognized by the Ministry of Education	1
Excellent course of city level	2
Classical course of city level	1
First prize in the National Physical Education Teaching Competition	2
First Prize in the National Finals of the Information Technology Innovation and Practice Competition for Primary and Secondary Schools	4 / Second prize 3
First Prize in the High-quality Physical Education Class in Chongqing City	2
First Prize for Quality Physical Education Classes in Shapingba District	5
Publication of national-level papers	4

Teachers no longer rely on experience for judgement. Instead, they leverage AI technology to accurately diagnose students' learning situations, optimize digital teaching capabilities, and significantly contribute to the development of teaching and research outcomes such as application guidelines for AI tools.

3. Honors and Recognition

Honors	Awarding unit
"Mobile Learning Best Practice Project"	UNESCO/Level
"Exemplary Cases" of the National Sunlight Education Initiative for Primary and Secondary Schools	National Level
Outstanding case of the "Wu Dong Lan Yun" large break activity	National Level
Innovative Cases in Basic Education in China 2025	National Level
First Prize in the Class Presentation Activity of the Sports, Science, Technology, and Art 2+2 Program	City Level

Scalability: From Jingrui's Practice to China's Solution

1. Universality analysis

The universal values of the Jingrui solution are manifested in three dimensions.

Dimensions	Specific connotations	Promotion advantages
The equipment threshold is low	The core function can be achieved by facial recognition combined with a regular camera	It is suitable for all kinds of schools without expensive equipment
The model is replicable	Mechanisms such as the integration of large-scale and small -scale classes and physical-condition -based class grouping	It doesn't rely on specific hardware but emphasizes institutional design
The concept is transferable	AI Empowers"Health First"	Applicable to all stages of basic education

2. Promotion Path

Level	Promotion strategy	Concrete Measures
Deepen within the campus	Continuously optimize the AI -CPE system	Expand into more academic fields to form a complete educational ecosystem
Radiate across the region	Relying on the Education Alliance of the Chengdu-Chonging Region	Carry out pilot promotion in Sichuan and Chongqing, and establish a cross-regional teaching and research community
Set a national example	Through the Innovation Case Platform for Basic Education in China	Output deliverable such as operation manuals and teacher training courses
Conduct international dissemination	Leveraging the platform of UNESCO and the World Digital Education Conference	Share China's practices and contribute China's solutions

3. Localization adaptation solutions

Follow the approach of “local pilot, iterative expansion , and overall integration”.

Procedure	Strategy	Applicable Scenarios
Explore unique features and select scenarios	Based on the existing venues, facilities and sports traditions of the school, select one or two scenarios that are easiest to implement for a pilot project first.	Rural areas and schools with limited resources
To integrate and blend to promote iteration	Integrate AI tools organically with the school’s existing teaching model evaluation system and gradually expand it.	All kinds of schools can adopt it
To systematically integrate to form an ecosystem	Incorporate smart sports into the overall development plan of schools and promote it in a coordinated manner with the five aspects of education.	Fully promoted when conditions are ripe

Differentiated suggestions for different educational stages.

Educational stages	Focus on direction
Primary school	Interest cultivation and habit formation
Secondary school	Skill improvement and physical fitness monitoring

4. Expected effect

Stages	Coverage scale	Expected outcomes
Three-year promotion period	Covering 1000 primary and secondary schools and benefiting 500000 students.	A large-scale application model of AI combined with physical education has been formed.
Five-year deepening period	Radiating Nationwide and Advancing Globally	Establish an AI-plus sports cloud teaching and research community and develop an iterative implementation guide.

Case 16

GeeKey: A Teaching Agent for Scenario-Based Learning in Civil Engineering

Tongji University, Shanghai, China

Background

With the rapid advancement of artificial intelligence (AI) technologies, universities, as leading hubs for talent development and scientific and technological innovation, are undergoing a profound shift from knowledge transmission to the cultivation of competencies and thinking skills. Fully leveraging intelligent technologies to comprehensively transform teaching models has become an inevitable pathway for reforming university talent development.

Generative AI has introduced new opportunities for learning support, yet general-purpose large language models (LLM) may exhibit limitations in domain fidelity, terminological precision, and reasoning robustness in technically demanding fields. Tongji University developed CivilGPT, a civil-engineering-oriented generative AI model designed for educational use. Building on this foundation, GeeKey, a teaching agent intends to support scenario-based learning, has been developed. The system is designed to augment instructor expertise by providing structured scaffolding, concept clarification, and feedback support aligned with course objectives and classroom governance. The aim is to improve learning effectiveness and instructional efficiency while maintaining disciplinary rigor and responsible use in formal teaching settings.

Case Implementation Status

1. CivilGPT: The Foundational AI Model Powering GeeKey

As the foundational backbone of GeeKey, CivilGPT integrates over 9 billion tokens of domain-specific data and brings together knowledge from ten disciplines including civil engineering, architecture, and mechanics, and thereby effectively supporting students' cross-domain knowledge retrieval and the development of collaborative thinking when addressing complex engineering problems. In addition, it incorporates a trustworthy civil-engineering knowledge graph constructed from course syllabi, comprising more than 11,000 knowledge points and over 13,000 relationships, which significantly enhances the specificity of instructional guidance, the accuracy of knowledge provision, and the rigor of teaching assistance.

2. GeeKey: Teaching assistant Agent and Its Scenario-Based Implementation

GeeKey deeply integrates CivilGPT with a knowledge graph and a digital–physical twin practice platform, forming a collaborative digital foundation that is trustworthy in knowledge, fit for teaching, and authentic in scenarios. It connects seamlessly with diverse teaching platforms and, centered on different instructional scenarios, develops multiple agent application modes, providing systematic technical support for "teacher–AI–student" collaborative learning (Figure 1).

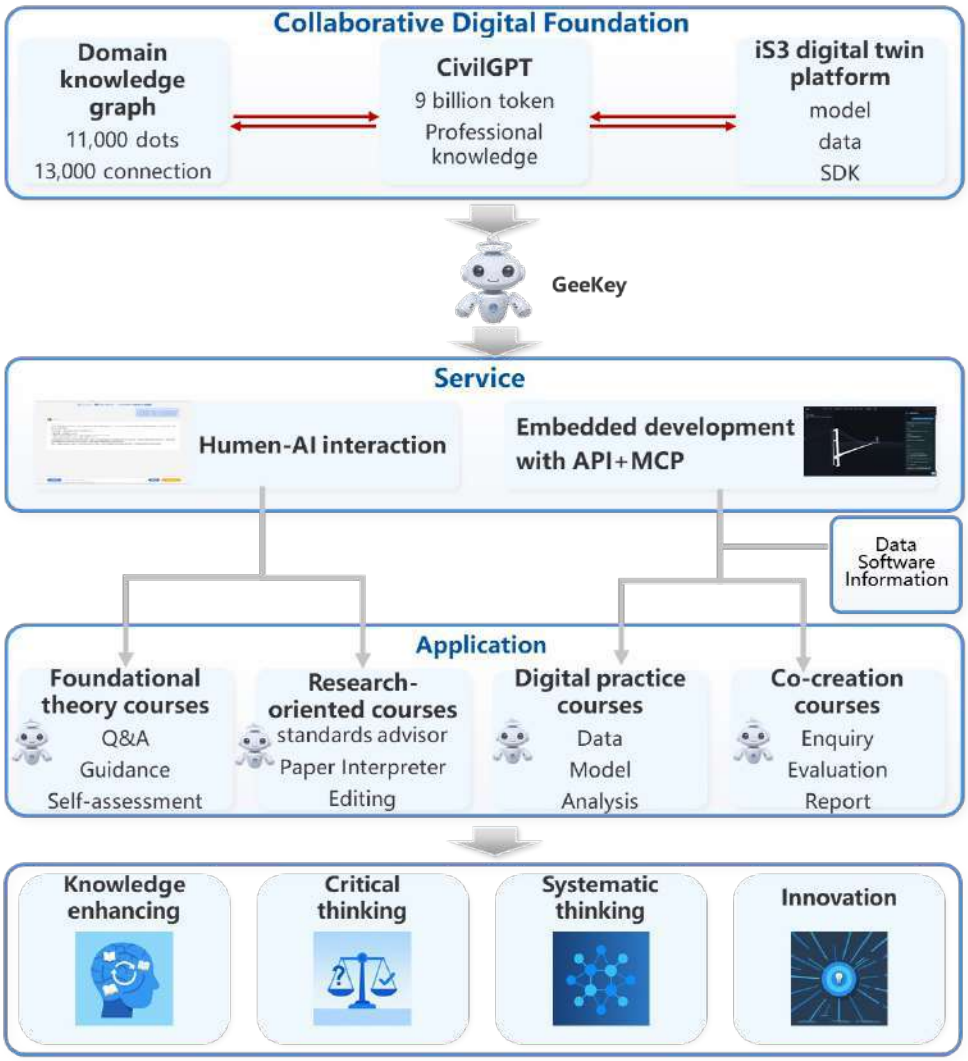

Figure 1 Implementation of GeeKey

For foundational theory courses, a knowledge-guided agent application mode was developed. It offers course Q&A services under the guidance of the knowledge graph (Figure 2) and adaptive self-assessment tools. Through layered probing along logical chains and targeted recommendations based on assessment results, it enables a personalized learning loop, strengthening students' disciplinary foundations.

For research- and innovation-oriented courses, a critical-thinking training application mode is established. It provides functions such as a standards-compliance advisor (Figure 3), a literature interpretation assistant, and an academic writing and editing tool, guiding students to understand the

logic of codes and standards, practice scholarly reasoning, and refine argumentative expression, thereby cultivating critical thinking.

For digital practice courses, a problem-driven agent application mode is created. It offers a configurable Software Development Kits (SDK) and a digital–physical twin platform (Figure 4), substantially improving students' implementation efficiency and practical capability. It guides students to focus on complex engineering problems, complete systematic practice projects, and temper systematic thinking.

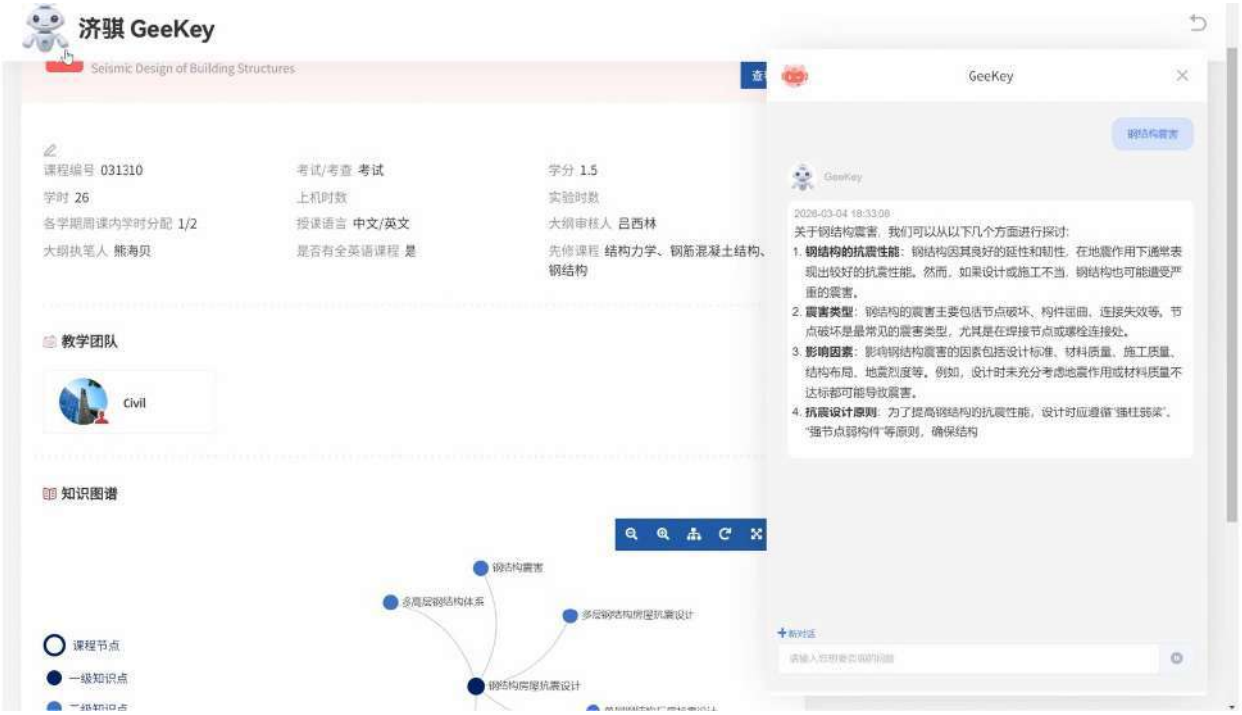

Figure 2 Knowledge graph guided Q&A

Figure 3 Standards-compliance advisor

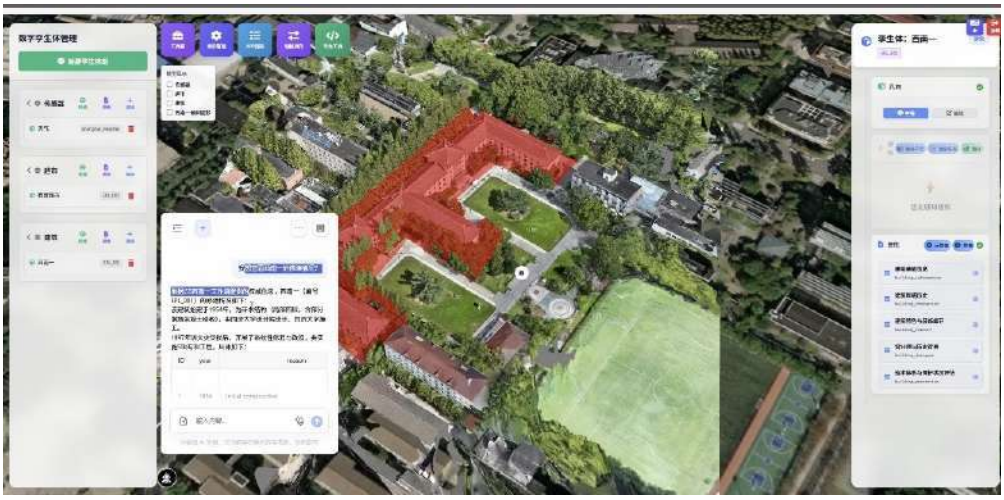

Figure 4 Interaction within the digital–physical twin platform

For teacher–student co-creation courses, an innovation-enabling agent application mode is constructed. It provides a multi-source heterogeneous data foundation and structural analysis tools to assist with tasks such as structural identification, analysis, evaluation, and prediction (Figure 5), empowering students to develop real-scenario solutions and enhance comprehensive innovation competence.

Figure 5 Assistance with structural analyses

Case Innovation and Breakthroughs

1. Discipline-Specialized Trustworthiness for Engineering Education

A central contribution is the discipline-specialized foundation for instructional support. By grounding the agent in a civil-engineering-oriented LLM (CivilGPT), the project addresses domain accuracy and reasoning stability—two prerequisites for responsible adoption in education, where erroneous guidance can propagate systematic misconceptions.

2. Operationalizing Scenario-Based Pedagogy Through Structured Scaffolding

While scenario-based learning is widely advocated, it is often limited by the cost of continuous coaching and feedback. GeeKey operationalizes this pedagogy by structuring student interactions

around explicit phases. The agent's design prioritizes process-oriented support and metacognitive prompting, thereby reinforcing engineering reasoning rather than superficial answer production.

3. From Tool Demonstration to Repeatable Instructional Workflow

The project advances beyond ad hoc use of generative AI by embedding the agent across the instructional cycle and aligning it with repeatable teaching routines: prerequisite remediation, inquiry support, assignment feedback loops, and differentiated practice. This workflow orientation supports sustainability and transferability in routine teaching contexts.

Promotion Value and Risks

1. Scalability and Transferability

GeeKey's functional design—scenario-based tutoring, scaffolded problem solving, and rubric-aligned feedback—supports deployment across multiple civil engineering courses with localized customization through scenario libraries and course-specific rubrics. The underlying design pattern is extensible to other engineering disciplines characterized by structured reasoning and standards-informed practice.

2. Risk Identification and Mitigation

(1) Student over-dependence: mitigated through hint-based guidance, reflective prompting, and assessment practices that reward reasoning processes.

(2) Academic integrity risks: mitigated through clear usage policies, process-oriented tasks, and integrity-aware assessment redesign.

(3) Privacy and compliance: mitigated through institutionally governed deployment and minimization of sensitive data handling.

Other Relevant Information

1. Case Award Status

The related work of this case was selected by the Ministry of Education of China as representative "Generative education-oriented LLM", "Higher-education AI agents", and "AI + Higher education exemplary case". In addition, with GeeKey as the core, a "Future Classroom" case was showcased at major international conferences, including the 2025 World Digital Education Conference, the 2025 World Engineering Education Conference, and the 2025 World MOOC and Online Education Conference.

2. Third-Party Evaluation

GeeKey has served more than 1,000 teachers and students in Tongji. Students commonly remark: "GeeKey is like a teaching assistant that's always online. It guides us step by step toward a deeper understanding of the problem and helps us complete practical projects efficiently and to a high standard." Teachers comment: "GeeKey is highly capable in handling technical Q&A and guidance. It improves the efficiency of developing innovative teaching models, allowing us to focus on students' key cognitive difficulties and truly tailor instruction to individual needs."

3. Case-related images, videos, and other materials.

An introduction video of the presented case has been attached.

Case 17

An Integrated AI Enhanced Learning Ecosystem: From Virtual Anatomy to Immersive Clinical Simulation at the University of East Capital School of Medicine

Mona Abdel-Aal Elzahry

University of East Capital, Egypt

Background

Medical education traditionally separates basic sciences from clinical skills training, creating a disconnect that hinders students' ability to integrate knowledge. As a newly established institution welcoming its first cohort in 2025, the University of East Capital School of Medicine seized the opportunity to design a curriculum that embeds educational technology.

We identified three core pain points that our curriculum would address:

- Fragmented learning: Students typically learn anatomy through cadavers, histology through glass slides, physiology through static graphs, and clinical skills through isolated simulation sessions, each in separate silos with little connection between them.
- Limited exposure to real patient variation: Traditional methods offer few opportunities to encounter rare diseases, anatomical variations, or the full spectrum of pathological presentations before clinical rotations.
- High-stakes, low-repeatability training: Students have insufficient chances to practice clinical reasoning, communication, and procedures in a safe, repeatable environment before interacting with real patients.

To address these challenges, we designed a technology-enhanced curriculum that integrates six advanced platforms: an AI-powered patient communication simulator, a high-resolution virtual dissection table, a dynamic virtual physiology platform, immersive VR goggles, a comprehensive virtual microscopy system, and an AI-powered interactive e-Book platform. Our objective is to build a

seamless learning journey that mirrors clinical reasoning, from cellular pathology to patient interaction and procedural practice, aiming to improving knowledge retention, clinical reasoning skills, and student confidence from the very first year of medical training.

Case Implementation Status

The University of East Capital School of Medicine adopted a phased, evidence-based approach to systematically deploy and integrate educational technology tools across the curriculum. As a new institution, we have the advantage of building this ecosystem from the ground up.

1. Needs Analysis and Platform Selection

A multi-disciplinary task force (faculty from anatomy, physiology, pathology, clinical skills, and educational technology) surveyed existing gaps and evaluated available solutions. Criteria included pedagogical effectiveness, scalability, interoperability, and vendor support.

The final selection comprised six ed-tech applications:

- AI Patient Simulator: A speech-enabled mannequin with vital sign control, CPR metrics, and cloud debriefing, allowing students to practice history taking and physical examination with an interactive, responsive patient.
- Sectra Table: A 55-inch touchscreen for 3D visualisation of real patient DICOM images and virtual dissection, enabling students to explore anatomy and radiology collaboratively.

Figure 1 AI Patient Simulator and Sectra Table

- Virtual Physiology Platform: Interactive software for simulating cardiovascular, respiratory, and renal dynamics, helping students visualise cause-and-effect relationships in organ system function.
- VR Goggles: Head-mounted displays with medical procedure and anatomy modules, providing immersive 3D exploration and procedural rehearsal.

Figure 2 Virtual Physiology Platform and VR Goggles

- Virtual Microscopy Platform (under-development): Whole-slide imaging with annotation and quizzing tools, allowing students to explore histology and pathology specimens at any magnification, anytime, anywhere.
- AI-Powered Interactive e-Book Platform: A digital textbook platform enhanced with AI that personalises learning pathways, generates formative quizzes, answers student questions in real time.

2. Infrastructure and Integration

A dedicated simulation centre was established to accommodate the Sectra Table and AI patient simulator. VR stations were set up in adjacent rooms, and the physiology, and AI e-Book platforms were deployed on a cloud server, accessible via student laptops, tablets, or on-campus computer labs. Virtual microscopy Platform is under- development as a complementary application, and is expected to be ready for deployment next academic year, All applications were linked to the university's learning management system, enabling single sign-on and centralised case management.

3. Curriculum Integration for First-Year Students (2025 Cohort)

With our inaugural cohort of 237 first-year students, we have begun embedding these technologies in a spiral, integrated fashion:

- Sectra Table sessions complement cadaveric dissection. Students view 3D reconstructions of the same anatomical regions, identifying structures and common pathologies collaboratively.
- VR Goggles are introduced for 3D anatomy exploration, allowing students to "walk through" the human body and develop spatial awareness.
- AI-Powered e-Book Platform serves as the central learning hub. Students access interactive content, receive AI-generated quiz questions tailored to their progress, and can ask the AI assistant questions.
- Virtual Physiology Platform will be introduced in the second year during the cardiovascular and respiratory systems blocks.
- AI Patient Simulator is introduced in the second semester of the first year during the Foundations of Clinical Practice course, and will continue in the following years with clinical scenarios (e.g., a patient with chest pain) that align with the systems being studied.
- Virtual Microscopy will be used alongside traditional glass slides for year one students starting from next year. Students will work through curated slide sets with embedded quizzes, building foundational and systemic histology and pathology skills.

4. Planned Integrated Modules for Years 2-3

For future cohorts, we have designed "Integrated Simulation Weeks" that will combine all six technologies into week-long modules. A typical module (e.g., Acute Myocardial Infarction) follows this educational workflow:

Table 1 Education workflow

Day	Educational Activity	Technologies Used
1	Students review histology slides (infarcted myocardium) and CT angiogram (occluded coronary artery), guided by AI-generated questions.	Virtual Microscopy, Sectra Table, AI e-Book
2	Physiology simulation: students model hemodynamics of infarction and predict drug responses, then check predictions against AI-curated resources.	Virtual Physiology Platform, AI e-Book
3	AI patient encounter: students take a history, perform a physical exam, and observe vital sign changes. The AI e-Book provides just-in-time references.	AI Patient Simulator, AI e-Book
4	Procedure practice: students practice defibrillation or catheterisation in VR, with the AI e-Book offering step-by-step guidance.	VR Goggles, AI e-Book
5	Debriefing: students and faculty review integrated performance data and reflect on connections between basic science and clinical decisions (under-development).	All platforms

This design ensures that students repeatedly encounter the same clinical concept across multiple modalities, reinforcing deep learning.

5. Faculty Development and Support

A "Technology-Enhanced Learning" training program has been implemented, with five faculty members trained as champions who mentor colleagues. Technical support is provided by the simulation centre staff.

6. Evaluation

By the end of 2026, we will begin collecting continuous feedback through student surveys, focus groups, and performance analytics to assess the impact on learning outcomes and refine our approach.

Case Innovation and Breakthroughs

1. Main Innovation Content

The core innovation lies in the **integrated, scenario-driven pedagogical model** that weaves together

six distinct technologies into a cohesive learning arc. Rather than using each tool in isolation, we developed a "spiral integration" framework where every technology reinforces the same clinical concept from different educational perspectives; molecular, anatomical, physiological, clinical, and procedural. This mirrors the way expert clinicians think, integrating multiple layers of knowledge to solve a patient problem.

Key innovations include:

- **Cross-platform case authoring:** Faculty can create a single case (e.g., "Heart Failure") that simultaneously populates a virtual microscopy slide (myocardial hypertrophy), a Sectra Table 3D model (enlarged heart with CT correlation), a physiology simulation (decreased ejection fraction), an AI patient script (shortness of breath, oedema), and a VR procedure (insertion of a pulmonary artery catheter). The AI e-Book platform then generates reading lists, quizzes, and personalised study recommendations for each student based on their performance across these activities. All resources are linked via the learning management system.
- **AI-driven communication training:** The AI patient simulator uses natural language processing to respond to thousands of interview questions, allowing students to practice open-ended questioning without an actor. The system logs conversation patterns, enabling faculty to identify common communication gaps. Through Real-Time Remote Simulation Control, it adjusts vital signs, speech, and sounds using any Internet-connected device, collect checklist data, and watch live video. It also provides patient authoring, creating new patients' scenarios by customizing vitals, checklists, patient file, and all speech questions and responses, share and collaborate with other users.
- **Personalised, just-in-time learning:** The Learning Management System serves as a "learning companion" that tracks each student's progress across all other platforms. This creates a continuous, adaptive learning loop.
- **Objective, multi-source debriefing (under-development):** The integration of performance data from all platforms (CPR metrics, conversation logs, VR hand-movement accuracy, virtual microscopy quiz scores, AI e-Book engagement metrics) into a single debriefing dashboard provides a holistic view of student competence. This allows debriefing sessions to focus on meaningful patterns rather than isolated mistakes.

2. Application Practice Breakthrough Content

Our integrated model addresses a long-standing challenge in medical education: the theory-practice gap. By anchoring every technology activity to authentic patient scenarios, students repeatedly apply foundational science to clinical situations. This is expected to improve clinical reasoning and diagnostic accuracy, as will be evidenced by OSCE scores and national board examinations as our first cohort progresses.

Furthermore, the scalability of the model is a breakthrough. Through cloud-based case sharing, our institution is planning to collaborate with national teaching hospitals and international partners, exchanging anonymised cases and best practices. This demonstrates that the model can be replicated and adapted across different educational contexts, including other health professions such as nursing, pharmacy, and dentistry.

3. Intellectual Property Status

The individual technologies are owned by their respective vendors. However, the **integrated curriculum design, case-authoring templates, and data aggregation middleware** are intellectual

property of the University of East Capital School of Medicine. These have been documented in internal white papers and are being prepared for sharing under a creative commons license to allow other institutions to adapt our workflow.

Promotion Value and Risks

1. Application Prospects and Achievements

The integrated ecosystem is currently used by 237 first-year medical students, with an average of 30 hours of hands-on interaction per student per semester. The cloud-based nature allows faculty to manage cases remotely, and the modular design means the system can be scaled to other health professions (nursing, pharmacy, dentistry, allied health) with minimal adaptation. As our institution grows, we plan to expand the ecosystem to accommodate up to 800 students annually by 2030.

2. Social and Economic Value

- **Social:** Students graduate with greater confidence and competence, reducing the risk of medical errors and improving patient safety. The AI patient simulator and AI e-Book platform reduce reliance on standardised patients and traditional textbooks, lowering costs while providing unlimited practice opportunities and personalised learning support.
- **Economic:** Although initial investment was significant, the long-term savings from reduced cadaver procurement, fewer actor hires, reusable digital cases, and decreased textbook costs are substantial. We target a 30% reduction in simulation centre operating costs over five years compared to traditional methods, alongside improved learning outcomes.

3. Potential Risks

- **Technical risks:** Dependence on multiple vendors introduces potential compatibility issues. We mitigate this by maintaining in-house technical support and using open standards where possible.
- **Ethical risks:** AI patient interactions must be monitored to ensure students do not develop unrealistic expectations of real patients (e.g., expecting scripted answers). We address this by explicitly teaching the differences between AI and human communication and by using AI simulation as a supplement, not a replacement, for real patient encounters. Similarly, the AI e-Book platform's recommendations must be reviewed to ensure they align with curriculum objectives.
- **Data privacy:** The collection of student performance data across platforms raises privacy concerns. We have implemented strict data governance policies, with all data anonymised for research and accessible only to authorised faculty.

Other Relevant Information

A video overview and sample case materials are available via the university's simulation centre and can be provided upon request.

Case 18

AI-Driven Virtual Simulation and Intelligent Interaction-Based Intelligent Teaching System for Diagnostics

Buyang Zhang

Xiangya Hospital of Central South University, Hunan, China

Background

The Intelligent Teaching System for Diagnostics covers four core teaching modules: Clinical Thinking Assessment Module, History-Taking Interaction Module, Clinical Diagnosis and Treatment Simulation Module, and Clinical Skills Simulation Module. It focuses on solving three core pain points in diagnostics teaching: inconsistent industry standards for teaching and training, scattered resources and poor compatibility of existing virtual simulation products; disconnection between theoretical knowledge and clinical training, and lack of repeatable and low-risk clinical training scenarios for students; limited faculty energy, difficulties in implementing personalized teaching, and challenges in uniformly improving teaching quality.

Current diagnostics teaching in China relies on traditional lectures and limited clinical practice, with inconsistent training standards, fragmented resources, and insufficient hands-on scenarios. These issues severely hinder clinical talent development. Meanwhile, unbalanced distribution of high-quality teaching resources and faculty exacerbates inequity in medical education. Therefore, building an AI-driven intelligent diagnostics teaching system is essential to improve training quality, standardize teaching, and promote equitable access to premium educational resources.

The project aims to build a unified, intelligent teaching system integrating clinical thinking, history-taking, diagnosis and treatment simulation, and skills training. It will provide students with repeatable, low-risk, realistic clinical practice environments and enable teachers to deliver personalized instruction efficiently. By transforming passive learning into active practice and repetitive mentoring into intelligent teaching, the system will enhance diagnostics education quality and support the standardized training of clinical professionals.

Case Implementation Status

Abandoning the simple digitization of textbooks, this case takes the cultivation of diagnostics talents as the core orientation, reconstructs the entire teaching process through digital-intelligent technologies, deeply integrates textbook knowledge points, real clinical scenarios and teaching logic, promotes the transformation of students from "passive listening" to "active training" and teachers from "repetitive instruction" to "precise teaching", and realizes the in-depth empowerment of medical education by digital-intelligent technologies. The design concept is as follows:

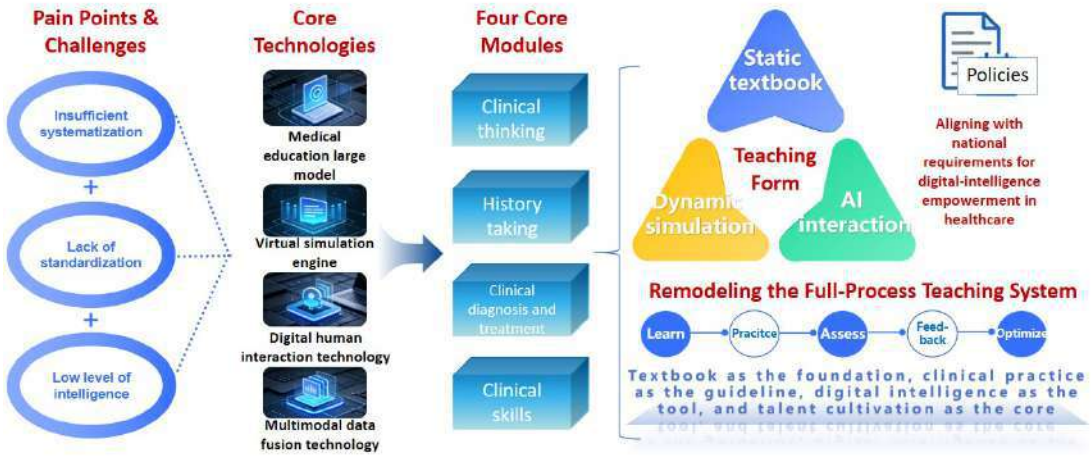

Figure 1 Design Concept

In terms of the rigor of medical logic, diagnostics serves as a core bridge connecting basic and clinical medicine, and the medical rigor of teaching content is the core lifeline of the project. The project has established a full-process medical logic verification and quality control system:

First, an editorial and review committee led by the person in charge of the Diagnostics Virtual Teaching and Research Office of the Ministry of Education and the chief editor of national planning textbooks has been formed to lead content design and quality control in all links, ensuring that the content complies with clinical diagnosis and treatment norms and medical education laws.

Second, all teaching cases and training scenarios in the system are derived from real clinical scenarios of tertiary-A hospitals, authorized and desensitized, and fully consistent with clinical practice.

Third, all training modules are strictly aligned with national planning textbooks, clinical diagnosis and treatment guidelines and licensed physician assessment standards, with a medical logic verification mechanism set in all links to guide students to develop standardized and rigorous clinical thinking.

In terms of the scientificity of service process reconstruction, the case breaks the fragmented training model of traditional medical education and reconstructs a closed-loop teaching service system covering the whole process of "Learning – Practice – Assessment – Feedback – Optimization" through digital-intelligent technologies to achieve precise empowerment for multiple stakeholders:

For students, a full-cycle independent learning path is built based on the PMPH Xiangya Medical Education Large Model, breaking the restrictions of training scenarios, time and faculty.

For teachers, intelligent teaching aids are provided to realize "teaching based on learning" and free up faculty energy to focus on students' clinical thinking cultivation.

For teaching managers, a full-dimensional teaching quality monitoring system is built to provide data support for teaching reform and curriculum optimization in medical schools.

The project has established a normalized content iteration mechanism to continuously optimize system modules in line with textbook and guideline updates and teaching needs, forming a sustainable operation and service system.

Instead of adopting general large models, the case has developed a proprietary technical system of vertical large models for medical education tailored to diagnostics teaching scenarios, integrated with virtual simulation engines and multimodal digital human interaction technologies, and built a full-link collaborative architecture of "underlying algorithms – core engines – scenario implementation" covering all teaching scenarios.

As the "intelligent brain" of the system, the vertical large model for medical education and intelligent evaluation algorithms construct a proprietary annotated corpus for diagnostics based on authoritative textbooks of People's Health Press, clinical guidelines and standardized cases from tertiary-A hospitals. Through special pre-training and fine-tuning in teaching scenarios, core algorithms for clinical semantic understanding, diagnosis and treatment logic reasoning, and multi-dimensional intelligent evaluation are formed to provide underlying support for all-scenario teaching and realize personalized feedback.

As the core of clinical skills training, the proprietary lightweight virtual simulation engine for medicine is independently developed to adapt to medical teaching scenarios, which can restore diagnosis and treatment scenarios, human anatomical structures and physiological feedback with high fidelity, simulate the operation process of core diagnostics skills, capture students' operations and conduct real-time verification and error correction. Adopting a plug-in-free design, the engine runs smoothly on ordinary terminal browsers, reducing the deployment threshold for medical schools.

Relying on vertical large models, the multimodal digital human interactive history-taking training system solves the pain points of scarce standardized patients and irreproducible scenarios in traditional teaching, builds a high-fidelity virtual standardized patient digital human system, supports multimodal natural interaction, simulates different patient characteristics and consultation scenarios, and supports students in immersive consultation communication and clinical contingency training.

Case Innovation and Breakthroughs

The innovations of this case are mainly reflected in three aspects:

Technological Innovation: The case breaks through the core bottleneck of the deep integration of digital-intelligent technologies and medical education, independently develops a semantic matching algorithm for medical large models adapted to the clinical medical teaching system, integrates high-fidelity virtual simulation engines and immersive digital human interaction technologies, overcomes industry challenges such as standardized intelligent evaluation in clinical teaching and multi-scenario cross-terminal adaptation, and builds a full-process digital technology closed loop of "Learning – Practice – Assessment – Feedback – Optimization". The core technical architecture and software and hardware support system are fully domesticated, filling the technological gap in the field of standardized digital teaching for diagnostics.

Model Innovation: It pioneers an industry-university-research-application integrated co-construction model of "authoritative publishing institution + top clinical hospital + national expert team". Led by the

editorial team of national planning textbooks and jointly developed with core national editors, a full-chain operation system from content editing, technical R&D, teaching implementation to achievement transformation is built, breaking the solidified model of single development and one-way output of traditional teaching products, and establishing a sustainable operation mechanism for normalized iteration and national promotion of high-quality medical education resources.

It breaks the scenario barriers and spatial-temporal restrictions between classroom teaching and clinical practice in traditional medical education, and innovatively constructs a new all-scenario intelligent teaching model of the trinity of "static textbooks + dynamic simulation + AI interaction". Relying on cloud-integrated deployment, it promotes the nationwide sinking of authoritative and high-quality medical education resources to grassroots medical schools and medical institutions in remote areas, and can fully adapt to multi-level teaching scenarios such as systematic teaching in medical schools, standardized training and instruction in medical institutions, licensed physician examination preparation, and skill improvement for grassroots clinicians, truly realizing the all-dimensional expansion of medical education application scenarios and inclusive coverage of high-quality resources.

Supported by the AI-driven intelligent teaching system for diagnostics, this program focuses on the whole process of medical education and teaching, achieving three core applied practice breakthroughs, providing a replicable benchmark paradigm for the digital-intelligent transformation and high-quality development of domestic medical education.

First, it achieves the core breakthrough of AI full-link empowerment for teachers' teaching, solving the industry pain points of limited faculty energy and difficulties in implementing personalized teaching. A new human-machine collaborative model is built around the whole teaching cycle of pre-class, during-class and after-class:

Pre-class: Supports human-machine co-creation for lesson preparation, realizing automatic generation of multimodal teaching resources and optimization of teaching plans.

During-class: Creates immersive teaching scenarios based on highly interactive virtual simulation experiments, supported by real-time personalized evaluation and feedback to improve classroom education effectiveness.

After-class: Empowers all-time Q&A and tutoring to reduce teachers' burden and improve efficiency in an all-round way.

Second, it creates a virtual-real integrated future medical education space, connecting the "last mile" of digital-intelligent technology application. A teaching and practical ability center is laid out in key disciplines of diagnostics to build an immersive teaching space and a new human-machine collaborative teaching paradigm deeply integrating high-quality courses, digital textbooks, virtual simulation and artificial intelligence.

Third, it constructs a personalized training system under large-scale education. Based on big data, it builds students' learning portraits, accurately pushes adapted learning resources, integrates medical education large models to create inquiry-based learning scenarios, and cultivates students' clinical thinking and core competence in the intelligent era.

The practical breakthroughs of this program effectively promote the inclusive sharing of high-quality medical education resources, provide a mature practical path for the standardized and digital-intelligent upgrading of national medical education, and are of great value for consolidating the foundation of clinical talent training and promoting equity in medical education.

Promotion Value and Risks

As a digital education technology solution for diagnostics, this system breaks through traditional teaching pain points through AI guidance, virtual simulation and intelligent interaction, and realizes closed-loop teaching. Its application scenarios, software and hardware environments and implementation targets are as follows:

Adaptable scenarios cover four categories:

First, theoretical classroom assistance, combining virtual cases and AI interaction to improve the accuracy of theoretical teaching.

Second, clinical skills training, building realistic scenarios with VR/AR to support practical operation training and multi-user collaboration.

Third, after-class independent learning, pushing personalized resources based on AI academic situation analysis.

Fourth, teaching assessment, realizing standardized and intelligent quantitative evaluation.

The software and hardware environment adopts a cloud + local deployment mode: hardware is divided into basic and advanced configurations, with basic configurations meeting theoretical teaching and independent learning, and advanced configurations adapting to immersive training; software is compatible with mainstream operating systems, equipped with core AI technologies and virtual simulation tools, supporting multi-terminal access and campus platform connection.

Implementation targets cover the whole chain:

Core services for student groups, including undergraduate and junior college students majoring in medicine, standardized training and further education personnel, etc.;

Services for teachers and teaching managers to support precise teaching and management;

Services for medical schools, medical institutions, skill training institutions and scientific research units to provide customized deployment and promote the digital transformation of medical education.

The overall solution has strong adaptability and can meet different teaching needs.

The implementation of this case will generate extensive and positive social impacts.

First, its standardized and intelligent teaching system comprehensively enhances the diagnostic thinking, practical skills, and standardized clinical performance of medical students and clinicians, steadily improving the quality of medical services at the talent level. Benefiting about 100,000 to 120,000 undergraduate clinical medicine students nationwide each year, it supports high-quality clinical talent development.

Second, cloud-based deployment extends high-quality teaching resources to grassroots and remote medical institutions, narrowing regional and institutional gaps and promoting equity in medical education and healthcare.

Third, it sets a benchmark for integrating digital and intelligent technologies into medical education, driving its digital transformation.

Economically, the case offers substantial cost-saving and efficiency-improving value.

It greatly lowers medical teaching and training expenses by replacing costly equipment, consumables, and offline training. A single clinical skills training center with 500 trainees can save over 300,000 yuan annually, with total national savings exceeding 60 million yuan per year.

It also shortens the talent training cycle, accelerates the supply of qualified medical professionals, and

reduces institutional training costs.

Furthermore, it fosters the digital medical education industry ecosystem, reduces diagnostic errors and irrational medical insurance expenditures, achieving a win-win for industrial, social, and economic benefits.

This system reconstructs the medical teaching closed loop with AI and virtual simulation, creates a standardized, systematic and intelligent teaching benchmark, provides a replicable model for the digital transformation of higher medical education, promotes the inclusiveness of high-quality resources, and plays a demonstration and leading role in the field of medical education.

As a medical teaching aid, this system does not involve clinical diagnosis and treatment or human trials requiring ethical approval. A full-process compliance risk control system has been established through case desensitization, algorithm management, three-level review, real-time blocking and other measures, with no ethical risks.

Constructed in accordance with Class III Cybersecurity Protection, the system implements full-link encryption, hierarchical access and minimal authorization, with desensitized and anonymized cases and security protection components equipped on servers, with no significant technical risks; only minimal potential technical risks such as failure of data encryption, access control or protection components exist.

Other Relevant Information

December 2025: Selected as "Scientific and Technological Innovation Achievement of 2025 Publishing Industry Science, Technology and Standard Innovation Project" awarded by the National Press and Publication Administration.

Figure 2 Award Certificate

Case 19

Designing AI-Scaffolded Interdisciplinary Inquiry: A Biology-Chemistry Case Study in Chinese High Schools

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Background

Biology, as an experimental science, is grounded in students' engagement with the entire process of scientific inquiry—posing questions, conducting literature reviews, designing experiments, analyzing data, and drawing conclusions—to develop scientific thinking and rigorous research habits. However, current high school biology laboratory instruction often faces the "cookbook" dilemma: students mechanically follow procedures without experiencing authentic scientific inquiry. This stems from a fundamental tension between the cognitive demands of authentic inquiry—which requires significant investment in lower-order tasks such as literature reading and data calculation—and the constraints of limited instructional hours. While teachers aspire to guide students through the full inquiry process, they are often constrained by time consumed by tedious operations.

To address this challenge, we redesigned a standard textbook experiment—"Detection of Reducing Sugar in Biological Tissues"—into an inquiry project titled "Analysis of Reducing Sugar Content in Fruits." By sequentially integrating academic literature, a colorimetric APP, Origin software, and generative AI (DeepSeek), we constructed an authentic "Literature-Method-Product" research pathway. In this pathway, technology undertakes lower-order tasks such as literature guidance, data quantification, and complex calculations, redirecting students' cognitive resources toward higher-order thinking activities including experimental design optimization and model evaluation. Thus, within limited instructional hours, students achieve deep learning and engage in authentic scientific inquiry, offering a new model of AI-enhanced high school biology laboratory teaching.

Case Implementation Status

A quasi-experimental design was employed with 100 eleventh-grade students from Hunan Geology Middle School, Lushan International Experimental School, and Xiamen No.1 Middle School. The entire teaching process followed a scientific inquiry framework (Figure 1), as illustrated by classroom documentation.

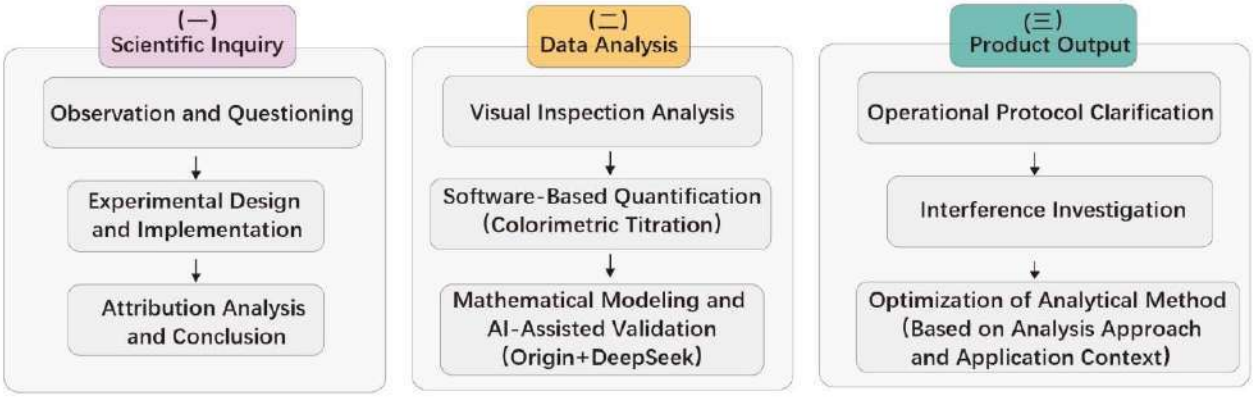

Figure 1 Teaching process and specific content

1. Observing Phenomena and Posing Questions

The teacher first presented experimental results of four fruit juices reacting with Fehling's reagent (Figure 2), encouraging students to observe and question (Figure S1).

Figure 2 Reaction results of fruit juices with Fehling‘s reagent (from left to right: apple, orange, cherry tomato, pear juice)

Based on pre-class literature readings, students raised questions such as: "What factors influence the color variation?" "How can we determine reducing sugar concentration?" "Does fruit color affect the final reaction color?" The teacher guided students to focus these into a testable hypothesis: "Reducing sugar concentration is positively correlated with color intensity." This process shifted from "verifying known conclusions" to "exploring unknown relationships.”

2. Designing and Implementing Experiments

Students designed experimental protocols informed by methods reported in the literature, focusing on variable control (Figure S2). The teacher projected different plans using Seewo for peer evaluation. Students worked in pairs: one operator, one recorder. After completion, the teacher displayed experimental phenomena and photos of student operations (Figure 3), guiding students to analyze inter-group differences and whether they strictly followed the single-variable principle. Students concluded that higher reducing sugar concentrations yield more intensely colored reaction solutions, consistent with their hypothesis.

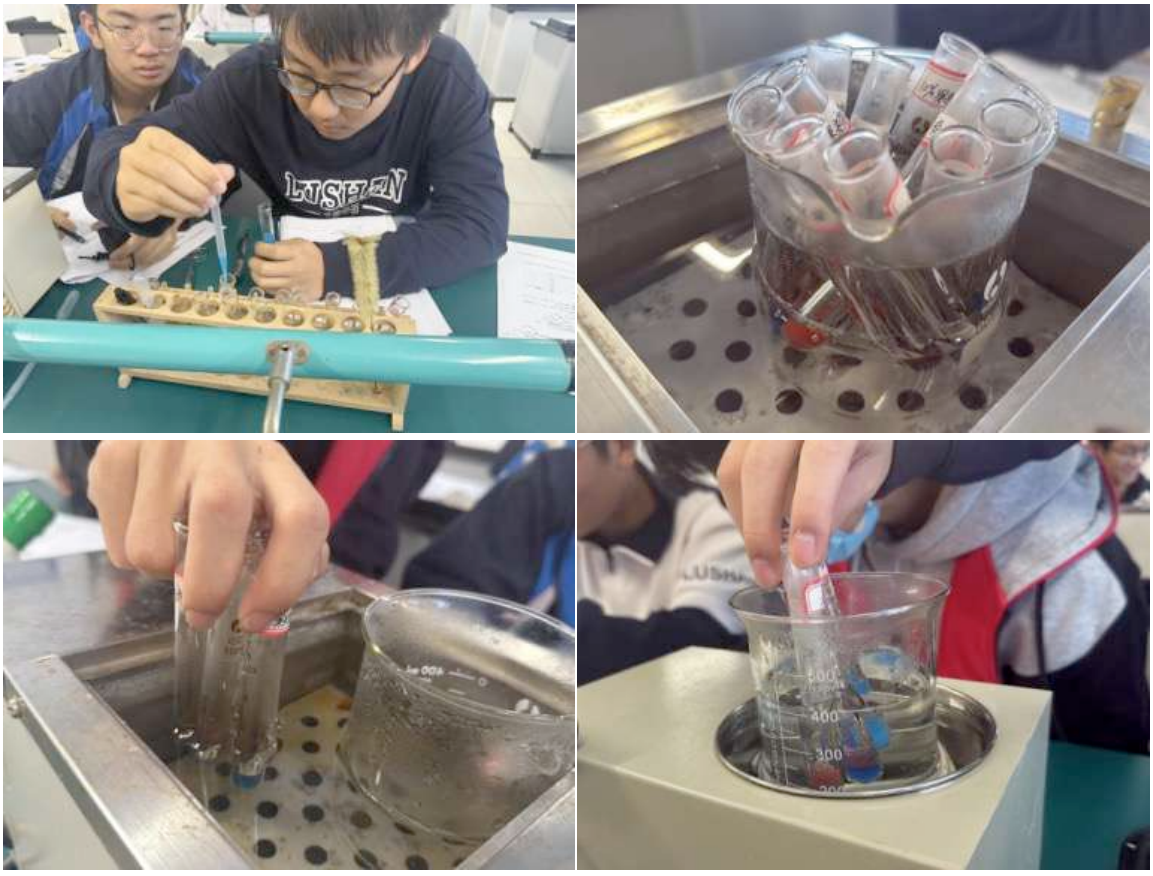

Figure 3 Student experimental operation records

3. Data Analysis

This phase represented the critical intervention point for digital tools, with students experiencing methodological progression.

3.1 Visual Inspection

Students initially ranked fruit samples visually but quickly recognized this method's subjective limitations, generating an intrinsic need for objective quantification tools.

3.2 APP-Based Quantification

Students used Colorimetric Titration APP to convert colors into RGB data (Figure 4), using R^2 as evaluation criteria from literature to preliminarily rank reducing sugar content, while recognizing that digital output validity is model-dependent.

Figure 4 RGB data exported from Colorimetric Titration APP

3.3 Mathematical Modeling and AI Assistance

Seeking higher precision, students used Origin to explore relationships between R/G/B values and fructose concentration, discovering that R/B value established a better mathematical relationship, successfully fitting a standard curve with R^2=0.96 (Figure 5). They then input the formula and RGB values (Figure S5) into DeepSeek for validation, shifting cognitive focus from calculation to understanding the mathematical model itself. This iterative process fostered a critical understanding of the relationships among data, tools, and models.

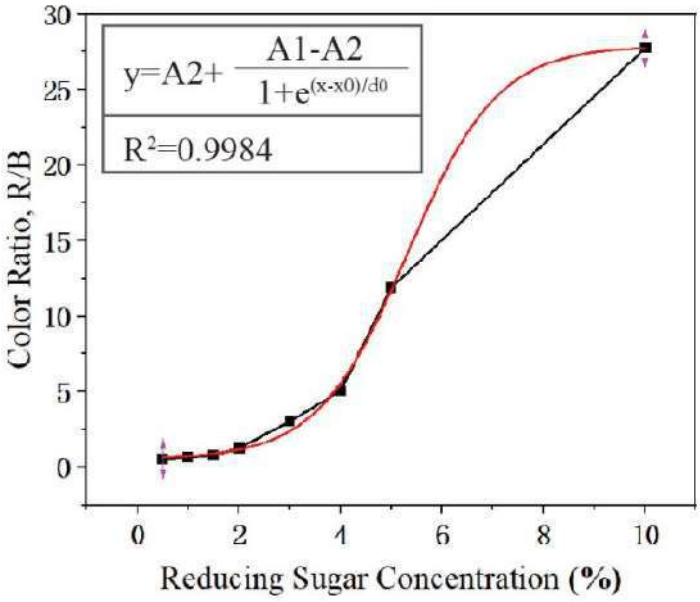

Figure 5 Calibration curve of reducing sugar concentration vs. R/B value

3.4 Post-Class Practice and Product Output

Addressing authentic interdisciplinary questions raised by students—such as "sample color interference" and "vitamin C interference"—students consulted literature, designed experiments, and incorporated findings into their kit manual precautions (Figure S6). This process prompted students to integrate multidisciplinary knowledge and develop engineering thinking and problem-solving abilities.

Case Innovation and Breakthroughs

1. Main Innovation Content

The core innovations of this case are threefold:

(1) Teaching Model Innovation: From Qualitative Verification to Quantitative Products. Breaking away from traditional "cookbook" experiments, this model transforms qualitative textbook experiments into quantitative measurement and product creation, guiding students through a progression from visual observation to quantitative measurement to mathematical modeling.

(2) Research Pathway Innovation: Constructing a "Literature-Method-Product" Authentic Research Process. Grounded in cognitive apprenticeship theory, this pathway begins with digital literature and ends with tangible products, guiding students through the complete process of knowledge investigation, experimental design, iterative practice, and artifact creation.

(3) Interdisciplinary Integration Innovation: Solving Authentic Problems Across Disciplines. Driven by the engineering task of writing a kit manual, this approach integrates biology, chemistry, information technology, and AI knowledge, fostering systematic engineering thinking through solving authentic problems such as vitamin C interference.

2. Technology Breakthrough

The major technological breakthrough lies in constructing a "cognitive partner" sequential digital toolchain, serving as a pedagogical bridge between disciplinary concepts and technological tools. Rather than applying isolated technologies, this chain creatively integrates image recognition (APP), data science tools (Origin), and generative AI (DeepSeek) into an interdependent, logically coherent inquiry sequence. This design achieves cognitive labor redistribution: technology handles lower-order tasks, redirecting students' cognitive resources toward higher-order activities such as experimental design optimization and model evaluation.

3. Application Breakthrough

This case successfully introduces research paradigms typically encountered at university level into high school classrooms, completed within regular instructional hours (4 sessions). To rigorously evaluate instructional effectiveness, we developed an 8-dimension scientific inquiry competency rubric: A. Literature-Based Problem Definition, B. Experimental Design, C. Inquiry Process Completeness, D. Data Analysis, E. Result Discussion, F. AI Use, G. Literature-Informed Deepening Inquiry Design, H. Synthesis and Artifact Generation.

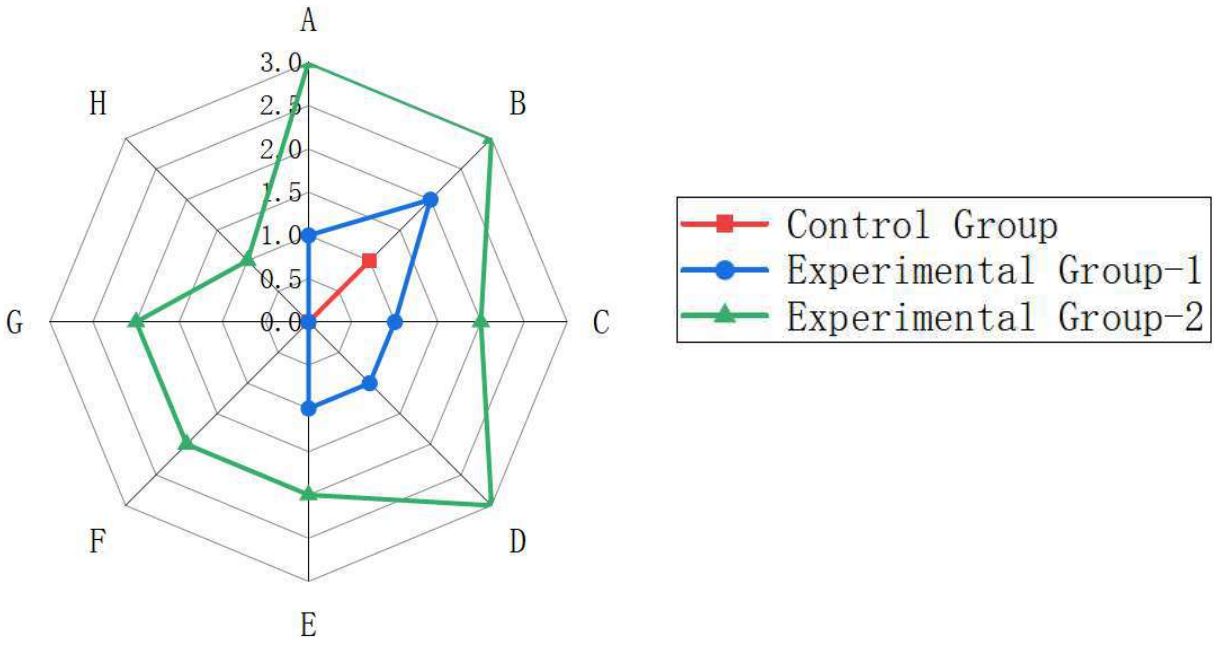

Figure 6 Comparison of three groups' performance across eight dimensions (CG: Control Group; EG-1: Lushan Experimental Group; EG-2: Xiamen Experimental Group)

Quasi-experimental findings show that experimental groups significantly outperformed the control group in core dimensions including problem definition (A), data modeling (D), and AI use (F) (Figure 6). For example, the Xiamen group achieved full scores in dimensions A and D and successfully fitted an R^2 = 0.96 standard curve using Origin. These findings demonstrate that the model enhances both the depth and efficiency of student inquiry within limited instructional time, providing empirical evidence and an operational paradigm for high-quality scientific inquiry in basic education.

4. Intellectual Property Status

This project represents phased research outcomes of multiple educational science planning projects, supported by:

(1)Changsha Micro-topic "Research on the Application of NOBOOK Chemistry Virtual Experiment Components in High School Biology Reducing Sugar-Protein Identification Experiments" (Completed 2024, Changsha Education Bureau)

(2) Hunan Provincial Education Society "14th Five-Year Plan" Education Research Project "Research on Interdisciplinary Education Models for Core Literacy in High School Biology" (No. A-369, in progress)

(3) First Hunan Provincial Basic Education Teaching Reform Project "Construction of an Academic Performance Indicator Framework System for Natural Sciences in Ordinary High Schools Guided by Core Literacy" (No. Y20230713)

(4) Second Hunan Provincial Basic Education Teaching Reform Project "Research on the 'Model-Centered' Classroom Paradigm in High School Biology Based on Deep Learning" (No. Z2024015)

The intellectual property rights of related teaching designs, assessment rubrics, and course resources belong to the First author.

Promotion Value and Risks

1. Application Prospects and Achievements

This case has developed a complete, transferable teaching package including interdisciplinary content integration methods, a four-session teaching process, a sequential toolchain configuration guide, and a scientific inquiry competency rubric. The model applies beyond "reducing sugar detection," having been successfully transferred to develop multiple interdisciplinary projects including "Engineering Insulin Modification," "Campus Water Cycle," and "From Bird Structures to Kite Design," demonstrating dual transferability in both single-subject deepening and interdisciplinary integration.

(1) Student Development: Students in the experimental group demonstrated significant gains in knowledge integration, scientific argumentation, and innovative thinking.

(2) Teacher Growth: The model empowered teachers to transition from "textbook implementers" to "curriculum designers."

(3) Scalability: The refined model has been successfully implemented across multiple schools and promoted as exemplary cases in provincial teacher training and national teaching seminars.

2. Social and Economic Value

Social Value: By engaging students in designing dietary recommendations for diabetics and creating detection kits, the project connects scientific knowledge learning with social responsibility and healthy living, effectively enhancing students' scientific literacy and social responsibility.

Economic Value: The model primarily relies on existing free or widely available software, requiring only smartphones and computers as hardware, making it low-cost, highly accessible, and cost-effective.

3. Demonstration and Leadership

This case provides an exemplary "cognitive enhancement" model for science laboratory teaching under new curriculum standards. It demonstrates that digital tools' value lies not only in "efficiency improvement" but more importantly in reshaping teaching structures and releasing students' cognitive potential. Its clear "Literature-Tool-Product" pathway and practice of "cognitive labor redistribution" will provide valuable inspiration for frontline teachers and researchers, leading high school laboratory teaching from "operation-oriented" to "thinking-oriented" approaches.

4. Potential Risks

Several potential risks should be noted. Technical risks arise from high demands on teacher and student digital literacy; insufficient pre-class training may lead to software operation difficulties. This can be mitigated by providing pre-class reading guides and tool operation videos. Ethical risks involve students potentially over-relying on AI or accepting its outputs uncritically. To address this, instruction should emphasize model evaluation and result validation throughout the inquiry process. Implementation risks stem from the model's heavy dependence on teachers' comprehensive abilities as curriculum designers, technology integrators, and inquiry facilitators. Mitigation strategies include strengthening teacher professional development and recognizing that higher-order synthesis tasks may require extended timelines.

Case 20

Enabling Project-based Learning in a General Education Course on Generative AI

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Background

This case centres on the design and implementation of a 5-week long project-based learning that immerses students in the end-to-end development of a GenAI-enabled product to meet a business or societal need, in a newly launched General Education course.

The students often struggle to understand AI concepts because traditional teaching methods do not provide sufficient and self-initiated project-based learning for students to not just experiment various GenAI tools, but to build and present a GenAI product end-to-end, aiming to solve a business or societal problem.

To bridge the gap, a 5-week long group project is applied in the second part of the General Education course, which immerse students in the end-to-end product development, while challenging students to discuss ethical concerns about privacy, bias and misinformation. The students learn how to define use needs, draw project plans, iterate AI prompts, and evaluate outputs for better quality and reliability. The project requires three deliverables: a 10-minute presentation with a working prototype, report writing focusing on AI impacts, debate writing on the potential societal and ethical concerns raised by the AI product created by the students.

In addition, a field visit to AWS GenAI Experience Space and a guest talk by HSBC senior staff arranged in the 3rd week of the project period, inspire students with real-world examples and effective business strategies. This approach strengthens students' confidence and practical experience to connect the learning to business applications.

The project-based learning experience was well received and earned an overall rating of 4.6 out of 5 from over 50 student respondents in the post questionnaire.

Keywords: General Education, Generative AI, project-based learning

Case Implementation Status

Part 1 – GenAI skill training

Prior to undertaking the group project, students complete a 7-week hands-on training programme on a range of GenAI tools. This training equips them with the essential practical knowledge on chatbot, prompt design, image generation, deep learning model, GenAI-powered workflow, business apps, project management tools. The training programme enables students with essential hands-on skills to build simple GenAI chatbots with guided instructions. The assessments lead students to polish prompting techniques (clear and specific instructions, role assignment, zero-shot and few shot techniques), explore different techniques to improve the output quality and identify potential problems from the GenAI, including misinformation, unclear outcomes, lack of updated information and biased outputs. The details of each week training content and the assessment which students are required to submit after completing the lab activities are provided in Table 1.

Table 1 7-week hands-on training details, with five graded submissions

Week	Lab Activity	Assessment
1	LLM basic skills - explore AI models, adjusting prompt parameters, uploading images to generate stories, creating comic strip endings	Not applicable
2	LLM advanced skills - build chatbots on ChatBot.com, Poe, and Dify by ingesting course documents, enabling RAG (Retrieval-Augmented Generation) for retrieval, publishing the app, and adding guardrails	Two custom chatbots with information retrieval abilities
3	LLM Workflow design - integrate Bing Web Search AI into a Dify chatflow, which enables chatbot with web search and information retrieval capabilities	Build a GenAI chatflow with the ability to answer questions based on information from the university pages
4	Business GenAI exploration - test Trip.com TripGenie (flights, inspirations, hotels), trying Amazon Rufus for product Q&A	Build a Poe chatbot hat outputs a correctly formatted URL and details
5	GenAI-enabled office automation - use LLMs to boost productivity by connecting HKBU GenAI to Google Sheets for AI-powered formulas	Build a GenAI-powered worksheet to automate job matching tasks
6	Build and evaluate simple AI models with Google Teachable Machine and MediaPipe	Build two deep learning models for hand-gesture classifier and cat-dog classification
7	Use Microsoft 365 Copilot and Copilot Pages to create project-management visuals with Mermaid charts	Not applicable

Part 2 – Field trip and Project idea formulation

Following the GenAI skill training, students will form a group with at most 5 students, in designing and developing a marketable GenAI-enabled product that responds to a specific societal or business need. A field visit to the Amazon Web Services (AWS) GenAI Experience Space located in Causeway Bay was

arranged to expose students to real-world GenAI business applications and effective pitching practices, supporting more creative and persuasive student proposals. Experienced business practitioners provided a half hour brief introduction to the latest development of GenAI and agentic workflow to enlighten students with different kinds of possibilities in applying GenAI to solve real business problems. A list of 12 ideas is presented and discussed during the class. Students may choose one topic from the lists or come up with their own idea. Students are required to submit their project plan within a week on the selected topic.

Table 2 Proposed Project Ideas

Idea	Project Description
1	GenAI Graduation Book: Create an AI-enhanced graduation book that turns photos into funny stories, visuals, and short videos
2	TeachersPayTeachers Business: Build a TPT store offering free AI-generated K–12 lesson plans, slides, worksheets, and quizzes
3	KOL-Style Short Videos for Kickstarter: Produce two influencer-style AI videos and a product webpage for fictional Kickstarter items
4	Smart Chatbot for HKBU Website: Develop a RAG-powered assistant that navigates HKBU site content (faculties, student affairs, accommodation) and returns helpful links
5	Promote Transdisciplinary Education at HKBU: Create 20-second and 1-minute AI-generated promo videos
6	Gen AI News Summarization and Podcast: Build a pipeline that summarizes Hong Kong Generative AI news into podcasts
7	eCommerce Store for GenAI Products: Design a Power Apps/Pages eCommerce site selling AI-generated content
8	AI Safety and Regulation Research: Conduct a focused comparative study (e.g., US vs EU vs China) on AI safety and regulation
9	HKBU Short Video Promotion: Produce 30-second AI-assisted videos promoting an HKBU program
10	Study Materials for courses: Create a one-page summary, 20 pages of notes, quizzes, and a Q&A chatbot
11	AI-Powered Travel Memory Book: Turn travel photos into stories, postcards, and interactive video
12	Chinese Novel Translation: Convert a famous Chinese novel into other language with interactive image and animations

Part 3 – Product development and Presentation

Students dedicate five weeks to build and refine the product. They then deliver a presentation that explaining the problem, values of such product, their GenAI-enabled functionality and reflects on their key learning from the project. Students produce a written proposal and deliver a presentation explaining the problem, values of such product, GenAI functionality and demonstrate the technical aspect of it. Instructors introduced what constitutes a strong business problem and solution using real-world examples, explained the project workflow, and guided students in breaking complex projects into manageable components.

Within the four-week project period, there are four dedicated sessions as consultation time to discuss proposals and project ideas with each project group. Over a four-week sprint, students design, build, and iteratively refine a working prototype. Deliverables include a concise written proposal and a final presentation/demo that clearly state the problem and target users, articulate the product's value, explain and showcase the GenAI-enabled functionality and technical approach, and reflect on key learnings, limitations, and future improvements.

Across the four weeks, each team has four dedicated consultation sessions to review progress and refine ideas. Instructors assist students in overcoming challenges by providing targeted guidance on scoping and feasibility, prompt engineering and model/tool selection, Retrieval-Augmented Generation (RAG), guardrails setup, and evaluation metrics. They run quick debugging walkthroughs for data, API, or deployment issues, share exemplars and templates.

Clear task guidelines and assessment rubrics were provided to help students understand expectations (see figure 1).

Element	Excellent (A)	Good (B)	Less Satisfactory (C or below)
1. Co-creating Solutions (25%)	Integrates AI and human feedback to develop innovative and effective solutions, demonstrating high creativity.	Effectively combines AI with human feedback to create practical solutions, showing good collaboration and creativity.	Limited integration of AI and human feedback, resulting in basic or incomplete solutions; collaboration is minimal.
2. Technical Capability (25%)	Develops a fully functional prototype with inspiring features, demonstrating exceptional use of prompts.	Builds a working prototype with most features functioning well, effectively utilizing prompts.	Prototype is incomplete or lacks key features; use of prompts are basic or inadequate.
3. Story-telling Ability (25%)	Delivers an inspiring and compelling narrative that clearly communicates project values, with great planning and presentation skills.	Provides a clear narrative that communicates project values well, with good planning and presentation skills.	Narrative lacks clarity or inspiration; project values are poorly communicated; planning and presentation skills need improvement.
4. Insights, Concerns, and Findings (25%)	Uncovers deep insights and critical concerns, presenting findings in a thorough and insightful manner.	Identifies important insights and concerns, presenting findings clearly.	Insights and concerns are superficial or missing; findings lack depth.

Figure 1 Assessment Rubrics

Part 4 – Ethical and societal discussion

In the last two weeks, students are required to reflect on the ethical implications of their specific product, considering areas such as emotional harm, privacy, bias, and misinformation. They must then propose practical, product-specific guidelines to mitigate these risks. They will deliver a within 1000 words report to describe the mentioned tasks.

In addition, students analyse a real-world GenAI business application showcased in the AWS GenAI Experience Space and use it as an inspiration to refine and pitch their own product via a poster. Students are encouraged to design the poster with GenAI.

Case Innovation and Breakthroughs

The project-based learning described in this paper is a 13-week long learning journey. It demonstrates the full lifecycle of GenAI product development, inspired by typical AI product development cycle in business environments. Students first take 7-week training (2 hours each week) for the GenAI skill training as described in Section 2. Students submit a project plan with milestones and timeline, try different approaches step-by-step, test alternative approaches, and learn project management, scoping, and delivery practices in addition to GenAI technical skills.

The 7-week training offered to students proves to be essential and important to students. Students follow a structured, multi-task pipeline with various hands-on training across chatbots, prompt design, RAG, guardrails, image/video generation, workflows, and business applications. For example, the Chinese novel translation teams orchestrate Dify and Grok in a complex, guarded RAG workflow to measurably improve fidelity, consistency, and safety.

Ethical and societal impact discussion is built into the project learning process. Teams analyze privacy, bias, misinformation, and emotional harm in their specific product and implement mitigations such as guardrails, retrieval augmented generation, and careful data handling. The field visit to the AWS GenAI Experience Space was proved to be effective and inspiring that students can learn from industry experts and play the demonstrations during the visit. This visit offer them first-hand experience on how to present the ideas and showcase the GenAI product impacts.

Last but not the least, a programmatic assessment approach was adopted, with interconnected tasks that progressively deepened students' understanding of GenAI applications, product pitching, risks, and mitigation strategies. Through the four dedicated discussion sessions, instructor-led guidance is essential because it helps students avoid simple mistakes and keeps them in the right direction. The students often start with ideas that are exciting but not feasible within the time and data we have. One group planned to predict stock prices with GenAI and quickly learned that the results were not accurate or stable. The instructors explained why financial prediction needs specialized models and clean time series data, in which, GenAI may not be effective to solve this problem.

Promotion Value

The project learning allows students to learn through experimentation. Students actively experimented with GenAI tools by, for example, varying prompts within a single tool, comparing responses of the same prompts across tools, comprehensively assessing whether the tool is performing the functions it claims.

Overall, the project-based learning experience was well received and earned an overall rating of 4.6 out of 5 from over 50 student respondents in the post survey. The survey consists of 20 questions, which 10 of them are related to the instructor performance and the other ten questions are related to the course plan and project-based learning design. We observe that the students found the instructions for the group project were clear and specific. One specific comment is that the training offers students relevant and vivid demonstrations of how GenAI can be built in simple steps. In additions, students appreciated that the visit to AWS GenAI experience centre connect them well with the real world applications so they can truly experience AI in both our daily lives and the workplace, which significantly arouses their interest in this General Education course.

The 5-week group project period enables interdisciplinary learning experience. For example, Chinese Literature students designing an AI chatbot with quizzes and animations for Chinese Literature learning. Students majoring in business school team up with students majoring in Computer Science deliver a project showcasing how GenAI can build an eCommerce site and with many useful business-driven design. In addition, we see highly engaging outcomes from the students in their group presentation and peer feedback.

This blended project learning pedagogy merging hands-on training with in-person immersion in a real business problem demonstrates a holistic learning for students by not just telling them the fact, but more by showing them how GenAI can be used to build a product, and how GenAI make impact to the society.

Case 21

Exploratory Practice of LLM-Enhanced Secondary Science Education

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Background

Science education is shifting from knowledge transmission toward an educational paradigm centered on scientific practice, inquiry practice, and the cultivation of higher-order thinking. Internationally, **A Framework for K-12 Science Education** and **the Next Generation Science Standards** have incorporated argumentation, inquiry, and practice into the core requirements of science education (Achieve, 2013; Council, 2012); China's curriculum reform likewise emphasizes reasoning and argumentation, inquiry practice, and the development of core competencies. Research indicates that secondary science education still faces multiple challenges: in scientific argumentation instruction, teachers bear a heavy burden in identifying and providing feedback on open-ended texts, while students' deep participation remains insufficient; in scientific inquiry and virtual experiment settings, there are also problems such as inadequate personalized support, a lack of process-oriented assessment, and limited modes of interaction. Accordingly, this case focuses on “LLM-enhanced secondary science education,” taking three types of scenarios-scientific argumentation, scientific inquiry, and virtual experiments-as entry points to explore a tripartite collaborative model of “teacher-student-LLM,” with the aim of improving students' depth of participation, quality of thinking, and learning outcomes.

Case Implementation Status

1. Demand Analysis

The preliminary needs analysis for this case revealed three common pain points in secondary science education: first, the cost of feedback in scientific argumentation instruction is excessively high, as teachers spend considerable time evaluating unstructured argumentation texts, resulting in feedback that lacks timeliness and personalization; second, continuous scaffolding in scientific inquiry activities is insufficient, and traditional classrooms struggle to sustain differentiated support for students' multidimensional needs; third, virtual experiment platforms lack intelligence, generally remaining at the level of operational simulation, with insufficient process-oriented assessment and personalized guidance, making them unable to support deep learning.

2. Technology Development and Personalized Customization

To address the above pain points, this case developed an intelligent support solution centered on a large language model. First, in the scientific argumentation scenario, prompts for the large language model were designed based on the Toulmin model of argumentation, and a tripartite collaborative framework of "teacher-student-large language model" was constructed, comprising "guided learning-group collaborative argumentation-communication and evaluation." Testing showed that the precision of the large language model's feedback on students' argumentation content reached 90.19%, indicating high usability.

Table 1 Precision and Recall of the Large Language Model's Feedback on Students' Scientific Argumentation Content

Assessment Point	All Items Annotated by the Large Language Model	All Items Expert-Annotated Manually	Number of Items Correctly Annotated by the Large Language Model	Precision of the Large Language Model's Feedback	Recall of the Large Language Model's Feedback
Claim	119	117	117	98.32%	100%
Evidence	222	249	212	95.50%	85.14%
Reasoning	111	90	85	76.58%	94.44%
Claim Completeness	82	111	82	100%	73.87%
Evidence Validity	203	228	190	93.60%	83.33%
Reasoning Soundness	109	85	77	70.64%	90.59%
Total	846	880	763	90.19%	86.70%

Second, in the scientific inquiry interaction scenario, this case constructed an enhanced interaction framework that clearly specifies the "student-educational agent-teacher" relationship, dividing interaction into three dimensions: behavioral, cognitive, and affective. (Wei & Xu, 2026) Based on this framework, the developed "Science Exploration Assistant" supports two-person collaboration and provides guided learning, companionship, reflection, and evaluation support through multi-turn dialogue.

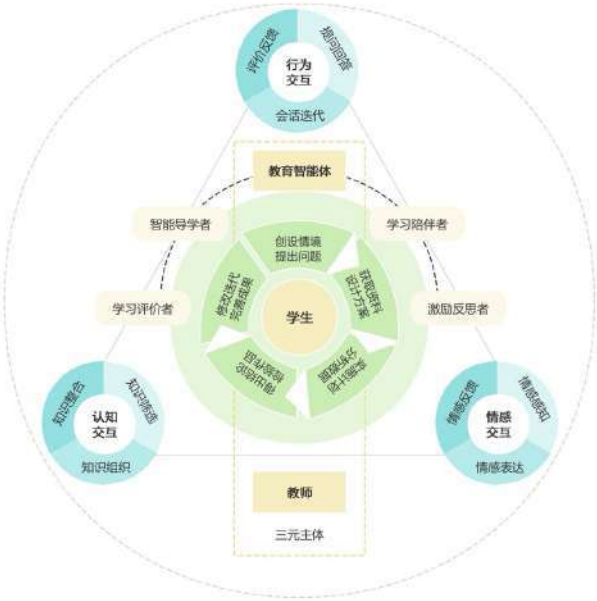

Figure 1 Interaction Framework for Large Language Model-Enhanced Scientific Inquiry

Finally, in the virtual experimental inquiry scenario, this case developed a system whose core innovation lies in the “intelligent orchestration layer.” By integrating state-monitoring middleware, Bayesian knowledge tracing, and semantic analysis by the large language model, this orchestration layer constructs dynamic learner profiles, thereby triggering a five-dimensional feedback mechanism that includes suggestions, error correction, questioning, danger warnings, and summaries, while also incorporating the PEARLS method to support students' structured reflection.

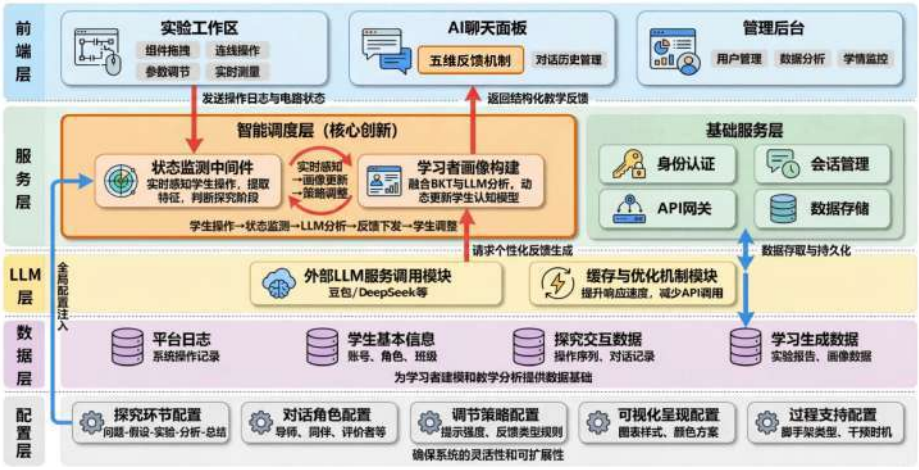

Figure 2 Layered System Architecture

3. Application Optimization and Teaching Practice

All three studies conducted iterative applications in authentic classrooms. In the scientific argumentation instructional scenario, over a four-week teaching practice, team members compared scientific argumentation instruction integrated with a large language model with traditional argumentation instruction, and the results showed that this model could effectively improve secondary school students' scientific argumentation ability, especially in the dimensions of evidence and

reasoning; at the same time, high-performing students gradually formed a cyclical argumentation pattern of “guidance-discussion-iteration.” In the study of the scientific inquiry interaction scenario, based on experimental data, this case used K-means clustering to identify four types of human-AI interaction patterns: guided off-task, cognitive response, affective participation, and collaborative construction. Among them, the collaborative construction pattern was shown to be the ideal form, as it better integrates cognitive depth, affective support, and interaction effectiveness. Finally, in the study of the virtual experimental inquiry scenario, team members conducted a six-week quasi-experimental study in two secondary schools. The results showed that the experimental group performed significantly better than the control group on post-tests across multiple dimensions of scientific inquiry ability and also demonstrated greater improvement in knowledge and skills, indicating that large language model-enhanced virtual experiments not only improve learning experiences but also produce substantial learning gains.

Case Innovation and Breakthroughs

1. Main Innovation Content

The core innovation of this case lies in not treating the large language model as a simple question-answering tool, but in deeply embedding it into key learning activities in secondary science education to form a new tripartite collaborative instructional model of “teacher-student-machine.” Compared with traditional digital tools, this case achieves a transition from “resource provision” to “process scaffolding,” from “static content” to “dynamic interaction,” and from “single-point tutoring” to “whole-process support.” In terms of educational and instructional models, the case simultaneously covers three high-frequency scenarios-scientific argumentation, scientific inquiry, and virtual experiments-thereby forming a transferable scenario-based application framework.

2. Technology Breakthrough Content

The technological breakthroughs of this case are mainly reflected in three aspects. First, it moves from text generation to educational situational awareness. Specifically, the “intelligent orchestration layer” in this case enables the large language model to provide feedback based on authentic learning processes-through state monitoring, feature extraction, context management, and learner profile construction-rather than delivering decontextualized generic responses. Second, it moves from single-form feedback to a multidimensional feedback mechanism. The five-dimensional feedback mechanism organically integrates suggestions, error correction, questioning, danger warnings, and summaries, simultaneously supporting continuous inquiry, conceptual correction, safety management, reflective facilitation, and knowledge internalization. Third, it moves from general interaction to educational interaction modeling. Through a three-dimensional interaction analysis system and cluster analysis, this case elevates students' interactions with the educational agent from experiential judgment to pattern-based research that is analyzable, identifiable, and open to intervention.

3. Application Practice Breakthrough Content

The breakthroughs of this case at the level of application practice are mainly reflected in three aspects. First, it demonstrates the usability of large language models in secondary school scientific argumentation instruction. In Huang Yu's study, the precision and recall of the large language model's feedback on students' argumentation content reached 90.19% and 86.70%, respectively, significantly outperforming traditional automated feedback tools. Second, it reveals effective interaction pathways

for scientific inquiry supported by large language models. The study identified four stable interaction patterns and pointed out that the collaborative construction pattern is the most effective in simultaneously promoting cognitive deepening, affective support, and sustained participation. Third, it verifies the significant effects of large language model-enhanced virtual experiment instruction. The research shows that the experimental group outperformed the control group overall in both scientific inquiry ability and knowledge-and-skill levels, indicating that large language models do not merely improve user experience but can also enhance learning quality.

Promotion Value and Risks

This case has strong potential for broader dissemination. First, in terms of application type, it already covers three high-frequency scenarios in basic education-scientific argumentation classrooms, inquiry activities, and virtual experiments-and therefore has strong horizontal transferability. Second, in terms of implementation, it can either support classroom discussion in the form of a lightweight conversational assistant or be embedded into existing school virtual experiment platforms, thereby forming tiered deployment pathways under different technological conditions. The three studies provide relatively sufficient evidence of effectiveness through quasi-experiments, cluster analysis, interviews, and multisource data analysis.

In terms of social and educational value, this case helps address practical problems such as the uneven distribution of high-quality science education resources and teachers' limited time for personalized guidance, while improving students' depth of participation and the quality of scientific thinking in argumentation, inquiry, and experimentation, thereby promoting the transformation of teaching in basic education toward a core-competency orientation. Its demonstrative significance lies in three aspects: first, it shows that large language models in secondary science education can be upgraded from auxiliary tools to collaborative instructional agents; second, it provides an operable framework and evidence chain for the tripartite collaboration of “teacher-student-machine”; third, it offers a feasible pathway with distinctive local practical characteristics for empowering science curricula with artificial intelligence in basic education settings.

At the same time, this case also involves potential risks. At the technical level, large language models may produce factual errors, logical misjudgments, or insufficient recognition of complex reasoning. At the instructional level, if teachers rely excessively on the system, their professional judgment may be weakened; if students regard the large language model as an “answer provider,” they may develop superficial dependence. At the ethical level, issues such as student data security, dialogue privacy protection, algorithmic bias, and the boundaries of use by minors require attention. Therefore, during the dissemination process, the principles of “teacher leadership, student agency, and technology empowerment” should be upheld, and mechanisms for review, monitoring, and intervention should be established.

Other Relevant Information

1.Case-related Images and Other Materials

Figure 3 Photograph of the Classroom Implementation of the Secondary School Scientific Argumentation Instructional Activity

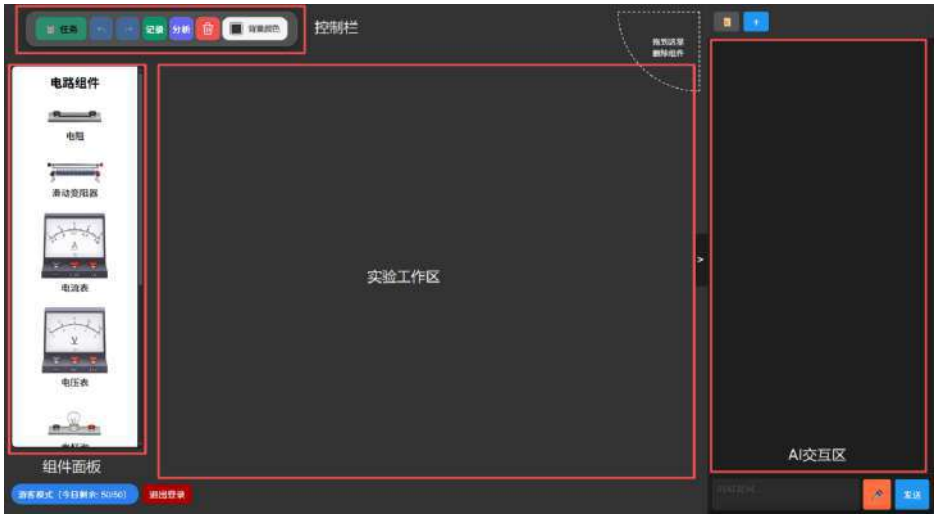

Figure 4 Student Operation Interface of the Virtual Experiment Platform

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Council, N. R. (2012). A framework for K–12 science education: Practices, crosscutting concepts, and core ideas. The National Academies Press.

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Case 22

How Can Artificial Intelligence Drive the Transformation of Primary Education with High-Quality: An Innovative Exploration

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Background

Since its establishment in 2018, Hangzhou Chovan Century City Experimental School in Xiaoshan District has upheld the school motto of “advocating culture and esteeming the ethic”, embraced the educational philosophy of cultivating students who are “joyful learners, capable doers and courageous innovators”, and highlighted “restructuring of temporal and spatial learning environments” as its distinctive teaching practice. The deep integration of artificial intelligence has become a key carrier for this exploration. Through AI-driven educational revolution, the school aims to build Future Learning Centers and promote the shift from “teaching more” to “learning more”, helping students move from good to great.

Based on policy analysis and action research, the school has identified four core challenges in student development: strong interdisciplinary education, actionable scientific spirit, visible health-first practice and memorable campus life.

Guided by the principle of student-centered education empowered by digital intelligence, this case explores new pathways for enhancing both subject literacy and social-emotional competence by iterating educational philosophy, reconstructing learning spaces, innovating talent cultivation models, and building a multidimensional intelligent evaluation system. At its core, the case seeks to safeguard the human qualities that algorithms cannot compress—intuition, empathy, morality and aesthetics.

Case Implementation Status

Narrative 1: Strong Interdisciplinary Education — Team-Based Class Mentoring with a Data Closed Loop

The school adopts a team-based class mentoring model to break down disciplinary boundaries and

establish a new paradigm for student development underpinned by teacher collaboration and a closed data loop, with the aim of cultivating capable, action-oriented students. In micro-classrooms, an AI voice-based data collection system captures classroom dialogue in real time and generates indicators such as interaction heat maps and cognitive participation. The Disciplinary Harbor AI Adaptive Learning System supports interdisciplinary collaborative lesson preparation and cross-class inquiry activities. With AI support, students are able to apply knowledge from multiple disciplines to real problems, while the process of collaborative inquiry becomes visible and traceable. The RACI responsibility matrix is used to clarify teachers' roles, ensuring clear rights and responsibilities in collaborative teaching. Classroom data, project outcomes, and teacher observations are integrated into student growth profiles, forming a closed loop of teaching–assessment–improvement.

Figure 1 Team-Based Class Mentoring

Figure 2 AI Learning Companion

Narrative 2: Actionable Scientific Spirit — "AI + Intelligent Making" Project-Based Learning for Cultivating Scientific and Innovation Literacy

Centered on the authentic theme of Xianghu Smart Mirror, the school has built a problem-driven multimodal inquiry mechanism that enables students to become joyful learners by solving real-world problems. Students collect water samples and upload them to an AI platform. Then smart classroom response devices track their inquiry pathways. Students engage in poetic dialogue with robots about Xianghu Lake. Those create a dual-track learning experience that integrates ecological data with cultural narrative. Students use brain-computer interface devices to perceive their cognitive states, and complete the transformation from ideas to physical creations in the IDOL Makerspace. This achieves cognitive synergy between scientific inquiry and humanistic immersion, as well as emotional synergy between individual thinking and teamwork.

Figure 3 Brain-Computer Interface

Figure 4 Project-Based Learning

Narrative 3: Visible Health-First Practice — Protecting Physical and Mental Well-Being through Digital Intelligence

The school has built a health profiling system based on the integration of multi-source data. It correlates sports data, classroom behaviors, emotional expression and other indicators to automatically generate dynamic health profiles. In the Heart-to-Heart Room, students can express themselves without pressure, while the system uses language recognition to detect trends in emotional fluctuation and helps shift support mechanisms from post-event intervention to early warning. For students with special needs, the school implements individualized education plan.

Figure 5 Lightning Run

Figure 6 Smart Exercise Bar

Figure 7 Heart-to-Heart Room

Narrative 4: Memorable Campus Life — Accumulating Growth Assets through Digital Intelligence

The school has built a full-scenario accompanying growth recording system, turning curiosity-driven exploration into visible outcomes. The Little Stage Digital Culture Exhibition system transcribes students' stories in real time into text and audio archives, making moral education activities recordable, traceable and interactive. The "Intelligent Composition Review Center" in the Circular Library archives students' writings over the years into their "First Book of Life", forming a time series of language development. Interactive experiences between the digital gallery and AI assistants bring works to life, inspiring students to create proactively and embodying the characteristic of "courage to innovate". Through automatic multimodal data collection and visualization, growth is transformed from "vague memories" into "clear assets", providing each student with a digital life archive.

Figure 8 Digital Cultural Display System

Figure 9 AI Writing Evaluation System

Through continuous iteration in institutional innovation and digital-intelligent integration, the school has built a smart education implementation system covering the full chain of collaborative education, scientific and innovation literacy, physical and mental health and growth documentation. This has enabled technology to transform from a mere supportive tool to an educational partner.

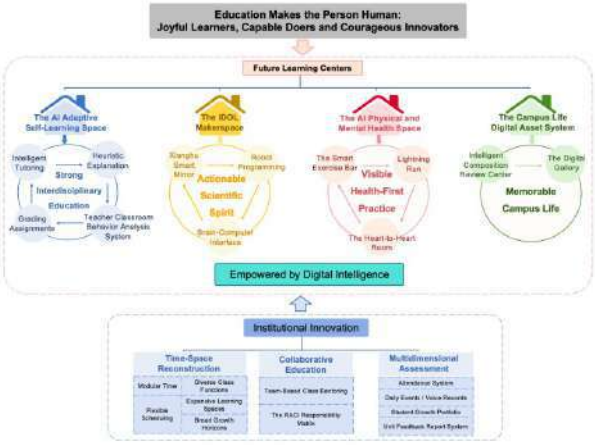

Figure 10 Technical Roadmap of “Mechanism Innovation + Digital-Intelligence Empowerment”

Case Innovation and Breakthroughs

1. Innovation in Educational Philosophy: Enabling Humans to Thrive as Humans in the Age of AI

The most important breakthrough of this case lies in its proposition: “safeguard the human qualities that algorithms cannot compress—intuition, empathy, morality and aesthetic judgment”. It establishes an educational philosophy in which the school adapts to children, every individuality takes root, and knowledge flows with emotion. Also, it elevates Social Emotional Learning (SEL) from an implicit curriculum to an explicit educational goal that carries equal weight with subject literacy.

AI functions here as a supporter rather than a substitute. Through natural language processing, it identifies trends in emotional fluctuation and shifts psychological early warning from experience-based judgment to data-informed evidence, while remaining teachers’ final interpretive authority over student profiles. This creates a symbiotic model in which AI provides cognitive augmentation and humans safeguard value judgment.

2. Innovation in Scenario Design: From Functional Zoning to Narratives of Life

Around the four narrative threads -- strong interdisciplinary education, actionable scientific spirit, visible health-first practice and memorable campus life, the school has created more than 30 Future

Learning Centers, turning the physical space into an active field that carries life narratives and stimulates both cognitive and emotional interaction.

The AI Physical and Mental Health Space integrates sports data collection, psychological and emotional counseling, and special needs intervention. The IDOL Makerspace enables a cognitive progression from technological experience, to problem inquiry, and finally to creative realization. The Digital Assets System transforms fragmented experiences into traceable, interactive "digital life archives". The AI Adaptive Self-Learning Space supports intelligent tutoring and collects data through the teacher classroom behavior analysis system. Together, these spaces achieve a threefold transformation: from physical existence to intelligent environments, from one-way utilization to human-machine interaction, and from transient experiences to long-term growth accumulation.

3. Innovation in Teaching Models: From Isolated Activities to Data-Driven Practice

Since 2017, the school has upgraded subject practice from scattered activity-based attempts to an institutionalized and systematic teaching paradigm.

At the level of real-problem orientation, projects such as Xianghu Smart Mirror embed knowledge learning into the inheritance of regional culture and measures of environmental protection, enabling disciplinary practice to gain real-world significance beyond the classroom. At the level of class-unit implementation, disciplinary practice takes the class as its basic organizational unit. At the level of AI data support, the "Understanding Learning" assessment system uses natural language processing to convert core competencies—including disciplinary interest, thinking quality, and collaboration ability—into observable and updatable dynamic profiles.

4. Innovation in Management Mechanisms: Team-Based Class Mentoring as a Governance Paradigm for Collaborative Education

Supported by AI, the team-based class mentoring model and future learning centers form an interconnected and organic whole. By introducing the RACI responsibility matrix, the school has transformed the class-based education unit from a "teacher-centered model" to "distributed collaboration": head teachers oversee project planning, subject teachers provide instructional guidance, and special needs tutors deliver individualized interventions. This forms a "class community" with clear rights and responsibilities, serving as the "organizational operating system" for the Future Learning Center.

As the key role in this collaborative infrastructure, AI enables every teacher to make professional judgments on the basis of the same data system. In this setting, the head teacher becomes the data hub, helping to generate a flatter, more efficient and more human-centered governance model for students' development.

The Smart Exercise Bar, the Heart-to-Heart Room, the AI Learning Companion Space, the AI Writing Evaluation System, and Teaching Behavior Analysis System are respectively provided by DaweiAI, Feixiang, Easy Education Technology, Vanlon and iFLYTEK.

Promotion Value and Risks

1. AI-Empowered Future Learning Centers and Achieve Scale Promotion of the Educational Philosophy established

This case constructs a replicable and scalable practical paradigm through four narrative scenarios. The school has built more than 30 Future Learning Centers, and 100% of teachers have integrated AI into regular teaching.

2. The Social Value of AI-Driven Educational Transformation unleashed

AI empowerment has supported the "Double Reduction" policy by freeing teachers from repetitive tasks and allowing them to focus on emotional companionship. The school has ranked first in the district-wide academic quality assessment for three consecutive years, with a parent satisfaction rate of over 98%. It promotes the balanced development of urban and rural education, and has established practice bases in 22 rural schools in Tibet, Hebei and other regions. The "Team-based Class Mentoring" collaborative education model, which supports teacher growth, has enabled 100% of teachers to obtain district-level honors, 80.3% to obtain municipal or higher-level honors, including 1 new gold award winner of the Provincial Education Reform Star, 5 new Municipal Teaching New Talents, and 20 new District Teaching New Talents.

3. A Multi-Level Demonstration and Leading Position Established

The school has hosted a national forum for four consecutive years to showcase future learning centers, which has been repeatedly reported as "a bright business card for regional education reform". One student won the "Innovation Star", the top honor in the national student information literacy improvement practice.

4. Face up to the Potential Risks in Promoting the Innovation Model

In terms of technical risks, the school has established a sound data security management mechanism. The campus life digital asset system is deployed locally to protect privacy, data confidentiality agreements have been signed with cloud service providers for other devices, all data property rights belong to the school, and data will be destroyed after service termination.

In terms of ethical risk, the school insists on preserving teachers' final interpretive authority over student profiles to ensure that AI does not overstep the essential nature of education.

Other Relevant Information

In January 2022, the article Construct a New School Modality through a New School View of Time and Space was published in School Administration.

In January 2022, the school project Research on a Practical Model of Preschool-to-Primary Transition Based on the Time-Space Reconstruction won the First Prize of Provincial Educational and Scientific Research Achievements issued by the Zhejiang Provincial Office of the Leading Group for Educational Science Planning.

On December 2, 2024, Hangzhou Chovan Century City Experimental School in Xiaoshan District: Taking Disciplinary Practice All the Way Through reported by Zhejiang Education News to introduce the school's innovative approach to disciplinary practice.

In September 2025, Empowering Classes: Another Strategy to Strengthen Disciplinary Practice in Primary Schools won the Second Prize of Provincial Basic Education Achievements issued by the People's Government of Zhejiang Province.

The school was selected as nation's first chair institution of Association of Disciplinary Practice Education, working jointly with 41 schools both within and outside Zhejiang Province to explore new pathways for AI-empowered education. Its achievements have been promoted and applied in more than 10 provinces, including Beijing, Shanghai, Guangzhou and Jiangsu.

Thanks to its practice of Future Learning Centers featuring "mechanism innovation + digital-intelligence empowerment", the school has successively won 36 honors, including Provincial Modernized School,

Provincial Standardized School of Compulsory Education and Provincial Demonstration School for Educational Robotics Teaching. The large-scale promotion has achieved remarkable results, receiving more than 3,000 visitors annually, training over 1,000 principals and teachers each year, and welcoming more than 18,000 peer educators from across the country. Relevant experiences have been reported over 100 times by 20 mainstream media outlets such as People's Daily Online and Xuexi Qiangguo, with a total readership exceeding 3 million.

Case 23

Educational Transformation Driven by Technology:Innovative Practice of Artificial Intelligence TeachingSpace in Primary Schools

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Introduction: When Teaching Space Is Redefined by AI

Against the educational transformation of the digital era, artificial intelligence is no longer a remote technical concept, but a real force that enters classrooms, empowers learning, and accompanies growth. Limited by equipment, data, resources and scenarios, traditional teaching spaces can hardly support personalized learning, immersive experience and diversified creation. Based on shadowless cloud computing, connected by data, and guided by real learning needs, the AI teaching space keeps technology behind the scenes and brings learning to the forefront. It enables every child to see a broader world of knowledge and enjoy more independent growth possibilities in a perceptible, touchable and creative space.

I. Space Rebirth: From Traditional Classrooms to AI-Powered Smart Learning Fields

The birth of the AI teaching space responds to real pain points in education. In the past, computer classrooms suffered from frequent equipment failures, difficulty in saving works, inefficient collaboration, delayed feedback, obvious resource gaps between urban and rural schools, and abstract knowledge that could hardly be transformed into intuitive experience. Today, we reconstruct learning fields with cloud architecture, Internet of Things, big data and artificial intelligence, building a new teaching space featuring cloud-terminal integration, data connectivity, scenario immersion and global interconnection. It is no longer a single place for skill training, but an intelligent ecology integrating exploration, creation, collaboration and practice—with stable and reliable equipment, real-time preservation of works, cross-scenario learning continuity, and whole-process evaluation, making technology truly serve the essence of education.

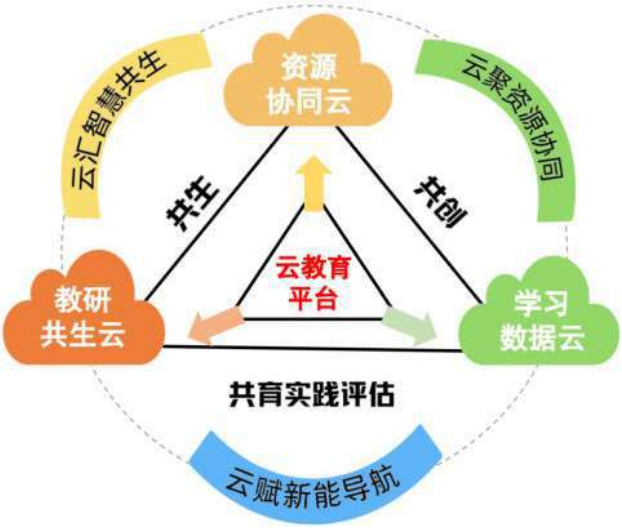

Figure 1 Structure of the Platform

II. Classroom Renewal: AI Makes Knowledge Perceptible, Explorable and Creative

Relying on the AI teaching space, we integrate technology into real courses, shifting learning from "passive acceptance"to "active creation", and forming a number of replicable and experiential model classrooms.

Figure 2 Replicable and experiential model classrooms

(I) AI Astronomy Class: Touching the Stars and Bringing the Universe Close at Hand

In the AI astronomy inquiry class, artificial intelligence serves as a "super telescope" for students to explore the universe. With cloud computing power and intelligent recognition tools, students obtain real-time star map data, simulate celestial movement, and observe constellation orientations, turning distant galaxies in textbooks into interactive, stimulable and verifiable immersive scenarios. AI assists in analyzing the position, brightness and orbit of celestial bodies, helping students independently raise questions, design inquiries and draw conclusions. The classroom is no longer limited to pictures and words, but an astronomical laboratory accessible to every student, igniting scientific curiosity and fostering inquiry literacy.

(II) AI Art Class: Everyone Is a Creator, and Art Has No Boundaries

The AI art creation class breaks the threshold of traditional techniques and returns art creation to expression itself. With AI tools, students conduct color analysis, composition assistance, style transfer

and creative generation, turning their ideas, emotions and stories into digital works. The cloud desktop supports cross-terminal saving and modification, allowing unfinished creations in class to be continued at home; the group sharing space enables real-time collision of ideas, with instant peer and teacher comments. AI does not replace creation, but releases imagination. It enables every child to express bravely and create confidently, cultivating aesthetic ability and innovative spirit in artistic practice.

(III) AI IoT Practical Class: Understanding Technology from Life and Returning to Life

We connect intelligent terminals to the teaching space, building tangible, operable and transformable real IoT scenarios. Small projects such as intelligent flower watering, voice control and environmental monitoring turn artificial intelligence and IoT from abstract concepts into experiential life applications. Students understand technical principles through hands-on connection, debugging and optimization, and develop computational thinking and engineering literacy by solving real-life problems, truly realizing "learning by doing, learning by using, learning by creating".

III. Model Transformation: Data Empowerment for Precise and Personalized Teaching

The most valuable part of the AI teaching space is not equipment upgrading, but the transformation of teaching paradigms. The platform collects learning process data non-sensitively to form a complete student profile, shifting teachers from empirical judgment to data-supported precise teaching. The AI homework platform enables rapid assignment, real-time collection, intelligent correction and personalized feedback; the classroom evaluation system provides instant recording and visual presentation, organically linked with the moral education system to stimulate internal learning motivation through incentive evaluation. Layered tasks, personalized resources and adaptive exercises are no longer difficult to implement, allowing every student to grow at their own pace.

IV. Equity Empowerment: One Cloud Connects Urban and Rural Students to Share the Same Starry Sky

The greatest value of technology lies in promoting equity. With a low-threshold, low-cost and high-stability cloud architecture, the AI teaching space enables rural and under-resourced schools to access the same computing power, resources and classrooms without high-end hardware. Urban and rural students attend the same AI astronomy class, create artworks together via AI, and research IoT projects jointly, allowing high-quality resources to cross geographical barriers. Cloud-based synchronous teaching and research enables teachers to learn and grow collaboratively, promoting opportunity equity through tool equity and educational balance through digital collaboration, so that every child can enjoy high-quality future-oriented learning.

Figure 3 Equity Empowerment

V. Practical Echoes: Witnessing Children's Growth in Spatial Transformation

Since its regular application, the AI teaching space has brought tangible changes: classrooms are more vibrant, and students dare to think and create; learning runs more smoothly without lost works; feedback is faster, and growth is clearly visible; gaps are narrower, and rural students shine with confidence. Students' information awareness, computational thinking, innovation ability and cooperation literacy have been continuously improved; teachers' teaching methods have become more open and diversified; the school has formed a replicable, promotable and sustainable digital education model. Relevant achievements have been selected as the National Excellent Case of Educational Management Informatization and won the Zhejiang Provincial Excellent Achievement Award for Educational Informatization, providing a practical sample for the digital transformation of primary schools in the region and even across the country.

Conclusion: Advocating Technology for Good to Cultivate Future-Ready Talents

Educational transformation driven by technology ultimately points to better education and more holistic growth. The AI teaching space is not a pile of technologies, but an educational innovation centered on children, based on learning, and pursuing equity. In the future, we will continue to deepen the integration of technology with curriculum, teaching and evaluation, making AI more understanding of education and space warmer, so that every child can grow confidently and face the future in the digital era.

Case 24

"Three-stage closed-loop, multi-interaction, technology empowerment" human-computer collaborative teaching mode innovation

Jining University

Case background

1. Teaching pain points and challenges

As a core foundational course for primary education majors, "Curriculum and Instruction" plays a pivotal role in cultivating teachers' scientific educational concepts, practical teaching skills, and professional value recognition. However, traditional teaching models face three major core challenges:

- The problem of the disconnection between knowledge and practice: the curriculum is highly theoretical and abstract, and it is difficult for students to transfer the classical theories of Dewey and Taylor effectively to the real teaching situation of primary and secondary schools, which leads to the disconnection between learning and application and the difficulty of the transformation between theory and practice.
- The shallow valley of interaction: The teaching is mainly based on the teacher's lecture, and the students lack the personal experience of "designer" and "implementer". The classroom interaction is easy to become superficial discussion, and the students lack the personal perception of the complexity and dynamic of the teaching process, and the path of cultivating practical wisdom is not smooth.
- The problem of lack of motivation: The learning motivation is mostly driven by the score, the value identification of the teacher's profession and the education feeling are not deep, the professional vision of "excellent teacher" is vague, the inner learning motivation is difficult to sustain, which affects the establishment of lifelong teaching belief.

2. The Necessity and Practical Significance of Applying Artificial Intelligence Technology

These pain points stem from the limitations of traditional teaching paradigms in personalized support,

contextualized experiences, and deep interaction. The emergence of generative artificial intelligence (GenAI) technology offers new possibilities to address these challenges. The necessity is reflected in:

- Enabling personalized education at scale: GenAI provides customized learning paths, resource recommendations, and real-time feedback based on student performance data, addressing the limitations of teacher availability in large-class settings and providing technological support for student-centered teaching.
- Bridging theory and practice: AI can generate or analyze massive teaching cases, creating realistic teaching scenarios to help students analyze cases and simulate decisions, effectively connecting abstract theories with concrete practices.
- Empowering deep engagement and higher-order thinking: AI can serve as a 'debate partner' or 'catalyst for thought,' generating thought-provoking topics and providing multi-perspective insights in classrooms. This approach stimulates students' critical thinking and creative expression, ultimately fostering deep learning.
- Reforming the teaching evaluation system: AI enables comprehensive and multimodal data collection and analysis throughout the learning process, supporting formative and developmental assessments. This liberates teachers from repetitive tasks, allowing them to focus on value guidance and the cultivation of higher-order competencies.

Therefore, driving pedagogical innovation through GenAI technology is not only an urgent response to current teaching challenges, but also a strategic choice to proactively align with the digital transformation of education and cultivate future-ready 'research-oriented teachers'.

Implementation process

1. Overall Technical Solution: Constructing a New Ecological System of "Teacher-Student-Machine" Tripartite Collaborative Teaching

The core of this case study is to build a "teacher-student-machine" collaborative system with GenAI as the key enabling element. Teachers serve as instructional designers, guides, and evaluators; students act as active explorers, collaborators, and practitioners; while AI technologies (represented by tools like "AI Workbench," "AI Lecture Companion," "AI Learning Companion," and general-purpose agents such as DeepSeek and DouBao) function as personalized learning supporters, interactive facilitators, and data analysts. The synergy among these three elements forms a closed-loop teaching process.

2. Specific Application Measures and Technical Types

- Technology Type: Primarily utilizes generative artificial intelligence (GenAI) technologies, including large language models (LLMs)and their derivative educational agents (e.g., AI lecturers and AI study partners), intelligent content generation tools, and learning analytics technologies.
- Application Platform: Leveraging the school's smart teaching platform, it integrates the aforementioned AI tools to create a seamless online-offline teaching environment.

3. Implementation Steps and Schedule

Phase 1: Pre-class – AI-powered personalized preview and intensive lesson preparation (before each class)

(1) Student Activities: Watch 35 theoretical micro-lectures (406 minutes) recorded by teachers on the platform. Complete unit tests automatically pushed by the AI system.

(2) AI Application: The platform's AI learning companion automatically analyzes students' knowledge

gaps based on test results, and recommends personalized supplementary reading materials, targeted exercises, and mind map creation tasks. Students can use AI tools to generate or manually draw mind maps, and submit questions online.

(3) Teacher's role: Receive the AI-generated learning analysis report (including common questions and difficulty distribution), then prepare lessons with precision and design key discussion topics for class.

Phase 2: In-Class – AI-Driven Deep Interaction and Higher-Order Thinking Training (Offline Class, 32 Hours)

(1) Scenario Design: Based on AI-powered learning analytics, the teacher poses thought-provoking and controversial core questions (e.g., "How to evaluate homework design in a 'double reduction' case using Tyler's principles?").

(2) Multi-Interaction:

- Student-student interaction: Group discussion, debate and role play.
- Teacher-student interaction: The teacher organizes topic-based quick-response activities and debates, using smart classroom tools (bullet comments and random roll call) to ensure full participation.
- Student-Teacher Interaction: During group discussions, students can utilize GenAI tools (e.g., DeepSeek) to generate suggestions like "Apply Bloom's Taxonomy in this context" or "Design an alternative teaching scenario," thereby broadening perspectives and stimulating critical thinking.

(3) AI's role: As an' instant resource hub 'and' idea generator,' AI provides theoretical foundations, counterexamples, or interdisciplinary perspectives to spark discussions, overcome mental inertia, and enhance engagement.

Phase 3: Post-class – AI-supported consolidation and formative assessment (after each lesson)

(1) Student activity: Complete project-based assignments (e.g., designing a unit teaching plan). Submit for initial review and revision suggestions by submitting to AI Assistant.

(2) AI Application: AI performs format review of assignments, evaluates the correctness of basic theory applications, and provides preliminary feedback. It also continuously records process data such as student participation, interaction quality, and project progress across all stages.

(3) Teacher activities: Review AI feedback and student final outcomes, providing targeted and developmental evaluations and guidance. Utilize AI-generated comprehensive learning portfolios for teaching reflection and curriculum iteration.

Innovation Highlights

1. Ecosystem restructuring: From 'dual' to 'triple' -Breaking the traditional teacher-student binary structure, AI is formally integrated as an indispensable 'third element' into the educational ecosystem. This establishes a symbiotic 'teacher-student-machine' relationship, achieving complementary advantages between human resources and computational power.

2. Process reengineering with a 'three-stage closed-loop' system seamlessly integrates online and offline learning: The closed-loop process— 'pre-class (AI-powered personalized preview) -in-class (AI-enhanced interaction) -post-class (AI-driven assessment expansion)' —ensures deep AI integration throughout the entire teaching chain, moving beyond superficial applications to guarantee systematic

and continuous technological implementation.

3. Interactive elevation: "multi-dimensional interaction" stimulates higher-order thinking. The new dimension of "student-machine interaction" is introduced in classroom interaction, enabling students to exercise critical thinking and creative problem-solving ability through real-time dialogue, questioning and collaboration with AI, making the classroom a training field for higher-order thinking.

4. Evaluation innovation, data-driven value orientation: Establish a "process-oriented, developmental, and diversified" evaluation system based on AI-powered whole-process data collection. Through multi-stakeholder (teacher-student-machine) evaluations, competency-based assessment criteria, and growth portfolios, the evaluation focus shifts from knowledge memorization to skill development and value internalization, effectively stimulating students' intrinsic learning motivation.

5. The integration of ideological and political education with technological empowerment: By innovatively applying AI to ideological and political education scenarios—such as analyzing the educational ethos embedded in exemplary cases or generating positive/negative examples to guide students in value discernment—this approach achieves a subtle yet profound integration of technology into curriculum-based ideological and political education.

Case effectiveness

1. Student Development Outcomes

- Academic performance showed significant improvement: The control experiment (experimental class n=58, control class n=40) showed that the experimental class's stage, midterm, and final exam scores were significantly higher than those of the control class ($p<0.01$ to $p<0.001$).
- The higher-order thinking ability was enhanced: The paired sample t-test showed that the post-test scores of critical thinking, creative thinking, decision-making thinking and problem-solving ability of the experimental class were significantly higher than the pre-test scores ($p<0.05$).
- The practice and innovation have yielded abundant results: Students have won 8 awards in provincial-level and above teaching skills competitions for normal students; received 3 excellence awards in the National College Students 'New Media Course Innovation Competition; and secured 1 national-level and 2 provincial-level projects under the National College Students' Innovation and Entrepreneurship Training Program.
- Learning experience and career identity improvement: The comments of students show that their classroom participation, initiative, practical experience and understanding of teachers' career have been greatly improved.

2. Teacher Development Outcomes

- The teaching achievements have been recognized by authoritative institutions: This innovative model was awarded the Excellence Prize in the National Digital Education Innovation Achievement Award and the Second Prize in the National AI Empowered Online Teaching Innovation Achievement Competition. The related case was selected as a typical application scenario of "Artificial Intelligence + Higher Education".
- The teaching and research capability has achieved a leap forward: Based on this case, the course team successfully applied for two provincial-level teaching reform projects, won two provincial-level teaching achievement awards, and was approved for the university-level "Smart Course" construction project.

- The research has been fed back to teaching: successfully applied for the project of Shandong Higher Education Society (the construction of new paradigm of "teacher-student-machine" interactive teaching driven by large model), and formed a virtuous cycle of teaching and research.

3. Teaching Quality and Demonstration Effect

- The model has been successfully implemented across the teacher education programs at our institution, benefiting over 3,000 students with consistent improvements in course pass rates and excellence rates.
- Media attention and social impact: The innovative practice was reported by multiple mainstream media outlets such as China Education Network Television, China News Network, and China Daily Network, generating extensive social impact.
- As an exemplary case, it has conducted over 10 teaching observations, new teacher training sessions, and specialized lectures within the school, effectively fostering a reform-oriented teaching atmosphere.

Generalizability

1. Universality and Demonstrative Value

This case study addresses the common challenges faced by university teacher education courses and many theory-intensive humanities disciplines with high practical demands: large-class teaching, disconnection between theory and practice, insufficient interaction depth, and monotonous evaluation methods. Its "three-stage closed-loop" framework, the core concept of "multi-dimensional interaction," and the ecological perspective of "AI as a collaborative element" hold significant paradigmatic value and transferability. It provides a complete, empirically validated solution for how similar courses can systematically apply AI rather than in fragmented ways, and how technology can facilitate deep learning instead of superficial entertainment.

2. Practical promotion strategies

(1) Concept-driven, training empowerment: The organization conducts specialized workshops for teachers, focusing on the design philosophy of human-machine collaborative teaching, as well as the application methods and integration strategies of mainstream educational AI tools.

(2) The model is simplified and templates are provided: the "three-stage closed-loop" model is refined into an operational standardized process template and a teaching design checklist, reducing the application threshold for teachers.

(3) Resource co-construction and platform support: Encourage institutions or regions to jointly build and share case libraries for "AI+curriculum", micro-lecture resource libraries, and project task libraries. Improve or introduce intelligent teaching platforms integrated with AI-assisted teaching functions.

(4) Pilot implementation followed by iterative promotion: Select departments or course teams with reform intentions for pilot programs, providing technical and pedagogical support. After accumulating successful cases, scale-up promotion will be achieved through observation exchanges, achievement exhibitions, and other formats.

(5) Mechanism-based incentives and achievement recognition: The innovative practice of AI-integrated teaching will be incorporated into the evaluation system for teaching achievement awards, professional title assessments, and performance evaluations, thereby stimulating teachers'

continuous innovation drive.

3. Localization adaptation plan and expected outcomes

Different institutions can flexibly adapt to their own infrastructure, student characteristics, and curriculum objectives.

- For institutions with limited technical resources, priority should be given to utilizing free general-purpose large language models (e.g., DeepSeek, Wenxin Yiyang) to focus on designing the "student-machine interaction" component and exploring post-class AI-assisted evaluation.
- Courses tailored to different competencies: For design-focused courses, the role of AI in solution generation and iteration can be enhanced; for analysis-oriented courses, the application of AI in case mining and multi-perspective evaluation can be deepened.
- Expected outcomes: Through localized adaptation, the following objectives are anticipated to be achieved to varying degrees: enhancing students 'learning engagement and satisfaction; strengthening their ability to connect theory with practice and develop higher-order thinking; optimizing teaching process data for precision instruction and evaluation; promoting teachers' pedagogical innovation and digital teaching competency development. Ultimately, this will yield a series of school-specific "AI + Curriculum" demonstration cases, driving the comprehensive digital transformation of educational quality.

Conclusion

This case study demonstrates the viable approach and remarkable outcomes of transforming traditional classroom teaching models through scenario-based and systematic design, with generative AI technology as the core driver. It proves that AI's value in education extends far beyond instrumental substitution—it functions as a collaborative agent capable of restructuring teaching relationships, processes, and ecosystems, thereby unleashing the potential for educational innovation. Looking ahead, as AI technology continues to evolve, the new paradigm of "teacher-student-machine" tripartite collaboration in smart education will provide stronger support for cultivating innovative talents suited to the demands of the digital era.

Case 25

AI in Teacher Education: The Institutional Experience of Moscow City University

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Moscow City University, Russia

Case Background

Moscow City University (MCU) represents a distinctive case within the Russian higher education system. Established by the Government of Moscow in 1995, the university has evolved into a large metropolitan pedagogical institution integrating teacher education, applied research, and digital innovation. Since 2021, MCU has participated in the national academic leadership program Priority 2030, aimed at transforming universities into drivers of technological and socio-economic development. Within this framework, artificial intelligence (AI) has become a strategic direction for both research and educational transformation.

Globally, teacher education systems face several persistent challenges: the misalignment between graduate competencies and employer expectations, the subjectivity of pedagogical assessment, limited opportunities for safe professional rehearsal, and insufficient personalization of learning trajectories (Darling-Hammond & Oakes, 2021; Holmes et al., 2019). These challenges are particularly acute in pedagogical universities, where the quality of teacher preparation directly affects the broader educational ecosystem.

MCU's AI integration strategy emerged not as a technological experiment but as an institutional response to these structural challenges. The university has gradually developed an ecosystem of AI tools addressing assessment objectivity, predictive analytics, adaptive learning, and responsible generative AI use.

Implementation Process

AI integration at MCU evolved through regulatory clarification, infrastructure development, and research-based deployment. A foundational step in MCU's AI trajectory was regulatory clarification. In August 2023, Moscow City University officially legalized the responsible use of generative AI systems

(such as ChatGPT, YandexGPT, and GigaChat) for graduation qualification papers, becoming the first Russian university to formalize governance rules for pedagogically justified AI use. Academic integrity safeguards include access to Antiplagiat with AI-text detection. Rather than prohibiting AI, the university adopted a transparency- and disclosure-based governance model, framing generative systems as tools requiring pedagogical literacy and ethical responsibility. This regulatory foundation enabled the development of more advanced AI-based instruments.

The central innovation of MCU's AI ecosystem is the system Digital Mirror of the Training Session. Developed within the Priority-2030 framework in partnership with SberEducation, the system addresses a key limitation of traditional teacher assessment: reliance on subjective expert observation without quantitative multimodal analytics. The Digital Mirror is deployed in 71 "smart classrooms" equipped with synchronized video and audio recording systems. During 20-minute simulated teaching sessions, students perform as teachers while peers act as schoolchildren. Independent experts observe through a Gesell mirror, ensuring minimal interference. The system integrates three analytical modules: (1) computer vision analysis of gaze, facial expressions, and engagement; (2) automated speech and discourse analytics identifying pedagogical markers and speech distribution; and (3) a competency dashboard combining 15 expert-defined competencies with machine-derived indicators, expanded from 20 to 44 through iterative refinement.

Parallel to this implementation, MCU researchers developed a specialized annotated dataset for spoken discourse processing and established international collaboration with Tsinghua University and Central China Normal University. The university also co-developed a Digital Adaptive Textbook for Grade 6 biology with the publishing house Prosveshchenie, integrating diagnostic personalization mechanisms.

Innovation Highlights

The MCU case stands out as a strong example of Artificial Intelligence in Education due to several interrelated features. First, the system demonstrates discipline-specific personalization. The Digital Mirror does not measure generic engagement but aligns AI indicators with 15 professional teacher competencies, including emotional regulation, classroom management, and instructional clarity. This ensures construct validity and responsiveness to authentic professional standards (Darling-Hammond, 2021). Second, the architecture embodies hybrid intelligence. By combining computer vision and discourse analytics, the system produces a multidimensional representation of instructional practice. AI augments expert perception rather than replacing professional judgment, consistent with contemporary AIED frameworks (Holmes et al., 2019). Third, AI integration is institutionally embedded. It is supported by infrastructure (71 smart classrooms), governance regulation, predictive analytics systems, and research development. This systemic integration differentiates MCU's approach from fragmented EdTech pilots. Fourth, the model emphasizes evidence-based iteration. Correlation analysis between expert and machine-generated indicators informed expansion and recalibration of metrics, reinforcing methodological rigor.

Effectiveness Proof

Between 2024 and 2025, 681 students underwent AI-supported competency assessments, producing

635 recorded model lessons across seven institutes. Pearson correlation analysis revealed statistically significant relationships between expert and AI-derived indicators. Seven correlations exceeded r = .60, while 58 fell within the moderate range (r = .40–.59), indicating convergent validity between human and machine assessment criteria. For example, speech organization metrics correlated with expert evaluations of information systematization, and emotional ratio indicators correlated with assessments of emotional regulation.

Student survey data (n = 208 responses) showed substantial trust in the system: 73% agreed or rather agreed with automated evaluations; only 3% fully disagreed. Qualitative feedback indicated that AI enhanced perceived objectivity and reduced potential human bias, although some students questioned speech recognition precision. Importantly, most respondents viewed AI feedback as complementary rather than substitutive.

Promotion Plan

The Digital Mirror model can be replicated by other institutions under four core conditions: (1) availability of synchronized video and audio capture infrastructure; (2) clearly operationalized competency descriptors aligned with national or institutional standards; (3) institutional data governance policies regulating storage, access, and evaluation authority; (4) faculty development programs supporting AI literacy and interpretive competence. Because the system is modular, with separate components for computer vision, discourse analytics, and competency dashboards, it can be applied to other professional areas, such as medical communication training or legal simulation exercises. Scalability depends primarily on alignment between technology, pedagogy, and governance rather than on exclusive proprietary technology.

Ethical Considerations

MCU's AI governance reflects the principles articulated in the UNESCO's "Recommendation on the Ethics of Artificial Intelligence" (2022). Academic integrity is ensured through a transparency- and disclosure-based model: while students may use generative AI tools, responsibility for intellectual content remains fully with the author. Data privacy and security are maintained through processing audiovisual recordings within secure institutional infrastructure, with role-based and restricted access to analytics dashboards. Fairness and bias monitoring are supported by ongoing statistical comparison between expert assessments and AI-generated indicators, enabling recalibration where misalignment is detected. Human oversight remains central: AI-generated analytics are advisory rather than determinative, and final academic decisions are made by expert evaluators. In these terms, AI operates as a developmental support instrument embedded within human governance, not as an autonomous evaluative authority.

Conclusion

The experience of Moscow City University demonstrates a shift from isolated digital initiatives to a coherent, governance-supported AI ecosystem in teacher education. AI was not introduced as a technological add-on but embedded within institutional policy, professional standards, infrastructure, and research validation. The Digital Mirror of the Training Session shows how multimodal analytics can

enhance objectivity and personalization in teacher preparation while preserving expert authority. Empirical validation, positive student perception, and measurable institutional outcomes, including reduced dropout rates, indicate both pedagogical and organizational impact. Overall, the MCU case illustrates that sustainable AI transformation depends less on technological novelty than on alignment between pedagogy, governance, ethics, and evidence-based iteration. In this model, AI strengthens reflective professional development without displacing human-centered educational values.

References

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Case 26

Innovative Practice of AI-Driven Reading-Writing Transfer Teaching in Primary Chinese Language Arts

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Background

This case focuses on the second period of teaching The Land of the Pasture from Volume 2 of the fifth-grade Chinese textbook, addressing three core pain points in traditional Chinese language classrooms. First, students demonstrate weak ability to distinguish between dynamic and static descriptions in the text and tend to confuse the two rhetorical devices. Second, under pure text-based instruction, students lack concrete support for imagining the scenes depicted in the text, making it difficult for them to appreciate the expressive effects of language. Third, the implementation of reading-writing transfer remains challenging, as students fail to flexibly apply the integrated dynamic-static technique learned in class to practical writing.

Against the background that the New Curriculum Standard emphasizes cultivating core Chinese literacy and promoting the deep integration of digitalization into education and teaching, the application of artificial intelligence technology has become a critical approach to solving the above problems. The integration of AI tools with tablet-based classroom interaction systems can not only transform abstract text into intuitive visual images to reduce students' comprehension difficulties, but also realize interactivity in the learning process, as well as instant and personalized writing assessment. This enables technology to genuinely serve core Chinese teaching objectives such as "understanding descriptive techniques" and "achieving reading-writing transfer". Meanwhile, it aligns with students' cognitive laws of intuitive perception and independent inquiry, providing digital support for cultivating students' core competencies including language application and aesthetic creation. Thus, this practice carries significant implications for classroom implementation and teaching reform. The summary of the case is shown in Figure 1.

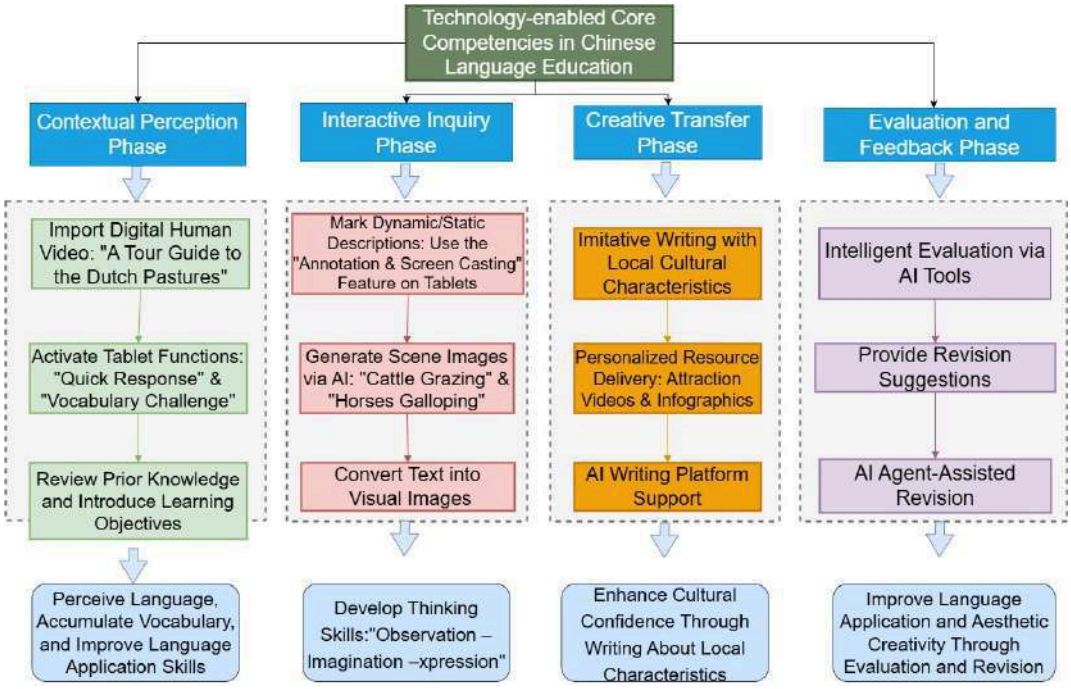

Figure 1 Case Summary

Case Implementation Status

The total duration of this teaching practice is 40 minutes. Centered on the principle that technology serves core Chinese literacy competencies, this practice integrates two types of technology: AI tools (including AI image generation, AI intelligent agent retrieval, and AI writing evaluation platforms) and a tablet-based classroom interaction system. It constructs a four-stage digital teaching chain: Situational Perception – Interactive Inquiry – Creative Transfer – Evaluative Feedback. The specific implementation procedures and technology application plans are as follows:

1. Intelligent Introduction & Activation of Prior Knowledge

Implementation procedures: The teacher prepares in advance a digital human video titled “Guide to the Dutch Pasture”, which reviews the characteristics of animals such as cows, horses and sheep covered in the previous lesson, and presents the learning objectives of this lesson: “exploring the beauty of dynamism and stillness, and understanding ‘the real Netherlands’”. At the beginning of class, the video is played on the electronic screen. After the video ends, the digital human poses a question: “What impressions did the pasture animals we learned about in the last lesson leave on you?” Students compete to answer using the “raise hand” function of the tablet classroom interaction system. The teacher randomly invites three students to speak, with their responses projected synchronously, and other students evaluate via the “like” function. Subsequently, a cloze exercise of key vocabulary is assigned. After students submit their answers, the teacher analyzes the error-prone questions and gives focused explanations on frequently mistaken words to consolidate foundational knowledge.

2. Independent Inquiry & Appreciation of the Beauty of Dynamism and Stillness

Implementation procedures: The teacher pushes paragraphs 3, 4 and 5 of the text through the tablet classroom interaction system and assigns the task: read silently, circle dynamic sentences in red and static sentences in blue, and annotate personal reflections. Students complete the task using the system’s “annotation” function. The teacher monitors students’ progress in real time and provides

one-on-one guidance to those with non-standard annotations. After independent learning, four students are invited to present their annotation results via the screen projection function, sharing the dynamic and static descriptive sentences and their perceptions.To deepen comprehension, the teacher pushes AI-generated scene images: cows grazing (dynamic), cows standing still (static), galloping horses (dynamic), sheep lying quietly (static), etc. Students discuss their reading experience of the integrated dynamic-static descriptions by combining the images and the text. The teacher summarizes the expressive effects: making the scenes more vivid and layered.

3. Collaborative Decoding & Comprehension of Emotional Connotations

Implementation procedures: The teacher poses the question: The sentence “This is the real Netherlands” appears four times in the text. Why does the author emphasize it repeatedly? What emotions lie behind it? Students are guided to think deeply. Then the teacher pushes AI retrieval instructions to search for the “writing background of The Land of the Pasture”. Based on the top three results, students extract key information such as the author’s historical context and the characteristics of Dutch pastures, and share within groups. Students work in groups of four to conduct information retrieval. Each group appoints a recorder to document key information and record the author’s longing for a peaceful life in the “group discussion” section. After the discussion, each group submits its findings via the group presentation function. The teacher selects three groups to display their results and leads the whole class to conclude that “the real Netherlands” is not only a picturesque pasture but also a symbol of freedom, tranquility, and harmonious coexistence between humans and nature. The author’s repeated emphasis serves to express praise for the Dutch pasture and yearning for such a way of life. To enhance understanding, the teacher assigns a static descriptive excerpt from The Boat of Venice for comparative reading: “What are the similarities (both adopt dynamic-static integration) and differences (The Land of the Pasture progresses from animals to the overall environment, while The Boat of Venice progresses from the boat to the whole city) between the two texts in depicting stillness?” After students complete the comparison table, the teacher summarizes and comments.

4. Expansive Transfer & Writing Skill Practice

Implementation procedures: Drawing on the local regional characteristics of the “Southern Frontier on the Great Wall”, the teacher assigns an imitation writing task: “Choose a favorite scenic spot such as Sand Lake or Helan Mountain, and write a paragraph of about 150 words using the dynamic-static descriptive method.” Resources are distributed to different groups: the “video observation group” receives a one-minute real-scene video of the scenic spot, and the “text-image reading group” receives written introductions and five high-definition images. Students extract key information (e.g., cruise boats and water birds as dynamic elements, sand dunes and lake water as static elements).After completing the imitation writing, students upload their work by photographing it to the AI writing platform. The platform scores the work from three dimensions: accuracy of dynamic-static description, language fluency, and sense of imagery, and generates revision suggestions (e.g., adding dynamic details such as “water birds skimming the water surface, leaving ripples”). Meanwhile, the intelligent agent evaluation tool quickly analyzes the paragraph and provides feedback on the consistency between emotion and scenic features, richness of detailed description, etc. (e.g., adding static details of the rock textures of Helan Mountain to strengthen a sense of vastness).Revising based on the dual feedback, students submit their work via the “work display” function. The teacher selects five excellent paragraphs to present, marking the AI score, intelligent agent evaluation, and comparisons between

drafts and revised versions, and guides discussion on "how to use dynamic-static description to highlight scenic characteristics". Finally, students vote via tablets; the top three paragraphs are awarded "Best Short Essays of the Southern Frontier on the Great Wall", with electronic certificates issued by the system. The flowchart for this part is shown in Figure 2.

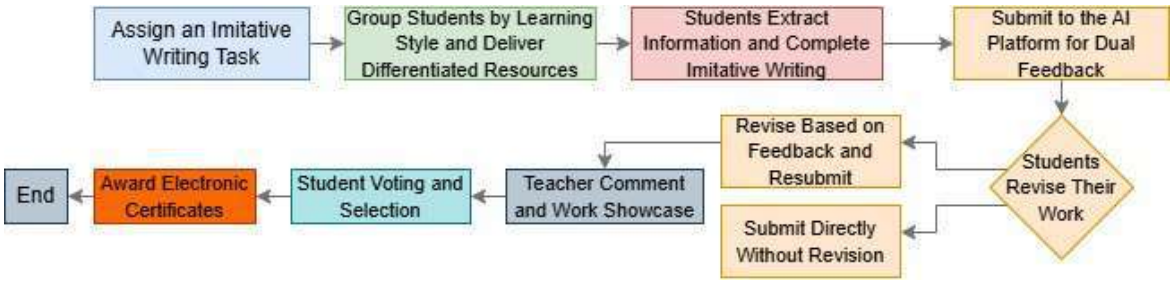

Figure 2 Flowchart of This Section

5. Summary & Review & Consolidation of Learning Outcomes

Implementation procedures: The teacher uses an AI tool to generate a knowledge framework covering three parts: dynamic-static descriptive methods, the meaning of "the real Netherlands", and key points of imitation writing. Based on the framework, students record a two-minute learning summary via the "voice" function on tablets, sharing their gains in this lesson, and submit the recording to the system. The teacher randomly plays two summaries, sorts out the classroom content, and concludes the lesson.

Case Innovation and Breakthroughs

1. Technology Integration Closely Aligned with Classroom Instruction

This practice abandons the misconception of "using technology for technology's sake". All digital tools are employed to serve two key Chinese language instructional objectives: "appreciating the expressive effects of static and dynamic descriptions" and "comprehending the text with the aid of reference materials". For instance, digital humans are used to address the problem of "insufficient interest in review and introduction"; AI tools enable accurate retrieval of the writing background to overcome the pain point of "difficulty in understanding textual emotions"; the AI writing platform combined with intelligent agent evaluation realizes writing transfer, instant feedback, and detailed supplementary assessment, thus ensuring the deep integration of technology and Chinese language teaching.

2. Hierarchical Interaction Covering All Students

Leveraging the group-push function of the tablet-based classroom interaction system, learning resources in the expansive transfer stage are divided into a "video observation group" and a "text-image reading group". The rich and diverse resources satisfy the needs of students with different learning styles. The AI writing platform, together with intelligent agent evaluation, provides hierarchical assessment criteria: the basic level focuses on "the accuracy of dynamic-static descriptions", while the advanced level emphasizes "rhetorical devices and emotional expression", thereby accommodating individual differences among students.

3. Closed-Loop Evaluation Enhancing Learning Effectiveness

A four-level evaluation system is constructed: "initial AI evaluation + supplementary intelligent agent

evaluation + teacher-student peer evaluation + self-revision". The AI writing platform generates instant scores and revision suggestions from three dimensions: "proportion of dynamic-static descriptions", "language fluency", and "sense of imagery". The intelligent agent evaluation provides supplementary feedback from the perspectives of emotion and detail. The teacher showcases excellent cases via the tablet classroom interaction system, and students revise and improve their work in accordance with the evaluation criteria, forming a learning closed loop of "creation – evaluation – improvement".

Promotion Value and Risks

1. Application Effectiveness and Prospects

This case has been validated in classroom practice among 120 fifth-grade students. The classroom participation rate increased from 65% to 92%, and students demonstrated significant improvements in distinguishing static and dynamic descriptions, understanding text connotations, and completing high-quality imitation writing. Over 80% of students recognized the educational value of digital tools. Relying on the standardized process of "Situational Perception – Interactive Inquiry – Creative Transfer – Evaluative Feedback", it can be rapidly replicated in the teaching of other scenic texts and across different grade levels, laying a solid foundation for large-scale promotion.

2. Social and Economic Value

Socially, AI-enabled Chinese language teaching effectively cultivates students' core literacy such as language application, aesthetic appreciation, and creative thinking, supporting quality improvement and efficiency enhancement under the "Double Reduction" policy. Economically, the adopted AI tools and tablet-based interactive systems are cost-effective and require no additional hardware investment, lowering the threshold for regional educational digital transformation and promoting the balanced allocation of high-quality teaching resources.

3. Demonstration and Leading Role

This case provides a replicable paradigm for the deep integration of technology and Chinese language teaching. It avoids the formalistic pitfall of "using technology for technology's sake" and constructs a hierarchical support system and closed-loop evaluation mechanism. It can serve as a practical reference for AI-integrated subject teaching in basic education nationwide, driving competency-oriented classroom reform.

4. Potential Risks

Technically, AI-generated content may contain inaccuracies, requiring prior teacher review. Ethically, attention must be paid to protecting students' data privacy and preventing over-reliance on AI from weakening critical thinking skills. Additionally, the digital divide should be addressed, with alternative learning plans provided for students lacking adequate device or network access.

Other Relevant Information

1. Strong Operability

The technologies employed in this case—digital humans, AI intelligent agents, and tablet-based interactive classroom systems—are widely available, user-friendly, and simple to operate. Teachers and students can acquire the necessary skills through one to two training sessions or guided practice,

evaluation + teacher-student peer evaluation + self-revision". The AI writing platform generates instant scores and revision suggestions from three dimensions: "proportion of dynamic-static descriptions", "language fluency", and "sense of imagery". The intelligent agent evaluation provides supplementary feedback from the perspectives of emotion and detail. The teacher showcases excellent cases via the tablet classroom interaction system, and students revise and improve their work in accordance with the evaluation criteria, forming a learning closed loop of "creation – evaluation – improvement".

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significantly lowering the barrier to adoption.

2. High Replicability

The instructional model developed in this case—comprising situational introduction, interactive inquiry, creative transfer, and evaluative feedback—can be readily transferred to other literary texts with similar learning objectives, such as The Gondola of Venice and The Pyramids, as well as to any language arts instruction requiring the teaching of descriptive techniques and reading-to-writing transfer. This model has already been extended to tablet-equipped classrooms across Grades 4 and 5, with demonstrated effectiveness.

3. Support for Core Literacy Cultivation

By integrating digital tools, this case not only facilitates students' mastery of language arts knowledge and skills but also cultivates their competencies in independent information retrieval, collaborative inquiry, and creative expression—aligning closely with the core literacy requirements of the new curriculum standards. It offers language arts educators a practical paradigm for leveraging technology to enhance literacy development. Furthermore, the integration of artificial intelligence enriches student engagement, diversifies learning pathways, and improves overall learning efficiency.

4. Promotion Pathways and Localization Adaptations

Pathways for Scaling: The model can be introduced through professional learning communities and teaching demonstrations at the school level, with gradual adaptation to local curricula. At the regional level, it can be promoted via teaching competitions and teacher training workshops.

Localization Strategies: During dissemination, other schools and teachers may adapt the model to their specific instructional contexts and regional characteristics. For example, writing tasks can be customized to feature local landmarks, AI evaluation rubrics can be calibrated to align with grade-level expectations and genre-specific conventions, and technology tools can be flexibly selected based on available school resources.

Expected Impact: When scaled, this model has the potential to transform language arts instruction by enabling personalized, interactive, and feedback-rich learning experiences. It supports the cultivation of students' critical thinking, information literacy, and creative expression—essential competencies for the 21st century—while offering teachers a practical pathway for meaningful AI integration.

Case 27

Digital-Intelligent Empowerment for AestheticEducation Innovation: Building a New Ecology ofRegional Smart Music Education

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Facing common challenges in regional primary and secondary school music education, such as "single evaluation methods, unbalanced urban-rural resources, insufficient digital applications, and relatively rigid teaching scenarios," Ruian City follows the "Compulsory Education Arts Curriculum Standards". Relying on technologies like AI, big data, 5G, and cloud computing, it has built the "Smart Aesthetic Education" regional smart music cloud platform. It explores and forms the "11254" regional smart music education model, constructing a new integrated digital-intelligent aesthetic education ecology covering the entire process of "teaching, learning, evaluation, research, and management". As of March 2026, the platform has covered 206 schools and 3,050 classes, served over 190,000 students, and achieved significant results in enhancing students' artistic literacy, teachers' professional growth, urban-rural education balance, and regional education governance, forming a highly exemplary sample for the digital transformation of regional aesthetic education.

Background

Despite progress, music education faced four critical bottlenecks:

- Imbalanced Evaluation System: Traditional assessment relied on "one song or one paper," neglecting formative processes and individual differences.
- Unequal Resource Distribution: A significant gap existed between urban and rural schools; remote rural schools struggled with a lack of specialized teachers and quality resources.
- Weak Digital Application: Low digital literacy among some teachers led to fragmented teaching and a failure to form a closed-loop digital link between teaching and management.
- Singular Teaching Scenarios: Rigid classroom models failed to meet diverse needs under the "Double Reduction" policy or stimulate long-term student interest.

In response, Ruian integrated digital intelligence into the entire music education process to transition from "traditional modes" to "digital intelligence".

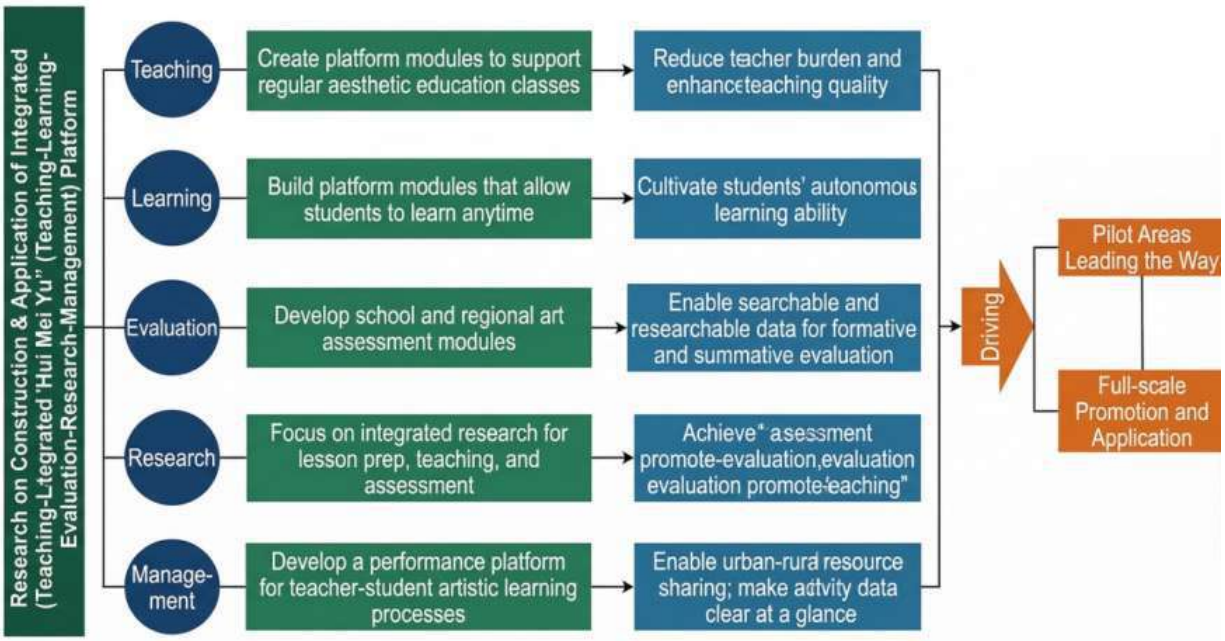


Figure 1 Implementation Path of the "Smart Aesthetic Education" Integration for Teaching, Learning, Evaluation, Research, and Management

Implementation Process

1. Top-Level Design: The "11254" Framework

Ruian adheres to the philosophy of "Digital Empowerment, Convergent Innovation, and Co-construction/Sharing":

- 1 Core Concept: Music belongs to everyone; digital intelligence promotes high-quality development.
- 1 Support System: The "Hui Mei Yu" cloud platform integrating Teaching, Learning, Evaluation, Research, and Management.
- 2 Development Marks: "Precision evaluation promoting precision teaching" and "personalized performance guiding student growth".
- 5 "Smart" (Hui) Paths: Smart Teaching (precision), Smart Learning (project creation), Smart Evaluation (data-driven), Smart Research (online-offline fusion), and Smart Management (digital portraits).
- 4 Technical Integration Strategies: Evaluation + Tech, Art + Tech, Research + Tech, and Management + Tech.

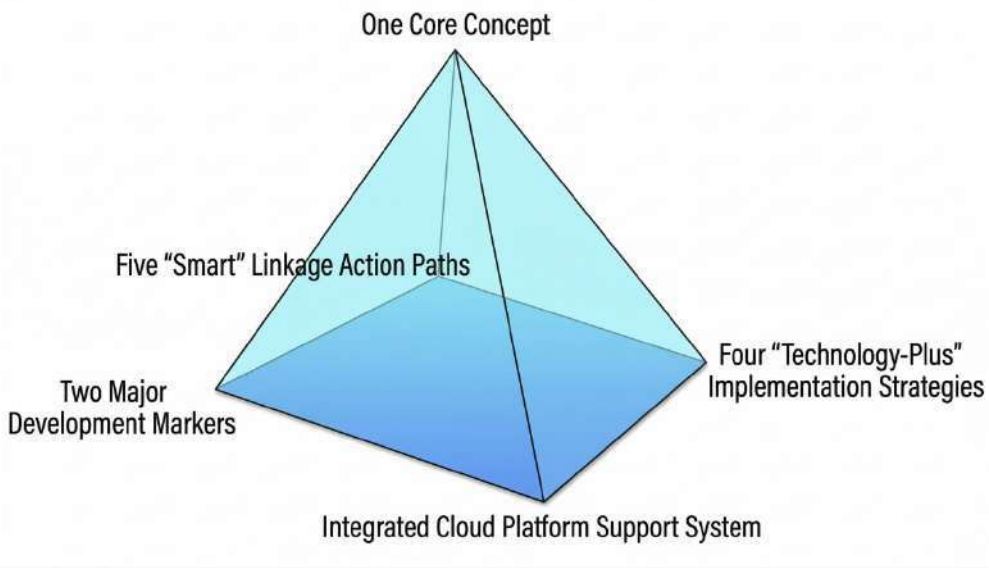


Figure 2 Schematic Diagram of Top-Level Design

2. Application Measures

Centered on the synergy of the "Five Smarts," it promotes digital-intelligent technology and categorized evaluation to resolve traditional teaching pain points.

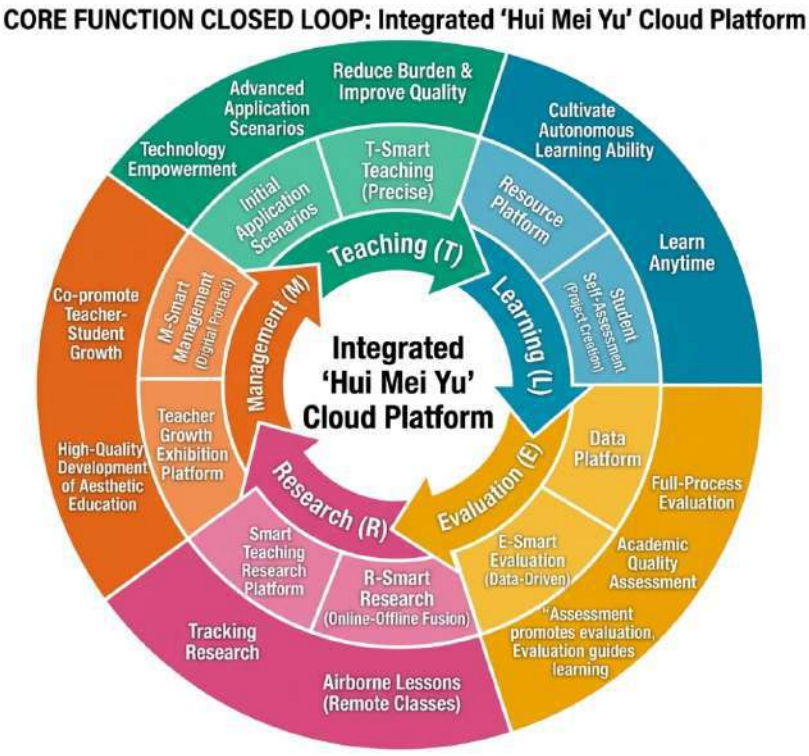


Figure 3 Functional Diagram of the "Smart" Aesthetic Education Integrated Cloud Platform

- **Smart Teaching:** Supports cloud-based preparation and resource sharing. Using a "Dual-track, Three-learning" (pre-class, in-class, post-class) interactive model and 5G-powered "Synchronous Classrooms," quality resources reach remote classrooms directly.
- **Smart Learning:** Provides micro-courses for anytime learning. The platform pushes personalized resources based on student data and allows students to upload certificates and practice records, making evaluation a continuous process.

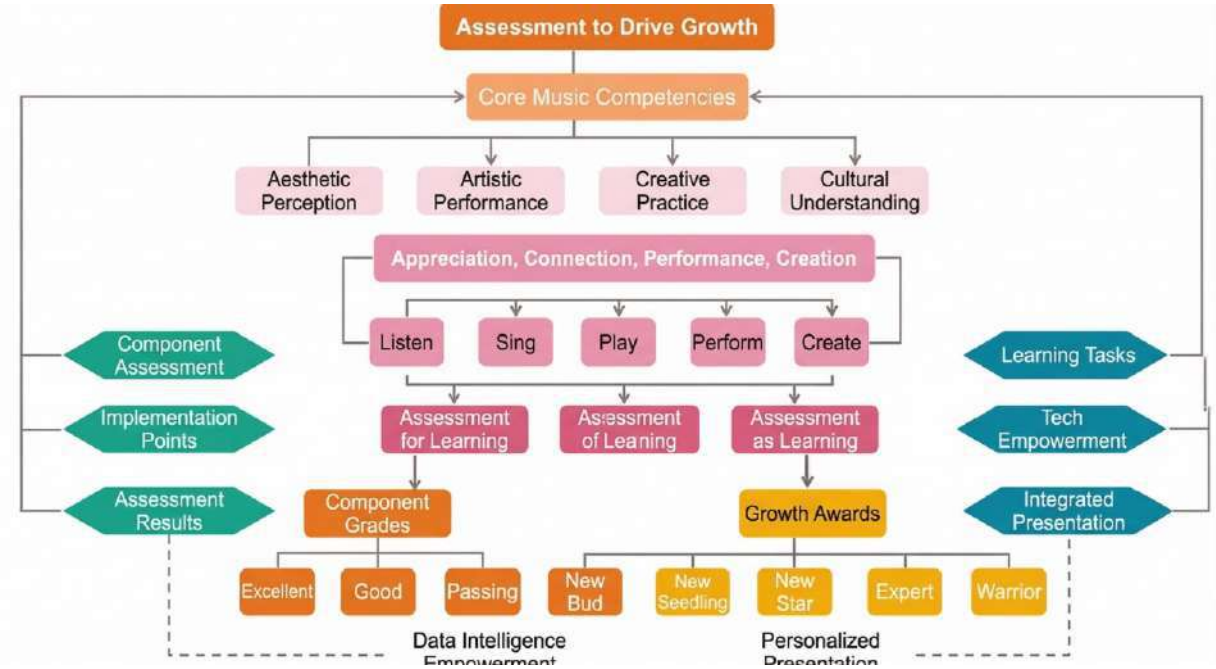


Figure 4 Structural Diagram of "Smart Learning"

- **Smart Evaluation:** Focuses on "Listening, Singing, Playing, Performing, and Creating". It utilizes AI automatic scoring for singing and rhythm, combining it with teacher input and process data to generate personalized report cards and digital "footprints".

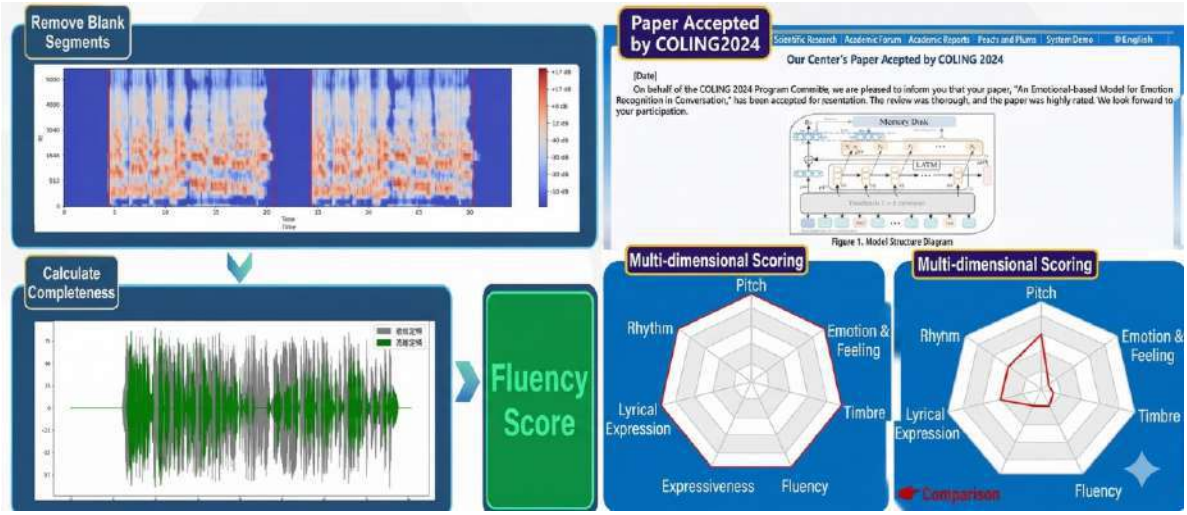


Figure 5 Evaluation Diagram of the Cloud Platform

- **Smart Research:** Facilitates collaborative cloud-based research and resource building, breaking teacher isolation and promoting urban-rural synergy.
- **Smart Management:** Generates digital portraits for both teachers (e.g., training, research, teaching growth) and students (e.g., learning data, comprehensive evaluation).

Figure 6 Data Analysis Chart of the Cloud Platform

3. Technical Solutions

The platform leverages six core technologies:

- AI Audio Recognition: Real-time feedback on pitch, rhythm, and expression.
- Big Data Analytics: Tracks learning trajectories for precision teaching.
- Smart Recommendation: Personalized tasks and resources.
- 5G & Cloud Broadcasting: Powers remote synchronous teaching.
- SaaS Cloud Platform: Ensures unified data standards and accessibility even for schools with weak networks.
- Data Security: Implements tiered authorization to protect privacy.

Innovative Highlights

1. From Tools to Ecosystem: AI is not just a tool but the systemic backbone of "Teaching, Learning, Evaluation, Research, and Management".

2. From Results to Growth: Focuses on continuous data collection and multi-dimensional analysis of a student's learning trajectory rather than a single exam.

3. From Unidirectional Delivery to Co-creation: Promotes two-way interaction between urban and rural schools through joint creation and online research.

4. From "Singing" to "Creating": Empowers students to become creators of melody, lyrics, and rhythm, expanding the boundaries of aesthetic expression.

Practical Results

1. Student Development

Enhanced Interest: The proportion of "highly interested" students rose from 60% to over 85%.

Personalized Growth: Instrumental music education now covers all schools; students have transitioned from simple unison singing to complex choral performances.

Flexible Learning: A three-tiered curriculum (classroom, practice, and cloud) allows students to learn anytime, fostering a "self-directed" learning atmosphere.

2. Teacher Growth

Research Breakthroughs: The project won the First Prize of the 9th Zhejiang Province Teaching Research Results. Teachers have won 230 awards in various competitions and published over 30 provincial-level papers.

Digital Literacy: Over 100 backbone teachers participated in developing specialized micro-courses, significantly enhancing their ability to use digital tools.

3. Regional Impact

Educational Equity: Effectively bridged the gap between urban and rural music education.

Systemic Transformation: Constructed a unified digital system for both music and arts, ensuring schools can fully implement the required curriculum.

National Recognition: Featured at the 6th China Education Innovation Expo and presented at the Ministry of Education's "Smart Education Demonstration Zone" seminars. The platform holds multiple national software copyrights.

Scalability and Future Outlook

1. High Universality: Addresses common pain points without requiring high-cost hardware.

Clear Logic: Follows a "Platform Deployment — Pilot — Training — Regional Replication" path.

2. Predictable Outcomes: Improves evaluation in the short term, promotes resource sharing in the medium term, and builds a "data-driven" aesthetic ecosystem in the long term.

Case 28

AI and Design Thinking Driven Online-Merge-Offline Project-Based Learning

Zhijun Wang

School of Humanities, Jiangnan University, Jiangsu, China

Background

In the era of intelligence, enhancing students' complex problem-solving abilities, collaborative innovation skills, and human-AI synergy has become a pivotal focus of educational reform. This case study is rooted in the core Educational Technology course, Online Course Design and Development. It aims to cultivate innovative product managers capable of utilizing online course design methodologies to address practical educational challenges in China, meeting the demands of the era of lifelong learning for all. Guided by the vision of becoming leaders in online course construction for the digital-intelligence era, the project leverages design and technology to empower learners, ensuring that learning returns to a state of intrinsic interest and passion. The initiative proposes and implements a teaching reform centered on "AI and Design Thinking Dual-Driven, OMO-Integrated Project-Based Learning." Students are guided to tackle real-world problems through a structured PBL framework consisting of four stages (Defining Problems-Gathering Inspiration, Ideating Solutions-Prototyping, Iterating-Outputting Products, and Application, Improvement-Evolution), seven links, and twenty-eight learning activities. This approach facilitates "0-to-1" innovation in online course design and solves complex practical problems. Consequently, students' innovative thinking has been revitalized, and three major pain points—lack of professional content, deficient complex problem-solving skills, and weak human-AI collaboration—have been effectively addressed.

Case Implementation Status

1. Demand Analysis

(1) Lack of Professional Content and Methods in a Specialized Innovative Field

Online course design and development is a professional field of innovation, where high-quality "user-centered" courses are constantly emerging in practice. However, due to the influence of traditional teaching-centered mindsets, the lack of professional teaching content and methods makes the courses lack depth. This limits students' thinking and makes it difficult for them to lead industry development.

(2) Difficulties in Using User-Centered Design, Achieving Cross-Field Innovation, and Applying Methods to Real Situations

To solve real-world complex problems through online course design, students need to practice user-centered design. However, because they lack opportunities and training in solving complex problems, they have the awareness of being user-centered but struggle to put it into practice. Their limited perspective makes it hard to break through the boundaries of their major to innovate. Even when they know the theories, they find it hard to use them to solve specific, real-life problems.

(3) Lack of Technology-Driven Learning Experiences, Leading to AI Dependency and Weak Human-AI Collaboration

Although they are Educational Technology majors, most of their past learning has been lecture-based. They lack deep experiences of learning through technology, making it hard to develop a deep understanding. At the same time, while students use various AI tools widely, their lack of AI literacy and self-thinking skills leads to a "dependency" on AI. They lack the mindset for human-AI collaboration, which limits their creativity.

第27题：您认为从事教育技术学专业相关的职业，自身最欠缺的是 [单选题]

选项	小计	比例
A.理论知识	20	12.66%
B.专业技能	53	33.54%
C.实践经验	78	49.37%
D.其他 [详情]	7	4.43%
本题有效填写人次	158	

Figure 1 Graduate Survey Courses

Figure 2 Students' Use of AI Tools

2. Teaching Effectiveness

(1) 100 Percent Coverage of Innovative Projects and Comprehensive Improvement in Students' Core Competencies

Through teamwork, students achieved "0-to-1" innovation 100 percent of the selected project topics reached the required standard of innovation. Compared to 2023 (before AI was integrated), the efficiency of topic selection significantly improved, with the time required being reduced from six class sessions to just two. Students demonstrated a comprehensive enhancement in the following areas:

- Online course design and development skills
- AI collaboration and a rational understanding of AI
- Innovation and complex problem-solving abilities
- Teamwork and interdisciplinary knowledge application
- Educational passion

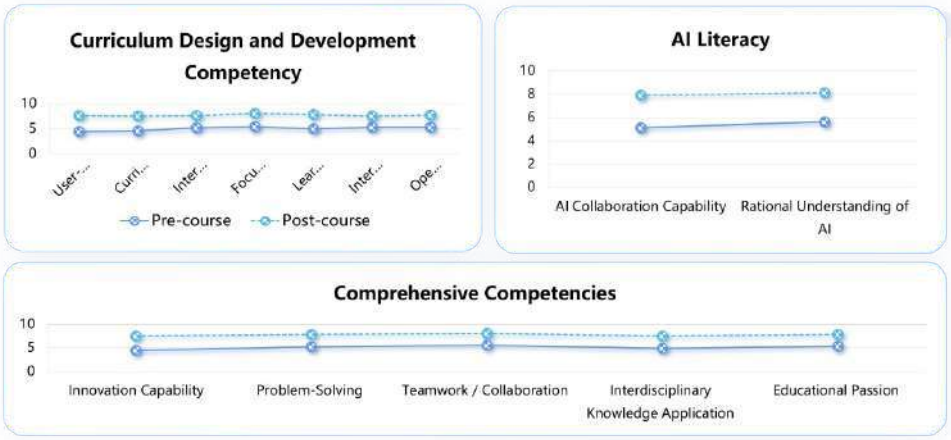
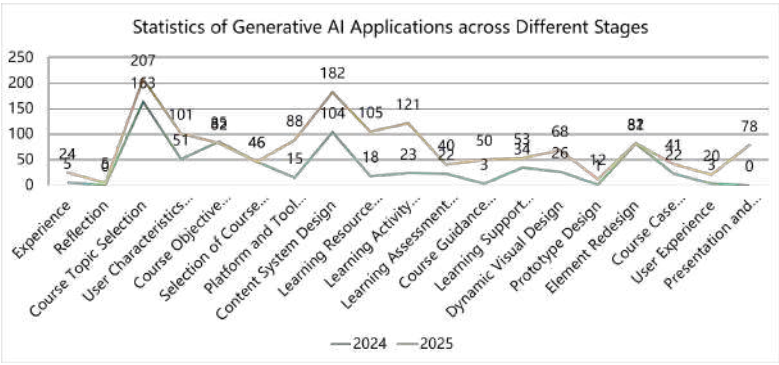


Figure 3 Data on Student Learning Outcomes

(2) Deep Full-Process AI Integration: Enhancing Human-AI Collaboration and Literacy

AI is deeply integrated into every stage of PBL. Student interactions with AI grew from 752 times in 2024 to 1,367 times in 2025, driving the intelligent design of courses. Students have developed a deeper understanding of the capabilities, limitations, and advantages of Generative AI. At the same time, their AI literacy, problem-solving skills, and innovative thinking have improved significantly, with AI playing multiple roles throughout the process.

Table 1 Statistics of Generative AI Applications across Different Stages (2024 vs. 2025)



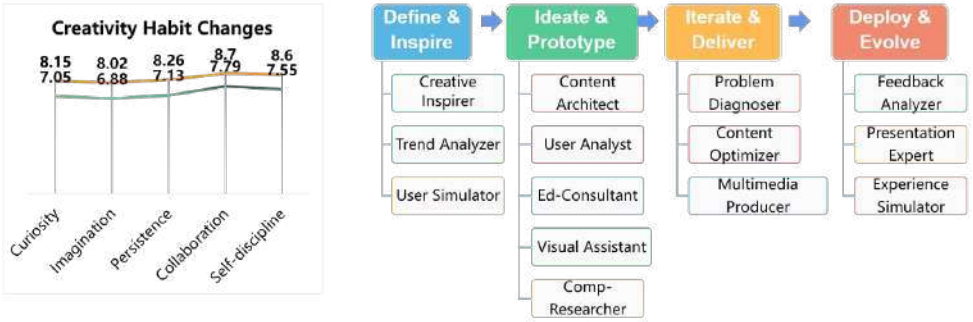


Figure 4 AI Playing Multiple Roles (2025 Data)

(3) High Classroom Engagement and Active Innovative Thinking: Stimulating Passion for the Profession

Over the past seven years, students have consistently maintained high levels of engagement and participation. It is common for students to become so focused that they lose track of time, often remarking at the end of the semester, "Teacher, we have accomplished the impossible!" The course deeply stimulates learning interest and a love for the major, allowing students to truly experience the appeal of their profession.

Figure 5 Student Questionnaire Feedback

(4) High Praise for Live-Streamed Competitions: Graduate Feedback Highlights Long-term Value

The course uses a data-driven and outcome-oriented comprehensive evaluation system, combining grading with awards to support long-term development. We hold an Online Course Creative Design Competition, featuring live streaming and evaluations by external experts. Various awards and certificates are issued to boost students' future careers. Interdisciplinary experts have highly praised the unique features of the course during online reviews, and the online audience enjoyed an immersive viewing experience. Years after graduation, students continue to send positive feedback, affirming the lasting value of the course in their professional lives.

Figure 6 Feedback from Graduates

3. Continuous Iteration

(1) Teaching Model Innovation: Achieving a Trinity Collaborative Symbiosis of "Teacher, Student, and Machine"

The course embodies a learner-centered philosophy, effectively stimulating student interest and motivation while allowing them to experience the value of their profession. The excellent results achieved during fully online teaching during the pandemic led to the creation of the "Online Course Creative Design Competition." By combining grading with awards, this initiative supports students' long-term professional development. High course recognition, a positive collaborative atmosphere, clear but challenging tasks, regular progress checks, and effective feedback mechanisms have all contributed to high student engagement, solving multiple practical challenges in both online and classroom teaching.

Since its inception in 2019, the course has undergone continuous exploration and iteration. It has evolved through various modes, including platform-supported classroom teaching, Online-Merge-Offline (OMO) teaching, fully online instruction, and AI-integrated teaching, achieving a deep integration of online resources and classroom practice. Currently, specialized AI agents are being developed to further advance AI-driven empowerment in education.

Figure 7 AI Analysis of Factors Driving Deep Student Engagement

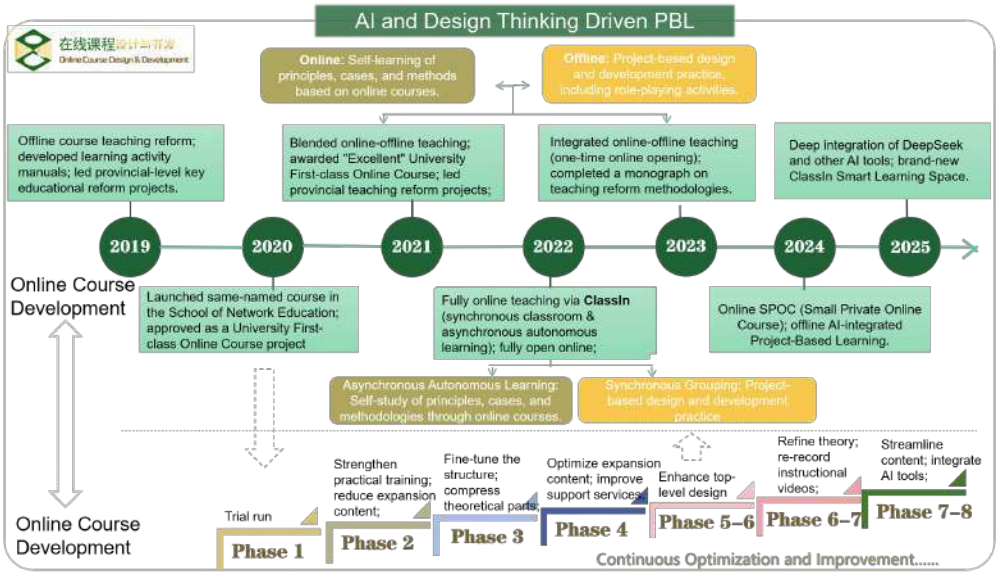


Figure 8 Continuous Iteration of the Course

Case Innovation and Breakthroughs

1. Main Innovation Content

(1) Innovation Philosophy: AI and Design Thinking Dual-Driven, OMO-Integrated Project-Based Learning

The course implements teaching innovation centered on AI and Design Thinking Dual-Driven, OMO-Integrated Project-Based Learning. Focusing on original, high-level learning content, students are guided to design innovative projects that solve real-world complex problems. Following a four-stage PBL framework driven by design thinking (Defining & Inspiring, Ideating & Prototyping, Iterating & Producing, and Application & Evolution), the course features a systematic learning activity chain, multimodal resources, an integrated digital-intelligence (DI) environment, and full-process evaluation.

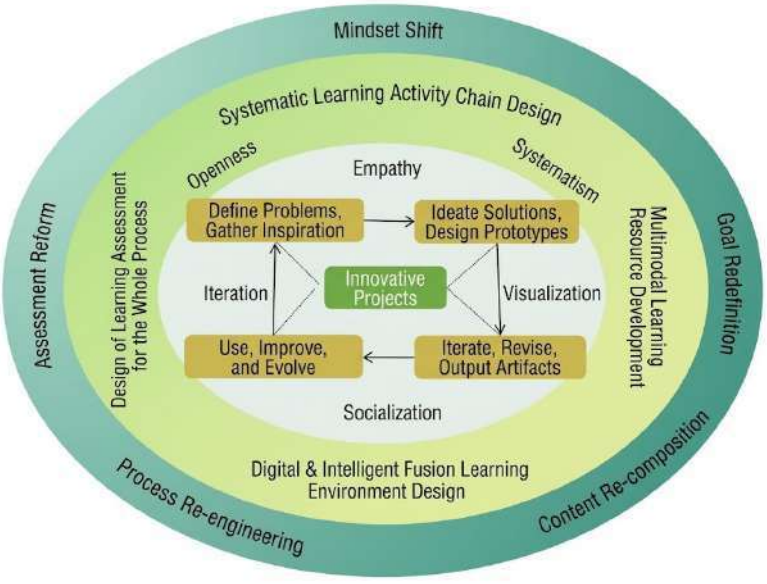


Figure 9 Innovation Philosophy

(2) Innovation Strategy: Solving Problems via Real-World Role-Playing and OMO Integration through Activity Chains

Utilizing the ClassIn OMO smart learning space, the course seamlessly connects platforms like China University MOOC, Feishu (Lark), and various Generative AI tools to create an integrated digital-intelligence environment. Based on the online course's objectives, a specialized Learning Activity Guidebook was developed. It guides students in forming project teams and conducting role-playing activities throughout the semester, achieving a deep fusion of AI, design thinking, and online-offline learning.

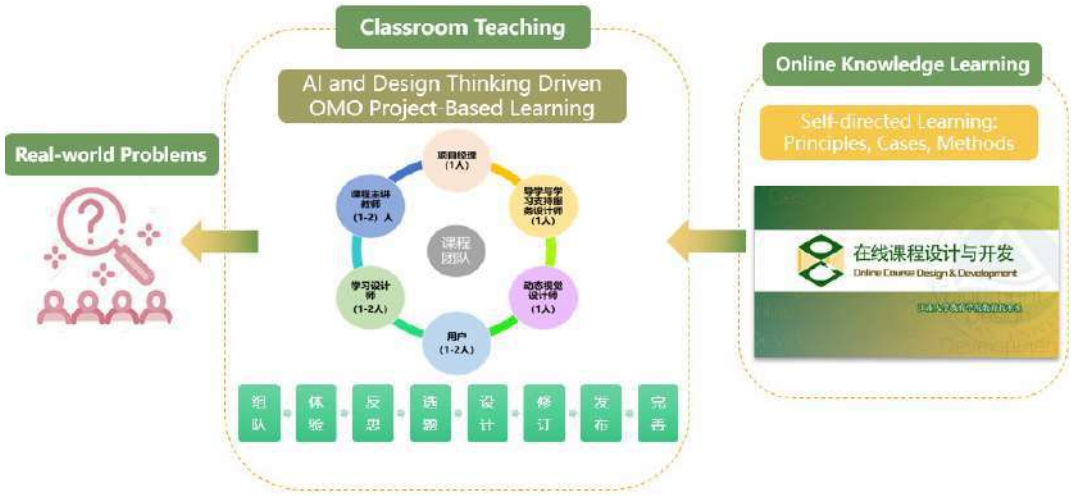


Figure 10 Innovation Strategy

(3) Innovation Content: Iterating Knowledge Graphs to Meet Modern Needs and Developing Original Online Courses and Textbooks

To meet the demands of the intelligent era, the course focuses on cultivating innovative online course development skills, problem-solving abilities, innovative thinking, human-AI synergy mindsets, and Tech-for-Good ethics. Based on the instructor's extensive research (44 published papers), a comprehensive knowledge graph was constructed. This system includes theories, methods, and cases, integrating expert wisdom with student achievements. The course has produced one original methodology textbook and one monograph to broaden students' horizons.

Figure 11 Knowledge Graph and Online Course Team

(4) Innovation Activities: Developing Learning Activity Guidebooks to Advance Deep Human-AI Collaborative Teaching

Based on the four-stage PBL framework, the course features a sequence of 28 learning activities across seven links (including experience, reflection, and topic selection). A specialized Learning Activity Guidebook clearly defines the goals, content, timing, steps, tools (AI, Design Thinking, course resources), and examples for each activity, facilitating efficient and deep human-AI collaborative teaching.

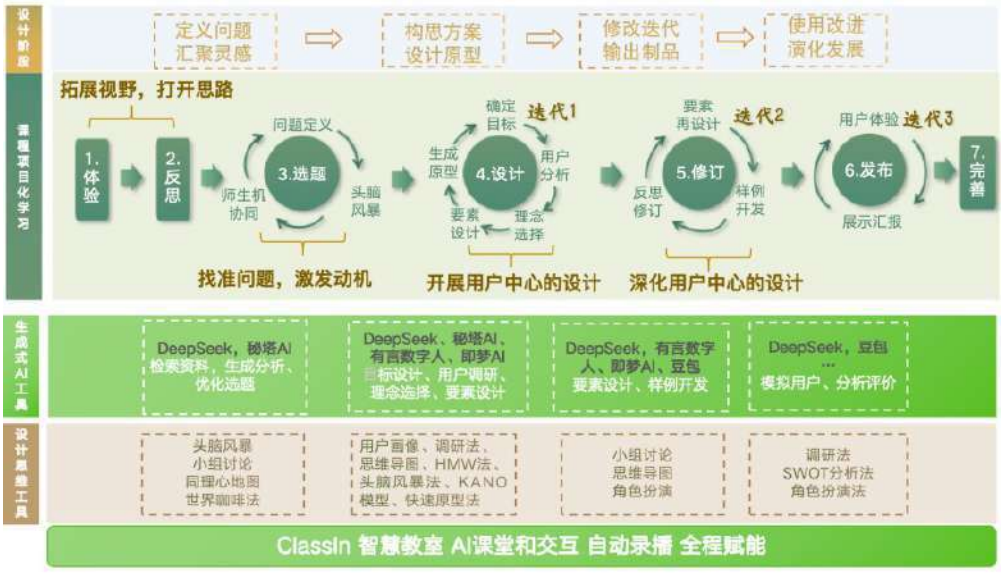


Figure 12 Activity Design and Implementation Plan

Figure 13 Learning Activity Guidebook

2. Technical Breakthroughs

This project developed a Specialized Agent Matrix for the course. By building a multi-layered collaborative architecture, it achieved the evolution from general-purpose agents to education-contextualized agents.

General GAI Support Layer: Integrates multiple Large Language Models (LLMs) such as Qwen, DeepSeek, and Gemini to provide basic content generation and broad knowledge support.

Task Agent Layer: Utilizing task-binding logic, eight specific task agents (including topic selection, user analysis, and solution evaluation) are deployed. These align with the PBL teaching steps to guide students through the cognitive construction of complex problems.

Role Agent Layer: Based on course textbooks, endogenous knowledge bases, and expert wisdom, professional role agents (such as Product Manager and Learning Designer) provide specialized logical guidance and decision support for the task agents.

Currently, this paradigm has expanded to multiple institutions, including Jiangsu Normal University and Yanbian University. Its demonstration value has been verified in over 100 cross-segment sharing sessions nationwide, proving its universal value in cultivating digital literacy and innovative thinking.

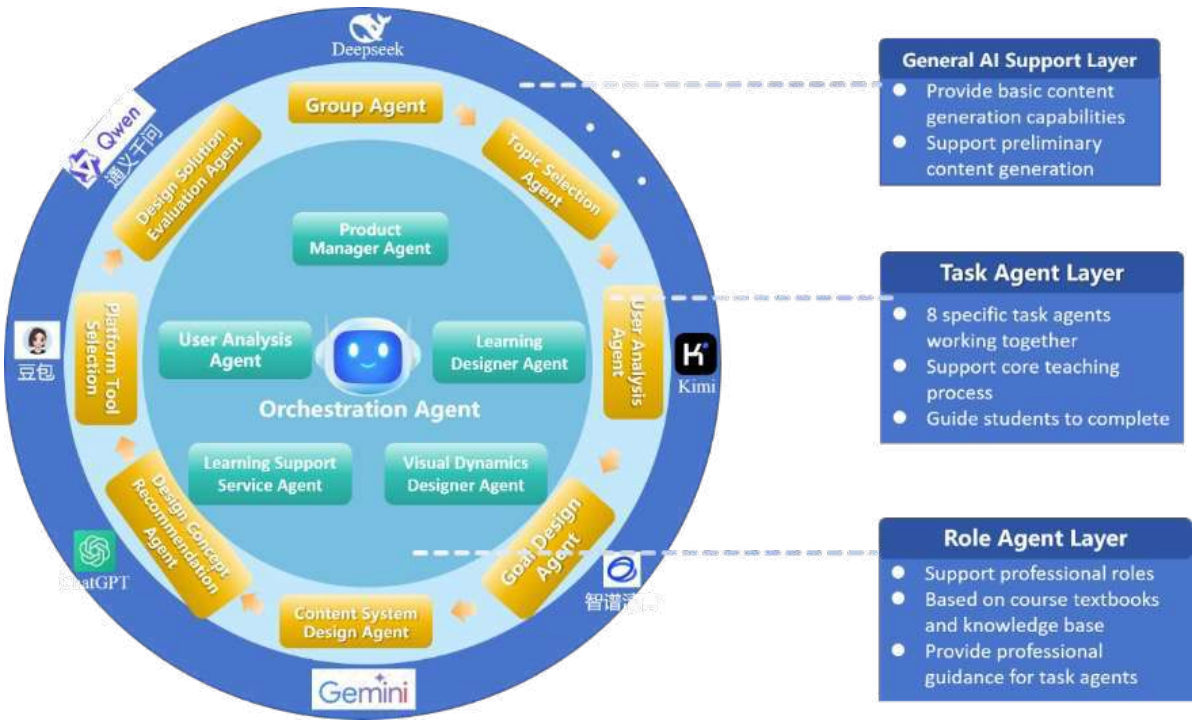


Figure 14 Agent Matrix

3. Application and Practice Breakthroughs

Based on this case, the research team collaborated with the Higher Education Training Center to develop the course "AI Digital-Intelligence Course Designer Online Bootcamp." In 2025, the first bootcamp successfully empowered 284 backbone teachers. Starting in 2026, it is expected to train 1,500–2,000 teachers annually, accelerating the upgrade of digital-intelligence course construction capabilities for frontline educators.

Furthermore, the results have demonstrated a strong cross-boundary leadership effect. Reports have been presented at major events such as the 5th National University Teacher Teaching Innovation Competition and UNESCO conferences. Over 200 sessions on AI-enabled teaching and smart course construction have been shared across higher, vocational, adult, and K-12 education. Additionally, more than 100 cross-disciplinary presentations have been delivered at the World AI Conference, the 2050 Vision Tech Festival, and in the tobacco, finance, management, and medical sectors, reaching over 10,000 teachers.

Figure 15 Course and Textbooks

Figure 16 Innovation Competition Activities and Cross-disciplinary Sharing

4. Intellectual Property and Academic Achievements In the past five years, the project lead has headed two National Social Science Fund projects (one completed, one ongoing). Over 20 papers have been published as the first author in CSSCI journals, along with five academic monographs, including:

The Connectivist View of Learning in "Internet + Education" (Beijing Normal University Press)

Connectivism: A New Paradigm for Corporate Learning (Shandong People's Press, forthcoming)

PBL Design Guided by Design Thinking in the Digital-Intelligence Era (Open University of China Press)

Online Course Design and Development (Electronic Industry Press)

Research achievements have won the Third Prize of the 6th National Excellent Achievement Award in Educational Science and the Jiangsu Provincial Philosophy and Social Sciences Award. In May 2026, the monograph AI-Enabled Digital-Intelligence Course Construction, which comprehensively synthesizes the course's philosophy, will be published by Tsinghua University Press. Related academic views and practical experiences have been featured in China Education Daily (June 2025) and China Teachers' Daily (February 2026), generating significant social impact.

Figure 17 Book Covers

Promotion Value and Risks

The core outcomes of this case are embodied in a “Research-Industry-Application” trinity. Based on the monograph AI-Enabled Digital-Intelligence Course Construction, the research team refined scattered teaching experiences into a replicable “Four-Step Construction Method” standard system, achieving the successful transformation of methodology into applicable knowledge. In terms of application depth and breadth, the project collaborated deeply with the China Higher Education Training Center and EEO (ClassIn) to transform the "AI Digital-Intelligence Course Designer Online Bootcamp" into a premier national "testing ground" for educational digitalization.

Regarding social impact, following the publication of the textbook and monograph, the team was invited to publish the article "How University Teachers Can Build Digital Courses" in China Education Daily. The project lead also participated in an exclusive interview with "Learning Power" (Xuexi Qiangguo) and a live broadcast for the "Educational Digitalization 100" platform, which reached a peak concurrent viewership of over 40,000+.

To address technical and ethical risks during implementation, the team constructed a rigorous risk prevention and control system:

Technical Level: By utilizing Retrieval-Augmented Generation (RAG) technology to integrate seven years of internal course data, the system effectively mitigates AI "hallucinations" and ensures academic accuracy.

Ethical Level: To counter students' cognitive dependency on AI, the team implemented the "AI Collaboration Code of Conduct," introduced "Collaboration Logs," and integrated "One Lesson, One Reflection" metacognitive training.

This mechanism makes the interaction process transparent and evaluable. It effectively overcomes cognitive inertia and ensures that while AI provides empowerment, the creative agency of the learner is always maintained. This provides a replicable ethical and security solution for digital-intelligence teaching.

Other Relevant Information

1. Case Award Status Award

Award Time	Award Name	Awarding Institution
2025	Grand Prize of the 10th XJTLU National University Teaching Innovation Award (1/5424)	Xi'an Jiaotong-Liverpool University
2025	First Prize of the 5th Jiangsu Provincial University Teacher Teaching Innovation Award	Jiangsu Association of Higher Education
2025	First Prize of the inaugural "Digital Education Innovation Achievement Award"	China Educational Technology Association

Award Time	Award Name	Awarding Institution
2025	The First Batch of National University Smart Course "Best Cases"	National University Course Resource Construction Alliance
2024	The First Batch of University Teaching Wisdom Application Cases by the China Association of Higher Education	China Association of Higher Education
2021	"Design Star" Award National University Blended Teaching Design Innovation Competition	Center for Teaching and Learning Development, Shanghai Jiao Tong University
2021	First-class Undergraduate Course of Jiangnan University	Jiangnan University

2. Third-Party Evaluation

(1) Expert Evaluation

Zhang Daliang (Vice President of the China Association of Higher Education): Wrote the preface for the core monograph of this case, "AI Empowering Digital Intelligence Course Construction," speaking highly of the Chinese solution of "AI + Design Thinking" in the case.

Chen Li (Professor at Beijing Normal University): Has long paid attention to and supported the research team's teaching reform based on connectivism, believing that this research achieved a theoretical leap from "revealing laws" to "revealing mechanisms." International Influence: Invited to deliver keynote speeches on platforms such as UNESCO, the Harvard China Education Forum, the World Artificial Intelligence Conference (WAIC), and the Global Developer Pioneer Conference, spreading the new paradigm of talent cultivation in the digital intelligence era to the world.

(2) Social and Media Evaluation

In terms of core newspapers, "China Education Daily" (June 2025) published a special article systematically introducing the original experience of this case in generative AI empowering project-based learning. "China Teacher's Daily" (February 2026) published a special article titled "Starting from the Change of a Class—Building a New Educational Ecology with Practical Knowledge Creation," deeply analyzing the case's contribution to building a new ecosystem for teacher professional development. In terms of mainstream new media platforms, related achievements have received exclusive interviews and reports from authoritative media such as "Xuexi Qiangguo," generating a widespread social radiation effect. Meanwhile, invited to participate in the "Education Digitalization 100 People" live broadcast sharing, the peak concurrent viewers exceeded 40,000+, triggering a phenomenal industry discussion.

(3) User Evaluation

Past students have maintained a very high level of engagement, and many graduates reported that the course projects became their core competitiveness for job hunting and further studies, rating it as "the most perfect assignment during undergraduate studies." The first "AI Digital Intelligence Course Designer Online Practical Camp" empowered 284 backbone teachers from over 50 institutions nationwide. Third-party questionnaire surveys and work analysis show that camp participants have an extremely high level of satisfaction with the course.

Case 29

Scenario-Driven AIED Transformation: Empowering African Educators through AI-Supported Pedagogy in Low-Resource Contexts

Sanura Jaya

Teacher Education Institute (Project initiated under SEAMEO RECSAM), Malaysia

Background

The rapid advancement of Artificial Intelligence (AI) is transforming global education systems, yet its integration remains uneven, particularly in low-resource contexts. In many African classrooms, educators face persistent challenges such as limited access to digital infrastructure, insufficient training in emerging technologies, and a lack of practical models for integrating AI into teaching and learning. (Muyunda et al., 2023; Yusuf et al., 2026).These constraints hinder the transition from traditional content-based instruction to competency-based learning (CBL), which emphasizes problem-solving, creativity, and real-world application.

Previous initiatives, including the *Smart Education for All* project, demonstrated the potential of accessible technologies such as mobile-based coding and microcontroller applications (e.g., Magnetcode) to support project-based STEM learning in low-resource environments. However, while these approaches improved access and engagement, they remained limited in enabling dynamic, multimodal, and intelligent learning experiences (Angwaomaodoko, 2025).

In response, this case introduces an AI-enhanced, scenario-driven educational model designed to bridge this gap. The implementation was conducted in two progressive phases involving educators from African countries. The first phase involved 10 participants from the Third Country Training Programme (TCTP), comprised five male and five female from Botswana (1), Ghana (3), Namibia (2), Nigeria (3) and Sierra Leone (1). This program focusing on needs analysis and initial exposure, which revealed low familiarity with coding, robotics, and AI tools. The second phase was implemented through an internship programme involving five educators from the Tertiary Education Trust Fund (TETFUND) Centre of Excellence, Federal University of Education, Pankshin, Nigeria (T_CEIPEC), where deeper engagement and application were carried out.

The objective of this initiative is to transform teacher professional development by integrating AI-supported tools, multimodal learning (speech-to-text-to-image), and hands-on project-based approaches into a scalable and context-responsive model. By aligning accessible technology with AI innovation, the project aims to empower educators to design interactive, inclusive, and competency-based STEM learning experiences suitable for diverse and resource-constrained educational settings.

Case Implementation Status

The implementation of this case adopts a scenario-driven AIED approach that integrates demand analysis, technology adaptation, and continuous application optimization to support educators in low-resource contexts. The initiative was initially developed under SEAMEO RECSAM and later extended through the Teacher Education Institute, Malaysia, enabling cross-contextual application across African educational settings.

The implementation was carried out in two progressive phases, allowing for systematic development, refinement, and validation of the model.

Phase 1: Exploratory Needs Analysis (Third Country Training Programme – TCTP, n=10)

The first phase involved 10 participants from the Third Country Training Programme (TCTP), representing Botswana, Ghana, Namibia, Nigeria, and Sierra Leone. This phase focused on identifying participants' baseline competencies, challenges, and readiness for integrating AI and digital technologies into teaching. Findings revealed limited prior experience in coding, robotics, and AI tools, highlighting a critical need for foundational capacity building.

Phase 2: Implementation and Validation (Tertiary Education Trust Fund – TETFUND, n=5)

Building on insights from Phase 1, the second phase was conducted through an internship programme involving five educators from the Tertiary Education Trust Fund (TETFUND) Centre of Excellence, Federal University of Education, Pankshin, Nigeria (T_CEIPEC). This phase focused on deeper engagement through scenario-driven, project-based learning, integrating AI tools with Magnetcode applications. The progression from exploratory analysis to applied implementation demonstrates the scalability and adaptability of the model across different contexts.

1. Demand Analysis and Contextual Understanding

The needs analysis conducted at the beginning of the internship programme provided critical insights into participants' baseline technological readiness. Descriptive findings indicated that 80% of participants had no prior experience with robotics, while only 20% reported limited exposure. This reflects a substantial gap in hands-on experience with emerging technologies among the educators.

Further quantitative analysis reinforced this finding. Table 1 illustrates the participants reported low levels of familiarity across key technological domains, with mean scores of 1.80 (SD = 0.447) for experience with coding or programming, 1.80 (SD = 0.447) for experience with robotics, and 1.20 (SD = 0.447) for familiarity with AI-based tools. These values, measured on a five-point scale, indicate that most participants had minimal prior exposure to AI and related technologies.

Table 1 Pre-Training Familiarity with AI, Coding, and Robotics

Item	Mean	Std. Deviation
Experience with coding or programming	1.80	0.447
Experience working with robotics	1.80	0.447
Familiarity with AI-based tools	1.20	0.447

The convergence of both descriptive and quantitative data highlights a critical need for foundational capacity building in AI and robotics integration. It also reveals that educators lacked the confidence and practical skills required to implement technology-enhanced teaching strategies in their classrooms (UNESCO, 2025; Yusuf et al., 2026).

In response, the training programme was intentionally designed using an andragogy-based approach (Knowles, 1978), emphasizing experiential learning, guided practice, and scenario-driven activities. By aligning the training with participants' initial competency levels, the programme enabled a gradual progression from basic understanding to practical application, thereby supporting meaningful and sustainable integration of AI technologies in teaching and learning contexts.

2. Technology Adaptation and Personalized Customization

To address the identified gaps in technological readiness, the project adopted a context-sensitive approach to technology adaptation, focusing on accessible, low-resource, and scalable AI tools (Navas-Bonilla et al., 2025; Shihab et al., 2023). The selection of technologies was guided by the need to support educators with minimal prior exposure while enabling meaningful integration of AIED.

A key innovation in this implementation was the introduction of a multimodal AI integration model, where participants explored the transformation of speech → text → image → code within authentic teaching scenarios. This approach enabled educators to understand how different AI functionalities can be combined to support interactive and student-centered learning experiences.

Participants engaged with a range of AI tools for different pedagogical purposes. Generative AI platforms such as ChatGPT, Gemini, and DeepSeek were used to generate educational content, including biodiversity facts, lesson narratives, and pseudocode for programming tasks (Songsiengchai, 2025). These tools supported educators in transforming natural language inputs into structured instructional materials and coding logic (Onah, 2025).

In addition, AI-powered text-to-speech and speech recognition tools, including ElevenLabs, Clipto.AI, and Google Text-to-Speech, were introduced to enable voice-based interaction within learning activities. These tools allowed participants to create voice-triggered educational programs, where spoken inputs generate corresponding textual, visual, and audio outputs (Lee et al., 2024; Triplett, 2023).

To support coding and computational thinking, platforms such as Replit and GitHub Copilot were utilized to assist in code generation, debugging, and the translation of pseudocode into executable programs. These tools helped reduce technical barriers (Saad et al., 2026) and enabled educators to focus on instructional design rather than complex programming syntax as illustrates in Figure 1.

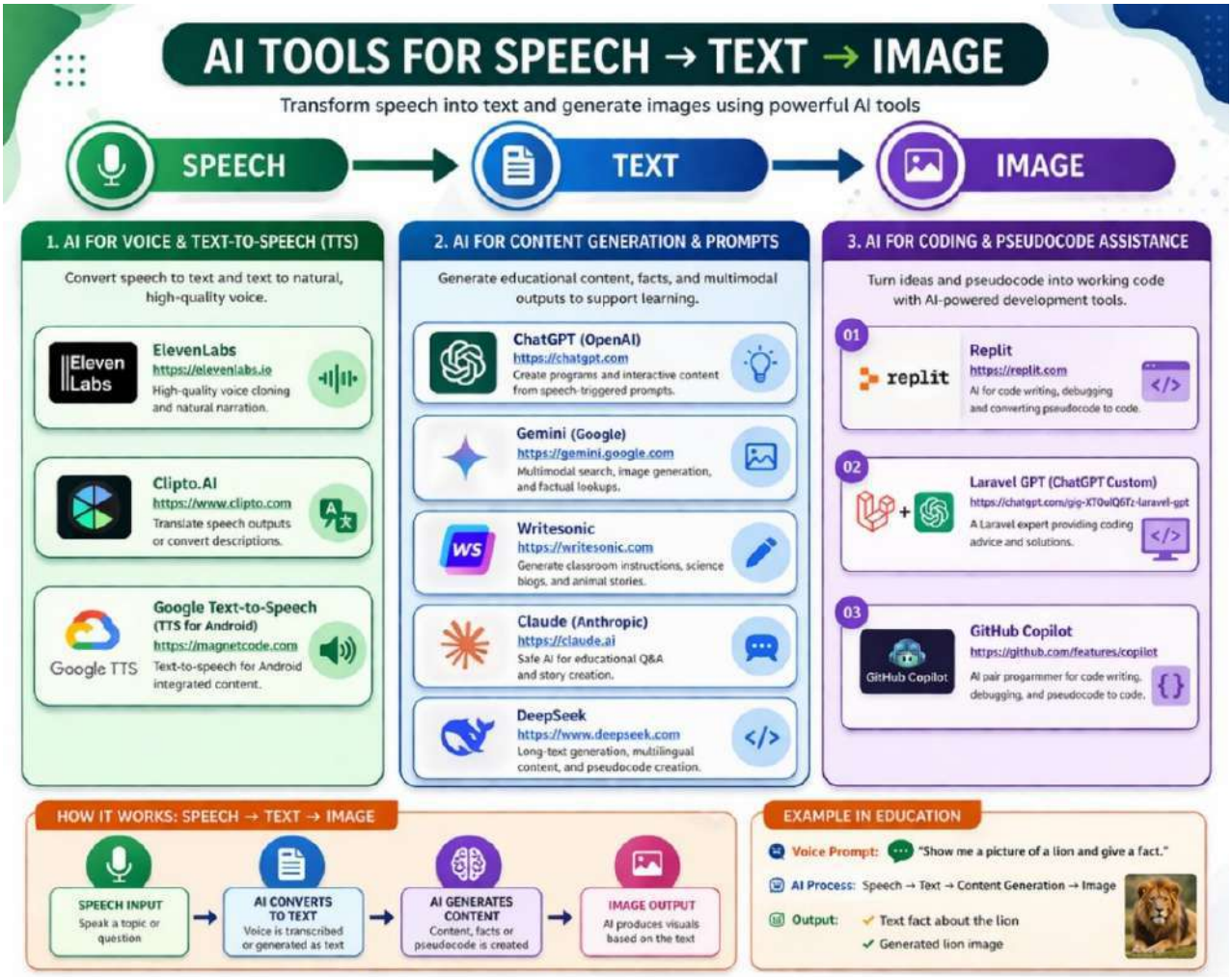


Figure 1 Overview of AI tools introduced for content generation, voice interaction, and coding support within the training programme.

Central to the implementation was the use of the Magnetcode application, a mobile-based coding platform that enables programming through smartphones without requiring continuous internet access or advanced hardware (Sanura & Parvinder, 2024; Sanura & Phiri, 2024). This made the approach highly suitable for low-resource educational contexts such as those in Nigeria (see Appendix A (Cloud Drive) for detailed implementation).

3. Scenario-Driven Implementation Practices

The implementation of the programme was structured around scenario-driven learning practices, designed to bridge the gap between theoretical knowledge of AI and its practical application in classroom settings. Rather than introducing AI tools in isolation, participants engaged in authentic, problem-based scenarios that reflect real teaching and learning contexts.

Prior to engaging with the AI-integrated project, participants were first introduced to foundational Magnetcode microcontroller activities to build their confidence in basic coding logic and system interaction. This initial exposure allowed educators to familiarize themselves with key concepts such as conditional statements, input-output relationships, and simple circuit simulation within a mobile-based environment. By establishing this foundational understanding, participants were better prepared to

integrate AI functionalities into their projects. The detailed Magnetcode coding examples and implementation steps are provided in the Appendix A. Figure 2 illustrates how participants engaged with the Magnetcode microcontroller in implementing simple project-based learning activities focused on water systems and biodiversity concepts.

Figure 2 Participants developing foundational skills through project-based learning activities using the Magnetcode microcontroller.

Source: The author's field data,2025

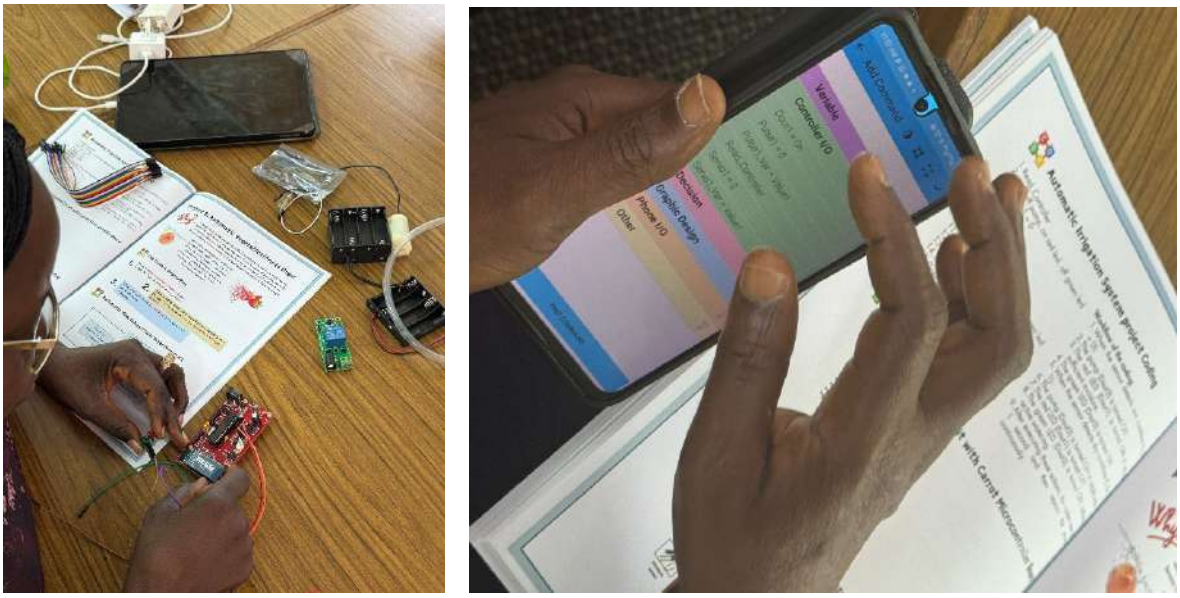


Figure 3 Participants developing foundational skills through project-based learning activities using the Magnetcode microcontroller.

Source: The author's field data,2025

Figure 3 illustrates participants' engagement with AI-supported tools to develop foundational skills in coding and content generation. Participants utilized mobile and web-based platforms to generate pseudocode, structure logic, and design instructional content using Magnetcode application and Claude AI to identify the code . This is demonstrating how AI can support educators in simplifying complex programming tasks. This stage reflects the transition from basic microcontroller understanding to AI-assisted development, enabling participants to build confidence in integrating AI into their teaching practices.

Figure 4 demonstrates the multimodal AI integration workflow implemented during the training, where participants applied a structured process linking speech input to text generation, image retrieval, and audio output. This workflow highlights how different AI functionalities are interconnected to create interactive learning applications. Through this process, participants translated natural language inputs into meaningful multimedia outputs, reinforcing computational thinking and enabling the development of scenario-based educational solutions.

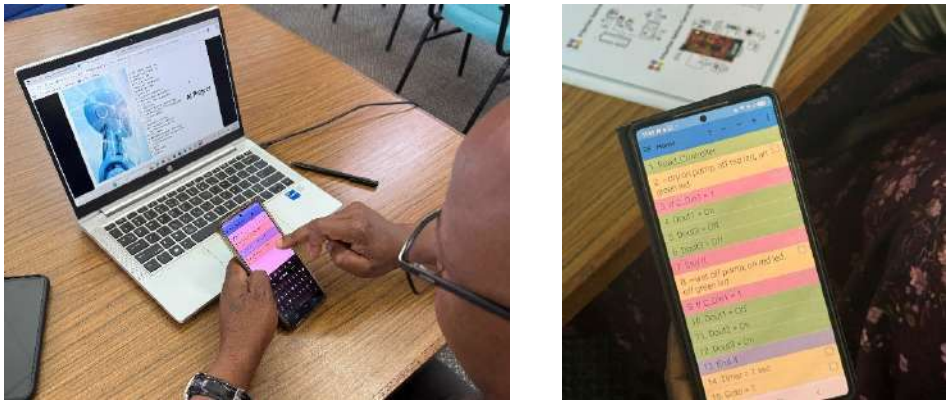


Figure 4 Multimodal AI integration workflow demonstrating the transformation from speech input to text, image, and audio outputs.

Source: The author's field data,2025

A central instructional design strategy was the "Say It, See It, Hear It" module, where educators developed interactive learning activities using a multimodal AI workflow that integrates speech input, text generation, image display, and audio output and align with STEM project based. In this scenario, participants designed a biodiversity learning system in which students can speak the name of an animal, triggering corresponding visual, textual, and auditory information. This approach enabled educators to experience how AI can support active learning, student engagement, and multimodal knowledge construction.

The implementation followed a structured workflow that guided participants through progressive stages of AI integration. First, educators used generative AI tools to research and generate content, such as identifying animal species and creating age-appropriate descriptions. Next, they sourced or generated educational images to support visual learning. This was followed by the creation of text-to-speech outputs, allowing learners to hear descriptive information. Finally, participants translated these elements into Magnetcode-based pseudocode, enabling the development of a functional, voice-activated educational application.

To ensure relevance and contextualization, the scenarios were adapted to reflect both global and local perspectives, including biodiversity themes such as rainforest ecosystems, marine life, and endangered species. Educators were encouraged to modify the scenarios based on their own teaching contexts, fostering ownership and adaptability of the learning design.

The scenario-based approach also incorporated key principles of andragogy, where participants learned through hands-on exploration, collaboration, and reflection (Porman, 2020). As shown in Figure 5, by engaging in meaningful tasks that directly relate to classroom practice, educators developed not only technical skills but also pedagogical confidence in integrating AI into their teaching.

Overall, the use of scenario-driven implementation practices transformed the training from a tool-focused workshop into an experiential learning journey, enabling participants to design, test, and refine AI-supported instructional solutions that are both practical and scalable in real educational environments.

Figure 5 Example of a scenario-based learning application where voice input triggers text, images, and audio in a biodiversity learning context

Source: The author's field data,2025

The Figure 5 illustrates a participant interacting with a mobile-based learning application developed through the Magnetcode and AI-integrated workflow. The application displays a visual output of an animal ("a cow") ("a duck") on the smartphone screen, demonstrating how speech or text input triggers corresponding images within the system.

This scenario represents the practical implementation of the "Say It, See It, Hear It" module contents, where learners engage with a multimodal AI system that connects speech recognition, text processing, and image generation. In this case, when a user inputs or speaks the keyword "cow," the system responds by displaying the relevant image, reinforcing conceptual understanding through visual representation.

The activity highlights how participants translated AI-generated content and pseudocode into a functional application using a mobile-based platform. It also demonstrates the effectiveness of contextualized, hands-on learning, where educators design interactive tools that can be directly applied in classroom settings, particularly in resource-constrained environments.

4. Application Optimization and Continuous Support

This case represents an extension and enhancement of the previously implemented *Smart Education for All: Empowering Inclusive, Lifelong STEM Learning Through Accessible Technology* initiative, which focused on integrating accessible mobile-based coding and microcontroller applications into project-based STEM learning in low-resource contexts. Building upon this foundation, the current implementation introduces an AI-enhanced, scenario-driven approach that transforms traditional coding activities into interactive, multimodal learning experiences.

The optimization process was informed by findings from Phase 1 (Third Country Training Programme – TCTP) and further refined during Phase 2 (Tertiary Education Trust Fund – TETFUND) implementation. Insights from the initial needs analysis revealed low levels of familiarity with coding, robotics, and AI tools, which guided the redesign of the training structure to include progressive scaffolding, starting from foundational Magnetcode activities and advancing toward AI-integrated applications.

A key optimization was the integration of a multimodal AI workflow (speech → text → image → audio), which simplified complex programming processes and enabled educators to develop interactive learning applications with reduced technical barriers. The use of generative AI and coding assistance tools allowed participants to generate instructional content, pseudocode, and functional programs more efficiently, thereby enhancing both usability and pedagogical effectiveness.

In addition, the continued use of the Magnetcode application ensured accessibility and scalability, particularly in low-resource environments. Its mobile-based, low-bandwidth, and offline-compatible features enabled seamless implementation across diverse educational contexts, including settings with limited infrastructure. Detailed coding workflows and implementation examples are provided in the Appendix A to support replication.

Continuous support was embedded through a structured and collaborative learning model. Participants engaged in iterative project development, peer collaboration, and guided facilitation, allowing them to refine their work through feedback and reflection. Supporting materials, including AI prompt guides, step-by-step workflows, and exemplar projects, were provided to facilitate independent practice beyond the training sessions.

To ensure sustainability, the initiative adopted a capacity-building approach, equipping participants with transferable skills and adaptable frameworks that can be applied across subjects and teaching contexts. Participants also demonstrated readiness to extend the module within their own institutions, contributing to a multiplier effect. This integrated support system ensures that the innovation extends beyond a one-time intervention and can be continuously implemented, adapted, and scaled within real educational environments.

5. Evidence of Implementation Outcomes

The implementation demonstrated significant improvements in educators' skills, confidence, and readiness to integrate AI into their teaching practices. Participants who initially had minimal exposure to AI technologies reported increased confidence in using AI tools, engaging in problem-solving activities, and designing technology-enhanced lessons. Educators also expressed strong intentions to apply these practices in their classrooms and to train other teachers, supporting scalability and long-term impact.

Post-Training Perceptions of Skills, Confidence, and Readiness

Following the professional development workshop, participants reported substantial improvements in their confidence and readiness to use AI speech recognition robotics in educational settings.

Table 2 Participants' Skills, Confidence, and Readiness After the Workshop

Item	Mean	Std. Deviation
The workshop increased my confidence in using AI Speech Recognition Robotics	4.80	0.447
I feel confident troubleshooting robotics tools	4.40	0.894
I feel confident guiding learners in robotics or AI activities	4.00	1.000
I feel prepared to integrate AI robotics into teaching	4.00	1.000
I have the necessary skills to plan lessons with AI or robotics	3.80	1.095
My institution supports the implementation of AI tools	3.60	1.140

Source: The author's field data,2025

Overall, the case illustrates how a scenario-driven AIED model, grounded in contextual adaptation and andragogy principles, can effectively support the transition from traditional teaching practices to innovative, AI-supported pedagogy in low-resource educational settings.

Qualitative Findings: Contents Analysis

A qualitative content analysis was conducted on participants' open-ended responses to identify recurring themes related to their experiences during the AI speech recognition robotics workshop. The responses were coded and categorised into several themes, including experiential learning, skill development, confidence building, challenges encountered, and future application in teaching. Table 3 summarises the themes, categories, and representative excerpts from participants' responses.

Table 3 Summary of Qualitative Content Analysis from Participants' Responses

Theme	Codes / Categories	Description	Sample Evidence
Experiential Learning and Hands-on Engagement	Hands-on practice, trial-and-error learning, practical exploration	Participants highlighted that assembling, wiring, and programming the robot allowed them to understand AI technologies more effectively through direct experience.	"It enhanced my understanding a great deal because it was hands-on."
Development of AI and Robotics Skills	Coding, wiring, debugging, testing, robotics components	Participants reported gaining technical skills such as coding robots, identifying electronic components, and testing AI speech recognition commands.	"Skills of identifying parts, wiring process, coding process, pairing and testing."
Increased Confidence in Using AI Technologies	Engagement, positive learning experience, ease of using AI tools	Participants expressed that the workshop improved their confidence and made AI technologies appear easier to use in educational settings.	"It exposed me to the fact that it's easy to teach using AI technologies."
Challenges Encountered During Training	Wiring difficulties, lack of coding foundation, time constraints	Some participants experienced challenges while assembling the robot or learning coding due to limited prior knowledge and limited training time.	"Coping with coding and assembling tools because of lack foundation."
Future Application in Teaching	Classroom integration, training others, continuous practice	Participants indicated their intention to apply robotics and AI technologies in their teaching and share the knowledge with colleagues.	"Integrate hands-on classroom project in teaching."

Overall, the qualitative findings support the quantitative results by demonstrating that the hands-on, project-based training approach enhanced educators' technological skills and confidence in using AI tools. At the same time, the challenges reported by participants highlight the need for extended training duration and continuous support when introducing advanced technologies such as robotics and AI into professional development programmes.

Case Innovation and Breakthroughs

1. Main Innovation Content

This case introduces a scenario-driven Artificial Intelligence in Education (AIED) model that integrates accessible technology, multimodal AI workflows, and andragogy-based professional development to

transform teaching practices in low-resource contexts.

A key innovation lies in the shift from traditional, tool-focused training to a scenario-based instructional design, where educators engage in authentic, real-world teaching situations. Instead of learning AI tools in isolation, participants design and implement learning applications that reflect classroom realities, such as biodiversity education and environmental problem-solving. This approach ensures that AI integration is pedagogically meaningful and directly applicable.

Another significant innovation is the introduction of a multimodal AI integration model (speech → text → image → audio → code), which enables educators to create interactive and dynamic learning experiences. Through the "Say It, See It, Hear It" module, learners can interact with educational content using voice input, triggering corresponding visual, textual, and auditory outputs. This represents a shift from static content delivery to interactive, student-centered learning ecosystems.

The case model also integrates andragogy principles, emphasizing experiential learning, problem-centered tasks, and immediate applicability. Educators are not passive recipients but active creators, designing AI-supported learning tools that can be directly implemented in their classrooms. This combination of pedagogy and technology distinguishes the model from conventional AI training programmes.

2. Technology Breakthrough Content

The technological breakthrough of this case lies in the integration of multiple AI functionalities into a cohesive, low-resource-compatible system. Rather than relying on high-end infrastructure, the model combines generative AI, speech recognition, text-to-speech, and coding assistance tools within a simplified workflow that can be executed using mobile devices.

A key advancement is the use of AI-assisted code generation and pseudocode translation, which significantly reduces the complexity of programming for educators with limited technical background. By leveraging tools such as generative AI platforms and coding assistants, participants are able to transform natural language instructions into executable programs, lowering the entry barrier for AI and robotics integration.

The integration of these AI capabilities with the Magnetcode mobile-based microcontroller platform further enhances accessibility. The platform enables offline coding, circuit simulation, and smartphone-based deployment, making it highly suitable for low-bandwidth and resource-constrained environments. This combination represents a practical and scalable technological solution for educational digital transformation in developing regions.

From an industry perspective, the case demonstrates a shift from isolated AI tool usage to a holistic AIED ecosystem, where multiple technologies are interconnected to support end-to-end learning experiences. This positions the model at an emerging frontier of educational technology innovation, particularly in contexts where accessibility and adaptability are critical.

3. Application Practice Breakthrough Content

The primary breakthrough in application practice is the successful implementation of a scalable, scenario-driven AIED model across multiple contexts, including participants from diverse African countries. The two-phase implementation comprising exploratory needs analysis (TCTP) and applied validation (TETFUND), demonstrates a structured progression from design to real-world application.

One of the most significant achievements is the transformation of educators' roles from content deliverers to designers of AI-supported learning experiences. Participants were able to develop functional applications, such as voice-activated biodiversity learning systems, where students interact with content through speech, images, and audio. This represents a shift toward competency-based learning, where students actively construct knowledge rather than passively receive information. The model also addresses a critical challenge in professional development: the gap between training and classroom implementation. By embedding learning within authentic scenarios and providing hands-on, project-based experiences, the initiative ensures that educators can directly transfer their learning into practice.

Furthermore, the approach demonstrates strong potential for scalability and replication, particularly in low-resource educational systems. The use of mobile-based tools, simplified workflows, and contextualized learning scenarios allows the model to be adapted across different subjects, institutions, and countries. This contributes significantly to the advancement of basic education by providing a practical pathway for integrating AI into everyday teaching practices.

4. Intellectual Property Status

The intellectual property associated with this case primarily relates to the instructional design framework, training modules, and implementation strategies developed by the author and affiliated institutions. The Magnetcode application, which serves as a core technological component, is an established platform developed and utilized within the *Smart Education for All* initiative.

The AI integration model, including the multimodal workflow (speech → text → image → audio → code) and the "Say It, See It, Hear It" instructional framework, represents an original pedagogical innovation developed through this project. Supporting materials such as training modules, coding templates, and instructional guides are maintained by the implementing institution and are used for educational and non-commercial purposes.

The project emphasizes open and accessible educational practices, enabling educators to adapt and implement the model within their own contexts. This approach supports knowledge sharing, capacity building, and broader dissemination of AIED practices while maintaining appropriate recognition of the original framework and implementation design.

Promotion Value and Risks

This case demonstrates strong potential for scalable application and sustainable impact in low-resource educational contexts. The implementation has already been conducted across multiple phases involving educators from diverse African countries, including participants from the Third Country Training Programme (TCTP) and the Tertiary Education Trust Fund (TETFUND) Centre of Excellence in Nigeria. These cross-context applications validate the adaptability and transferability of the model across different educational systems.

In terms of application scale, the model has been implemented through structured professional development programmes and can be extended through a multiplier approach, where trained educators replicate the model within their own institutions. The use of mobile-based platforms such as Magnetcode, combined with accessible AI tools, ensures that the approach can be deployed in

environments with limited infrastructure. This enables broader adoption at institutional, national, and regional levels.

The social value of this case lies in its contribution to equitable access to quality STEM and AI education, particularly in underserved communities. By equipping educators with practical skills and tools, the initiative enhances teaching quality, promotes student engagement, and supports the development of 21st-century competencies such as critical thinking, creativity, and problem-solving. Economically, the model reduces the cost of technology integration by utilizing low-cost, mobile-based solutions and open-access AI tools, making it a cost-effective approach for educational transformation.

This case also plays a demonstrative and leading role in advancing AIED within basic education. It provides a practical framework for integrating AI into teaching through scenario-driven, project-based learning, moving beyond theoretical discussions toward actionable implementation. The model can serve as a reference for policymakers, teacher training institutions, and educational organizations seeking to adopt AI in a pedagogically meaningful and context-sensitive manner.

Despite its strengths, several potential risks must be considered. Technical risks include dependence on digital devices, variability in internet access for certain AI tools, and participants' differing levels of technological readiness. These risks are mitigated through the use of offline-capable platforms such as Magnetcode and structured scaffolding in training design.

Ethical considerations include the responsible use of AI-generated content, data privacy concerns, and the need to ensure that AI tools are used to support, rather than replace, pedagogical decision-making. To address these concerns, the programme emphasizes digital literacy, critical evaluation of AI outputs, and ethical guidelines for AI use in education.

Overall, the case presents a scalable, inclusive, and future-oriented model that contributes to the sustainable integration of AI in education while addressing both practical and ethical considerations.

Other Relevant Information

1. Case Award Status

i. Award

The *Smart Education for All* initiative and its extended AI-enhanced implementation have received international recognition for innovation and impact in STEM education and digital transformation:

- Global Smart Education Innovation Award (2025), Beijing, China – Recognized for innovative practices in inclusive and technology-enhanced education.
- Best Paper Award (2025) – *Empowering African STEM Educators' Professional Development through Computational Thinking and Project-Based Learning*, recognizing excellence in research and practical impact.
- QS Reimagine Education Awards 2024 – Shortlisted among the Top 18 global projects, highlighting its contribution to transformative and scalable educational solutions.

ii. Publications and Academic Contributions

As part of the *Smart Education for All* initiative, the project's outcomes have been disseminated through international conferences and indexed publications, contributing to the global discourse on inclusive STEM education, computational thinking, and AI integration in low-resource contexts. Key publications include:

a. Sanura Jaya, Qusay Shihab Hamad, Mohammad Alomari & Rozniza Zaharudin. *Empowering STEM Teachers through AI-Integrated Biodiversity Education.* **ACCEPTED** and Camera Ready ,**9th International Conference on New Trends in Information and Communications Technology Applications** (A Springer Nature Computer Science book series) publication (2026)
b. Sanura Jaya, Rozniza Zaharudin, Shivam Bhartiya, & Mohammad Alomari. *Bridging Educational Gaps in Low-Resource Classrooms: AI-Enhanced Project-Based Learning for STEM Educators in Africa*. **ECNU Review of Education (ACCEPTED: 13 Mac 2026)** *(Accepted-Camera ready ,Scopus-indexed, Q2)*
c. Computational Thinking Pedagogical Module Interdisciplinary Interactive STEM (online published book) 2025 Learninghttps://online.fliphtml5.com/ComputationalThinking/klmw/
d. Empowering African STEM Educators' Professional Development through Computational Thinking and Project-Based Learning.
Available at:
https://www.researchgate.net/publication/392326270_Empowering_African_STEM_Educators'_Professional_Development_through_Computational_Thinking_and_Project-Based_Learning
e. Computational Thinking in Agricultural STEM-Based Project: A Case Study on the Impact of the Magnetcode Application Among Zambian Educators (2025)
Presented at: *The Asian Conference on Education 2024*
DOI: http://dx.doi.org/10.22492/issn.2186-5892.2025.50
f. The Impact of the Magnetcode Application on Education and Innovation: A Case Study among Zambian Preservice STEM Teachers at Malcolm Moffat College of Education
Presented at COMSTEAD 21, Kaduna, Nigeria (10–12 September 2024, online)
g. Magnetcode: Design Code and Circuit Simulation Module , Transition to innovative pedagogies in Zambia education
https://www.researchgate.net/publication/389324418_Magnetcode_Design_Code_and_Circuit_Simulation_Module_Transition_to_Innovative_pedagogies_in_Zambia_Education
h. Integration of the Magnetcode in Smart Agricultural STEM Project for Future Generation Lifelong Learning
https://www.researchgate.net/publication/389324227_Integration_of_the_Magnetcode_in_Smart_Agricultural_STEM_Project_for_Future_Generation_Lifelong_Learning

2. Third-Party Evaluation

The project has received positive recognition from academic, institutional, and international platforms, reflecting its relevance, scalability, and innovation. The inclusion of the project in global award platforms and peer-reviewed academic forums demonstrates its credibility and contribution to advancing STEM education and AI integration in diverse educational contexts.
Additional dissemination and engagement activities can be accessed via:
https://qsrea.evessiocloud.com/Awards2024/en/page/showcase-area-2024
https://www.linkedin.com/in/sanura-jaya-207521206/recent-activity/all/

3. Case-related images, videos, and other materials

a. Appendix A: https://drive.google.com/drive/folders/16zWHmIjC5C_lycwhkvUuGWY3OMxG4ZoN?usp=drive_link

b. TCTP Training Picture:https://drive.google.com/drive/folders/1Z8Ia56tj64nh9OIzw6wpZhE-cFC-Sypl?usp=drive_link

c. TETFUND Training Picture: https://drive.google.com/drive/folders/1jGsDoImfwI5iL5vLq6gOWTR--4rC0fO_?usp=drive_link

d. Learning materials: https://canva.link/ngmshss222x49pq

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Case 30

AI Blackboard Empowers the Balanced Development of Overseas Basic Education: A Case Study of the Smart Education Benchmark School at Tzu Chi School in Indonesia

Guo HongJie

Tzu Chi School, Indonesia & iFLYTEK, China

Case Brief

Amidst the global acceleration of digital and intelligent transformation in education, Indonesia faces prominent challenges exacerbated by its geographical constraints, including an imbalance in educational resources, a shortage of high-quality teachers, weak infrastructure, and monotonous classroom models. This project leverages AI Blackboard technology to provide a lightweight, low-dependency smart education solution tailored to the current state of Indonesian education. At Tzu Chi School in Indonesia, the project has achieved device deployment and teacher training. In collaboration with the school, a joint teaching and research group has been established, fostering a normalized teaching research mechanism. This initiative upgrades AI teaching from mere tool application to quality improvement and efficiency enhancement. By integrating local cultural concepts into teaching and utilizing functions such as AI virtual assistants, dynamic visualization, and classroom recordings, the project makes abstract knowledge concrete, classroom interactions efficient, and high-quality resources sharable. This has effectively improved teaching quality and students' comprehensive competencies.

The project has developed a replicable and scalable practical model, offering significant social value in addressing the uneven distribution of educational resources and compensating for the shortage of qualified teachers. Furthermore, as a benchmark for the international expansion of domestic AI technology, it provides a Chinese solution for the balanced development of global education. It underscores the responsibility of Chinese technology companies in empowering educational equity and holds extensive potential for international promotion.

Background

The current global education landscape is accelerating its digital and intelligent transformation. Technological innovation, with artificial intelligence at its core, has become a key driver for reshaping teaching models and advancing educational equity. Indonesia, as an archipelagic nation, faces multiple bottlenecks in its educational development: an imbalance in the regional allocation of educational resources, weak digital infrastructure, a monotonous traditional classroom model, and insufficient cultivation of students' digital literacy and innovative capabilities.

The AI Blackboard project is designed based on local realities. It provides a localized, lightweight intelligent hardware solution to compensate for the shortage of high-quality educational resources. By leveraging intelligent recognition and visualized teaching, it makes abstract knowledge tangible. Using AI virtual assistants, it enables precise and interactive teaching, thereby enhancing classroom efficiency. Through classroom recording and sharing, high-quality lessons are made accessible, alleviating the shortage of teachers and narrowing regional educational disparities.

The project promotes the digital, interactive, and intelligent transformation of classrooms. It fosters a balanced allocation of educational resources, improves the quality of education and students' comprehensive competencies in remote areas, and contributes to the realization of inclusive and high-quality educational development in Indonesia

Case Implementation Status

I. Local Needs Analysis

Against the backdrop of accelerating digital transformation in global education, Indonesia's basic education sector still faces multiple deep-rooted developmental bottlenecks that constrain the improvement of educational quality and the realization of educational equity.

1. Outdated Teaching Equipment and Models, Lack of Smart Capabilities

Existing equipment can only display static PPTs in a unidirectional manner, lacking functions such as interactivity, writing, lesson recording, and AI assistance. The presentation of key and difficult knowledge points remains abstract and lacks intuitiveness, making it difficult for students to comprehend.

2. Insufficient Classroom Interaction and Teaching Efficiency, Lack of Process Recording

Constrained by equipment and blackboard-bound teaching methods, teacher-student interaction efficiency is low. Limited by their personal knowledge structure, teachers are unable to adequately respond to interdisciplinary questions. The absence of structured classroom records leads to poor outcomes in lesson review and student revision.

3. Inability to Accumulate High-Quality Resources, Difficulty in Achieving Educational Equity

High-quality teaching resources, such as the experience of outstanding teachers and course materials, exist in a fragmented manner. They cannot be systematically accumulated, reused, or shared, making it impossible to benefit underperforming and remote areas. This results in an uneven distribution of educational resources.

II. Solutions

In response to the aforementioned challenges, and taking into account the local educational context and teachers' usage habits, the AI Blackboard, powered by iFLYTEK's Spark Cognitive Model, represents

an innovative solution that deeply integrates information technology with education and teaching. Deeply integrated with the Google ecosystem and centered around whiteboard applications, it features core capabilities such as smooth writing, science tools, voice interaction, virtual human interaction, and classroom recording. This enables balanced AI-powered audio-visual experiences, efficient full-natural interaction, intuitive AI-generated teaching board writing, engaging virtual assistants, and precise classroom recordings.

1. By replacing traditional projection-based teaching with lightweight intelligent hardware, the solution is adapted to Indonesia's dispersed geographical environment and weak network conditions. It achieves comprehensive coverage of schools across regions, solidifies the foundation for digital teaching, and lowers the barrier to accessing quality education. Furthermore, in accordance with Indonesian teachers' habits of using whiteboards, customized side auxiliary boards have been added to effectively address the issue of insufficient writing space.

Figure 1 AI Blackboard in Tzu Chi Classroom

2. By leveraging core smart teaching technologies such as real-time intelligent responses from AI virtual assistants, precise recognition of intelligent board writing, and multimodal visualized explanations, a closed-loop, intelligent classroom assistance system integrating "teaching, learning, and assessment" has been established. Through technological empowerment, this system addresses practical educational challenges, including structural gaps in regional teacher allocation, imbalanced development of subject-specific professional capabilities, and a weak support system for interdisciplinary teaching. By responding in real time to students' individual learning needs, dynamically deconstructing key and difficult subject knowledge points, and intelligently optimizing teaching interaction scenarios, it not only lowers the implementation threshold for high-quality teaching but also constructs a new teaching paradigm characterized by the deep integration of "technology, pedagogy, and cognition." This achieves a synergistic improvement in both teaching quality and classroom efficiency, promoting balanced educational development and innovation in teaching models.

Figure 2 AI Whiteboard and Virtual Tutor

Leveraging technological empowerment capabilities such as comprehensive classroom process recording, intelligent pinpointing and structured extraction of knowledge points, and systematic accumulation of teaching resources, a closed-loop mechanism of "teaching practice - resource transformation - co-construction and sharing" has been established. This transforms high-quality course resources from fragmented existence into a systematic, reusable digital educational asset library. Through cross-regional resource interconnection and collaborative co-construction models, it breaks down resource silos and geographical barriers inherent in traditional educational settings, enabling the inclusive provision of high-quality educational resources through technological empowerment. This innovatively forms a new resource-sharing paradigm characterized by the deep integration of "technology, resources, and teaching," injecting sustainable momentum into the balanced development of education.

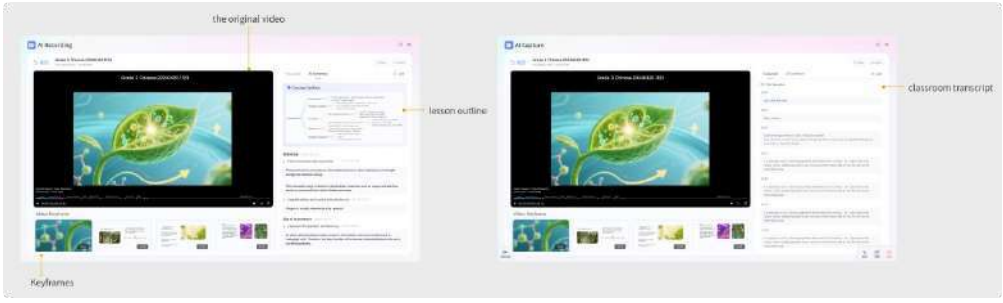

Figure 3 AI Recording and Resource Accumulation

With AI education technology as the core driver, this project systematically promotes the balanced allocation of basic education resources in Indonesia through the deployment of smart teaching devices, the establishment of intelligent teaching systems, and the digital accumulation of high-quality resources. It not only addresses traditional teaching pain points such as outdated equipment, fragmented resources, and insufficient interaction, thereby enhancing educational inclusivity and teaching quality and accelerating the achievement of high-quality digital development in education, but it also transcends the superficial value of mere device empowerment. By offering a comprehensive solution that integrates "technology export, model innovation, and resource sharing," it constructs a replicable and scalable pathway for the digital transformation of global education

This practice not only responds to the United Nations 2030 Sustainable Development Goals but also establishes a benchmark for Chinese AI technology serving global educational equity. It transforms China's mature experience in educational digitalization into an international public good, breaking

down educational barriers through cross-regional resource co-construction and sharing. By injecting Chinese wisdom and solutions into the balanced development of global education, it demonstrates China's responsibility and commitment in global education governance.

Case Innovation and Breakthroughs

1. Empowering Indonesian Classrooms, Activating the Instinct for Inquiry: Multidimensional Virtual Human Interaction

To enhance the immediacy of classroom interaction and enrich the forms of teaching engagement, this project leverages iFLYTEK's industry-leading generative AI virtual human technology to innovatively construct a new model of multilingual, interdisciplinary, and immersive smart teaching. This breaks through the limitations of traditional classrooms in areas such as language interaction, subject expansion, and contextual experience. A highly simulated virtual human auxiliary teaching system has been established, enabling real-time presence in the classroom. This significantly enhances students' learning interest and classroom participation, achieves rapid and precise responses to questions, and comprehensively boosts classroom interaction effectiveness.

By transcending the constraints of traditional classrooms in language interaction, subject expansion, and contextual experience, the system integrates standardized language training, personalized pronunciation correction, immersive scientific inquiry, and multilingual real-time interaction. This facilitates a transformation from "teacher-centered unidirectional instruction" to "human-machine collaborative, contextualized, and inquiry-based learning." It truly reshapes the teaching scene and upgrades teaching concepts through technology.

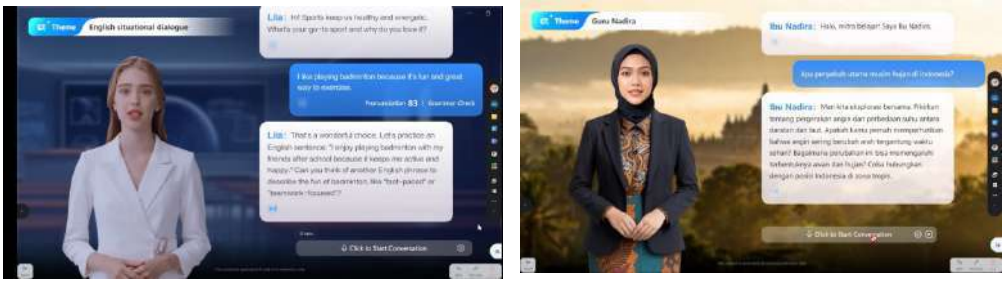

Figure 4 Virtual Tutor Teaching

2. Empowering the Accumulation and Sharing of Teaching Assets: Smart Lesson Recording and Sharing

With technological support comprising whole-process accompanying collection, AI-powered intelligent analysis, and automatic resource generation, an innovative new model of classroom digitalization has been constructed, characterized by “unobtrusive collection, intelligent processing, immediate reuse, and cross-regional sharing.” Through normalized, unobtrusive collection of teaching data, the limitations of traditional classrooms—where “teaching ends down educational barriers through cross-regional resource co-construction and sharing. By injecting Chinese wisdom and solutions into the balanced development of global education, it demonstrates China's responsibility and commitment in global education governance.

and is difficult to revisit"—are broken. Leveraging intelligent processing and large model analysis, structured micro-lessons and visual knowledge graphs are automatically generated, transforming the teaching process from "vague experience" to "precise data" and from "fragmented records" to "systematic assets."

This model not only provides efficient support for teachers' lesson reviews and students' independent revision but also promotes, in a lightweight and accessible manner, the accumulation, circulation, and sharing of high-quality teaching resources. It truly realizes data-driven teaching improvement and technology-empowered educational equity, reshaping the value chain of classroom teaching and the supply of educational resources.

3. Technological Breakthroughs

During the development of this case study, we have formed a scalable and replicable technical pathway centered on "precise demand positioning, rapid iterative delivery, and accumulation of reusable capabilities," achieving the following technological breakthroughs:

(1) Accelerated Engineering Development Driven by AI Coding

We have deeply integrated AI Coding into the processes of demand analysis, code generation, unit validation, and defect repair, forming a rapid closed loop of "demand - prototype - implementation - validation." This effectively shortens the cycle from requirement proposal to functional availability, significantly enhancing R&D throughput and delivery certainty.

(2) Lightweight Capability Platform through Workflow Orchestration

Addressing the high-frequency, fragmented, and time-sensitive teaching interaction needs in educational scenarios, we have adopted a configurable workflow orchestration approach. This abstracts "input (teacher/student operations) - processing (rules/models/services) - output (display/feedback)" into reusable process components, achieving modularization and composability of business logic. This enables products to be rapidly deployed in real classrooms and continuously iterated.

(3) Rapid Construction and Launch Mechanism for AI Light Application Toolbox

Based on the aforementioned AI Coding and workflow orchestration capabilities, we have rapidly developed and launched the "AI Light Application Toolbox." This accumulates a set of classroom interaction and teaching assistance tools (such as activity organization, classroom feedback, exercises and presentations, etc.) in a plug-in/component-based manner, enabling "on-demand activation, rapid expansion, and unified management." This mechanism enhances the product's adaptability to different schools, subjects, and teaching processes, significantly strengthening the "last mile" implementation capability in educational digital transformation.

These breakthroughs have upgraded educational information products from the traditional delivery model of "heavy versions and long cycles" to an agile supply model of "light applications, rapid iteration, and orchestration capabilities." This has significantly improved the responsiveness and coverage breadth to frontline teaching needs.

4. Breakthroughs in Application Practice

During the in-depth cooperation with Tzu Chi School on smart education, the project achieved systematic breakthroughs in application practice across three dimensions: equipment deployment,

subject integration, and teaching research mechanisms:

(1) Completion of Hardware Deployment and Teacher Capacity Building

The deployment of AI Blackboards for the seventh grade and specialized teacher training were completed, rapidly achieving equipment implementation and teacher adaptation, thereby laying a solid foundation for the integration of technology into teaching.

Figure 5 Specialized Teacher Training at Tzu Chi School

(2) Promotion of Innovative Subject Integration and Upgrading of Teaching Models

In subject teaching practice, the project focused on localized adaptation and enhancement of teaching effectiveness, deeply collaborating with local teachers to co-create high-quality lessons. In English language teaching, the school's signature "Jing Si Aphorisms" humanistic concepts were organically integrated. Leveraging the English virtual assistant, immersive interactive scenarios were constructed, which not only stimulated students' willingness to think actively but also significantly improved their reading comprehension and oral expression skills. Simultaneously, this cultivated students' core competencies in challenging prejudices and respecting diversity and differences. In mathematics teaching, utilizing the dynamic visualization technology of the AI whiteboard, static three-dimensional graphic knowledge was transformed into intuitive and perceptible dynamic demonstrations. This effectively lowered the threshold for understanding abstract concepts, promoting a transformation in subject teaching from "static explanation" to "dynamic inquiry," thereby enhancing both teaching quality and student learning outcomes.

Figure 6 Subject Lesson Integration at Tzu Chi School

(3) Establishment of Normalized Teaching Research Systems and Deep Integration Mechanisms

In collaboration with the school's AI Committee, a special joint teaching research group was formed, innovatively establishing subject co-creation and normalized teaching research mechanisms. This constructed an integrated system combining "technology, teaching, and research." Furthermore, it propelled AI-integrated classrooms from the superficial stage of tool application to a stage of deep integration characterized by "method optimization and quality improvement."

Practical feedback indicates that the AI Blackboard, with its high usability, effectively adapts to teaching scenarios and enhances classroom interaction and participation. Through core advantages such as the concretization of abstract knowledge, it effectively empowers the dual improvement of teaching efficiency and quality, providing a replicable practical paradigm for the deep integration of AI technology with education and teaching.

Figure 7 Tzu Chi & iFLYTEK AI Teaching Research Group Meeting

Promotion Value and Risks

1. Application Prospects and Outcomes

This project has completed the pilot deployment of AI Blackboards, specialized teacher training, and normalized application in the seventh grade at Tzu Chi School in Indonesia. In collaboration with the school's AI Committee, a special teaching research group has been established, along with subject co-creation and normalized teaching research mechanisms. This has propelled AI-integrated classrooms from tool application to a stage of deep integration focused on teaching quality improvement. The project has formed a replicable operational model encompassing "equipment deployment - teacher training - lesson co-creation - applied research - teaching closed loop." Adapted to Indonesia's educational context of "archipelagic dispersion, weak networks, and uneven teacher distribution," it possesses the conditions for rapid large-scale promotion to public and private schools across Indonesia, providing a mature pathway and practical sample for the upgrading of smart education nationwide.

2. Social Value and Economic Value

Social Value: AI technology compensates for the shortage of teachers in remote and ordinary schools, promotes cross-regional sharing of high-quality educational resources, significantly narrows urban-rural

and inter-school educational disparities, and contributes to the realization of inclusive and equitable education in Indonesia. It integrates patriotic concepts and local humanistic values, enhancing students' language expression, mathematical thinking, and digital literacy, thereby cultivating a new generation of talents who are inclusive, diverse, and adept at inquiry.

Economic Value: It reduces the cost of providing quality education, improves classroom teaching and teacher research efficiency, and minimizes redundant resource investment. By replacing traditional projection models with lightweight intelligent hardware, it enhances equipment utilization rates and long-term operational and maintenance benefits, supporting Indonesia's digital transformation in education and human capital enhancement, thereby contributing to high-quality economic and social development.

3. Demonstrative and Leading Role in Basic Education

As a benchmark practice for the deep integration of AI and education in Indonesia, this project has pioneered the establishment of a comprehensive system encompassing "technology empowerment + subject integration + local adaptation + mechanism assurance." It has created a replicable, scalable, and promotable paradigm for smart education. By setting a precedent in classroom innovation, resource balancing, teaching research mechanisms, and humanistic integration, it provides a practical reference and standard model for the digital and intelligent transformation of basic education in Indonesia. It stands as a shining example of Chinese AI technology serving global educational equity, leading the high-quality development of smart education in Indonesia and the Southeast Asian region.

Other Relevant Information

1. Case Award Status:

(1) November 2025: iFLYTEK AI Blackboard was awarded the Gold Award at the 12th Anhui Provincial Industrial Design Competition.

(2) October 2025: iFLYTEK's "iFLYTEK Spark Smart Blackboard: Evolving from a Board-Writing Tool to an AI Assistant for Teachers" was selected for the 2025 Standard Application Excellent Cases List by the China E-Learning Technology Standardization Committee (CELTSC), Ministry of Education.

(3) August 2024: iFLYTEK Spark Smart Blackboard received the Global Smart Education Innovation Award · Technological Innovation Award, which is organized and initiated by the Global Smart Education Conference.

2. Third-Party Evaluation:

(1) Tzu Chi School.Dr. BK Wong： "Our AI team stated that the smartboard from iFLYTEK was superior to others,"

(2) Tzu Chi School teacher added： "AI Board Writing, AI Tutor, and AIRecording System are my favourite tools to assist my class."

(3) Marlo Budiman, CEO of DSST:"This is a strategic move to bringworld-class AI into Indonesia's education ecosystem andexpand equitable access to quality learning nationwide."

Note ①: The above is excerpted from third-party interviews published in the press release of Sinar Mas Group, Indonesia.

Note ②: DSST is a technology company under the umbrella of Sinar Mas Group, Indonesia.

Case 31

Building a "Borderless Classroom" Driven by The Three Major Types of Knowledge Graphs: An Innovative Case of the AI-Empowered Computer Science Pilot Class

Xi'an Jiaotong University, Shaanxi, China

Background

The AI-driven education ecosystem transformation is prevailing, higher education faces significant challenges in talent cultivation. A core pain point lies in the misalignment between traditional large-scale teaching models and the growing demand for personalized and digital learning. As AI reshapes education, this disconnect has become increasingly pronounced, manifesting in three key areas:

First, rigid boundaries in traditional lecture-based classrooms hinder personalized and active learning. Confined to physical classrooms and textbooks, students often learn passively, without guidance from real-world problems or project-driven tasks. This makes large-scale individualized teaching unfeasible, fails to stimulate students' intrinsic motivation, and deprives them of opportunities for independent inquiry.

Second, fragmented AI application in teaching prevents systematic integration with professional curricula. Without seamless alignment with academic programs, AI cannot break classroom barriers effectively, nor can it foster systematic AI learning thinking or independent inquiry capabilities at the professional level.

Third, outdated teacher-student role positioning undermines the "learning-centered" teaching philosophy. Teachers remain dominant classroom-based knowledge transmitters, while students act as passive recipients. This underutilizes AI's strengths in resource integration and real-time feedback, limiting teaching-learning synergy and the value of autonomous and open education.

To address these pain points and transform professional education paradigms, Xi'an Jiaotong University launched an AI-empowered computer science pilot class. Leveraging the university's "AI Pioneer Program", the project integrates AI deeply into the entire computer talent cultivation process.

Focusing on core junior-year computer courses, the case aims to build an integrated AI-professional teaching system, reshape teaching models, and foster a "teacher-student-AI" model. Advocating "boundless classrooms, classrooms everywhere", it seeks to achieve personalized, large-scale, and intelligent teaching, cultivate top innovative talents, and provide a replicable model for AI-enabled university education reforms.

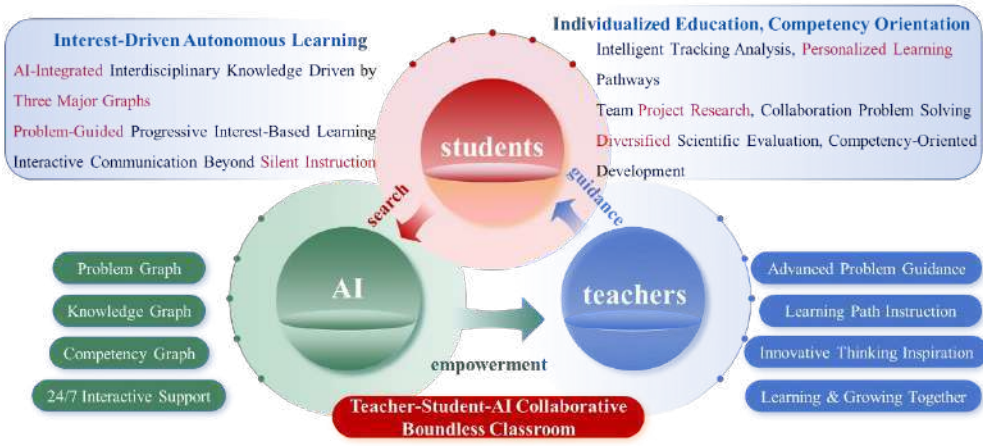

Figure 1 Three-Graph Guidance, Teacher-Student-AI Collaborative Boundless Classroom

Implementation Process

This case is built around Xi'an Jiaotong University's AI-empowered computer science pilot class. Leveraging smart teaching platforms, including Siyuan Learning Management System 2.0 and Jiaoxiaozhi AI Agent DeepEdu1.0, it integrates core technologies such as large language models, knowledge graphs, and generative AI. A "teacher-student-AI" model has been established across all core first-semester junior-year courses: Fundamentals of Programming, Principles of Computer Networks, Computer Organization, Operating System Principles, Specialized Experiments in Computer Organization and Architecture, and Specialized Experiments in Operating Systems. The initiative systematically deepens the integration of AI into the entire professional teaching process, with each course developing tailored technical application plans and implementation steps based on its disciplinary characteristics, as detailed below.

1. Specific Application Measures and Technical Plans for AI Technology

All core courses in the pilot class are developed in line with Xi'an Jiaotong University's AI Pioneer Program, a teaching reform initiative empowered by generative AI, known as "Smart Courses". Faculty and students collaborate to refine the courses' Three Graphs (covering questions, knowledge, and competencies) and develop innovative teaching agents. Centered on the teaching needs of core computer science courses, the project aims to build a new teaching system underpinned by Three Graphs navigation, AI-enabled collaboration, project-task orientation, and personalized learning pathways. Students are encouraged to break free from conventional classroom constraints, with

traditional lecture attendance made optional, and pursue autonomous, self-directed learning in an open environment. Under faculty guidance, students apply their knowledge flexibly by participating in research projects, academic competitions, and challenging practical tasks, achieving an effective shift from knowledge acquisition to capability enhancement.

Figure 2 Transform Teacher-Student Roles, and Reconstruct Teaching Organization in Accordance with the Four Core Links: Orientation, Self-Study, Seminar and Summary

(1) Construction of Basic Technical Foundation

A robust technical foundation supports full-course AI empowerment. Built on Siyuan Learning Management System 2.0 and integrated with the AI Agent DeepEdu1.0 system, the foundation features cross-course "problem-knowledge-competency" Graphs that guide personalized learning paths, reconciling large-scale education with individual student growth.

Multi-modal resources and sufficient computing power ensure stable AI operation. Digital human courseware and integrated learning materials form a comprehensive corpus, while computing resources from the Huawei-XJTU Innovation Incubation Center support AI tools, agents, and multi-platform collaboration.

(2) Course-Specific Technical Implementation

In Principles of Computer Networks, generative AI enhances engineering practice. By breaking in-class limitations, it enables students to independently complete TCP protocol code writing, from design and coding to function and performance testing, fostering deeper exploration of network protocol cores.

In Computer Organization, AI enables personalized, on-demand learning. Natural Language Processing (NLP) analysis of student data, combined with intelligent agents, generates dynamic question chains, personalized recommendations, and real-time Q&A, adapting teaching content to individual learning situations.

In Specialized Experiments in Computer Organization and Architecture, AI simplifies complex hardware learning. AI-generated digital human courseware visualizes hardware knowledge, while a retrieval-augmented Q&A platform and the Three Graphs provide comprehensive experimental navigation.

For Fundamentals of Programming, a three-in-one platform provides intelligent support. Integrating Siyuan Learning Management System 2.0, Cloudstudio AI Programming Platform, and EduCoder Evaluation Platform, it uses programming agents, including AIR Learning Companion, Agent, and Natural Language Processing (NLP), to enable intelligent Q&A, code management, and question setting, with plagiarism detection for intelligent teaching management.

In *Operating System Principles and Experiments*, AI integrates theory and practice. Combining MCP (Model Checker Plus) and large language models, the course has developed an OS diagnosis platform with 24/7 AI agents, achieving deep integration of graph guidance, AI assistance, and engineering practice.

2. Overall Implementation Steps and Timeline

The case is implemented in four phases over the junior year, starting in July 2025, to ensure systematic progress and quality. It covers 28 selected students, with clear tasks and timelines for platform construction, resource development, teaching application, and result optimization.

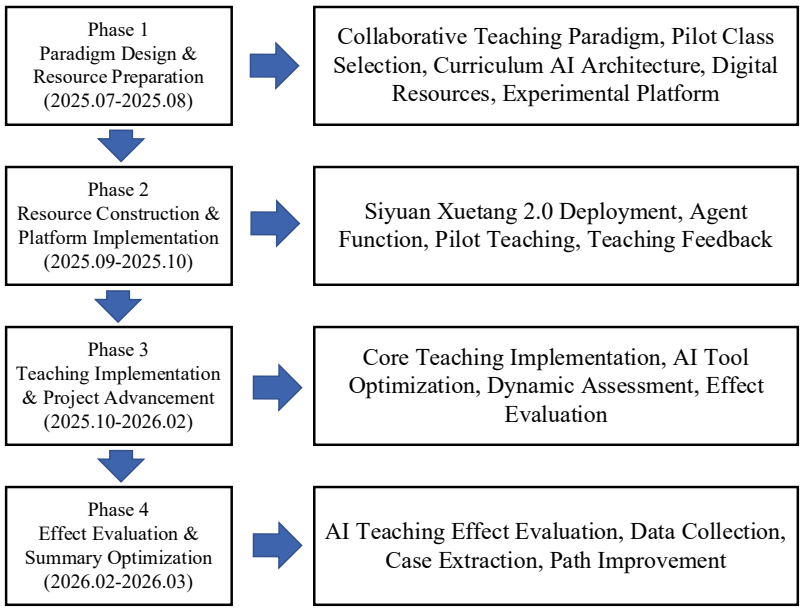

Figure 4 Four phases of AI-Enabled Pilot Class Case Implementation

Phase 1: Paradigm Design and Resource Preparation (Jul.-Aug. 2025)

This phase focuses on paradigm design and resource preparation. The core “teacher-student-AI” model has been established; selection criteria for the pilot class have been formulated and publicized, and 28 junior-year students with strong self-learning abilities have been recruited. An AI technology application framework has been built for each course, along with the agent system architecture and a multi-platform collaboration system; the initial “question-knowledge-competency” Graphs for all courses have also been developed. AI-enabled teaching materials, including digital human courseware, study guides, and MOOC resources, have been produced, experimental platforms and computing resources prepared, and teaching management regulations for the pilot class formulated.

Phase 2: Resource Construction and Platform Implementation (Sep.-Oct. 2025)

This phase completes platform deployment and resource construction. The full-course functional deployment of Siyuan Learning Management System 2.0 has been finished, and the first version of Jiaoxiaozhi AI Agent DeepEdu1.0’s agent functions, including question chain generation and intelligent Q&A, has been launched. The pilot class has officially launched AI-enabled teaching, built a future smart learning space (including workstations, seminar rooms, and workshops) for 28 students, and set

up the students' self-study mode. Each course has promoted teaching implementation in accordance with the technical plan, continuously improved teaching materials, and collected the first round of teaching feedback.

Phase 3: Teaching Implementation and Project Advancement (Oct. 2025-Feb. 2026)

This phase focuses on teaching implementation and continuous optimization. Students study independently with teacher guidance; AI tools are iterated based on learning data, and a dynamic evaluation mechanism has been established to ensure teaching quality. All courses have entered the core teaching implementation stage: students conduct independent, self-directed learning at their workstations, while teachers provide synchronous guidance and address common issues. AI teaching tools are continuously iterated and optimized: based on students' learning data, the content of the Three Graphs and the difficulty of question chains are dynamically adjusted, the course knowledge base is supplemented, and the accuracy of AI agents' Q&A and recommendations is improved. A dynamic evaluation mechanism for the pilot class has been established to ensure teaching quality.

Phase 4: Effect Evaluation and Summary & Optimization (Feb.-Mar. 2026)

This phase evaluates outcomes and refines the model. It comprehensively assesses AI teaching effectiveness, summarizes data and achievements, extracts typical cases, and improves implementation paths to form promotable reform experience.

Implementation Process

By breaking classroom boundaries and empowering student autonomy, the case creates an innovative, systematic AI-enabled higher education model. Centered on core computer courses, this model boasts four unique core advantages:

1. Breaking Classroom Boundaries to Achieve In-Depth, Full-Chain Integration of AI and Professional Teaching

Abandoning fragmented AI application, the case achieves full-chain integration of AI and professional teaching. It builds an integrated framework across the computer curriculum, embedding AI systematically in all teaching links, from theory to practice and pre-class to post-class, making AI a core support for talent training.

2. Reshaping the Teaching Ecosystem to Create a New "Teacher-Student-AI" Collaborative Paradigm

The traditional teacher-dominated model has been replaced by a new "teacher-student-AI" model. AI serves as students' 24/7 "super deskmate" and teachers' auxiliary tool, driving teachers to transition into guides and coaches, and students to become active knowledge explorers, shifting the focus to independent learning.

3. Precision Guidance to Build a New System of Large-Scale Individualized Teaching

AI-enabled precision guidance enables large-scale individualized teaching. Integrating the Three Graphs and dynamic question chains, AI analyzes student data to customize learning paths, resolving the lack of personalization in traditional teaching and reconciling large-scale education with individual growth.

4. Focusing on Ability Improvement to Upgrade Talent Training Levels

Focused on enhancing students' practical abilities, the model upgrades talent training by integrating AI assistance, real-world challenges, and theoretical-experimental synergy. Taking real industry problems and academic competitions as the starting point, students complete complex tasks with AI support to

develop critical thinking and engineering skills, transitioning from “knowing knowledge” to “applying and innovating”. Specifically, they tackle real challenges from leading industry enterprises, competition questions, and research tasks, such as TCP protocol design and operating system diagnostic platform development, while being guided to critically use AI-generated content for secondary innovation, fostering human-machine collaborative creation capabilities and system-level engineering thinking. Additionally, the model deepens the integration of theoretical and experimental courses, establishing an integrated training pathway of “theoretical understanding-experimental verification-design expansion-capability enhancement” to solidify this transformative shift in students’ learning outcomes.

Effectiveness Proof

The case has delivered remarkable results in student development, teacher growth, and teaching quality improvement. Objective data and practical achievements fully demonstrate its effectiveness, with specific outcomes detailed below:

1. Student Development: Dual Improvement in Independent Inquiry Ability and Academic Performance

Core course scores of pilot class students are significantly higher than the grade average. While these students generally had a strong academic foundation upon enrollment, this result confirms that the autonomous learning model of “boundless classrooms, classrooms everywhere” does not adversely affect their academic performance, and even enhances it. For example:

In the Fundamentals of Programming pilot class, students independently completed four experimental projects in four weeks, tasks that take regular classes an entire semester to finish, with better code quality, fully reflecting the role of the autonomous learning model in enhancing students’ practical abilities.

In Principles of Computer Networks, students developed a simple TCP protocol with AI assistance, achieving in-depth integration of theoretical knowledge and engineering practice, and significantly improving their network programming, system debugging capabilities, and understanding of kernel protocols.

In Specialized Experiments in Computer Organization and Architecture, the pilot class outperformed non-pilot classes in experiment completion and on-time submission rates; students also showed a marked increase in proactively raising questions and optimizing solutions, and their experimental reports were more standardized and systematic. End-of-term discussions with pilot class students revealed strong recognition of the pilot learning model.

2. Teacher Growth: Significant Improvement in Digital Teaching Capabilities

Teachers in the pilot class have achieved leapfrog progress in their digital teaching capabilities. From simply using smart teaching platforms, they have gradually participated in the development and iteration of agents for multiple courses. Through the AI learning analysis system, they can accurately grasp students’ learning progress, shifting teaching from experience-driven to data-driven, with significant improvements in their practical digital teaching capabilities and personalized tutoring skills.

Leveraging the achievements of AI teaching practice, the teachers have successfully applied for 1 major teaching reform project and 11 key teaching reform projects related to AI teaching, forming a virtuous cycle of “teaching promoting research and research feeding back teaching”. The teaching team of

Fundamentals of Programming and its instructors have been recommended to participate in the National University Teachers' Teaching Innovation Competition, and the teaching reform achievements have gained initial recognition.

3. Teaching Quality: Effective Implementation of Innovative Models

The AI-empowered teaching model optimizes the entire teaching process. Through data analysis, teachers can accurately identify key teaching focuses, dynamically adjust teaching content and difficulty, and achieve the organic unity of large-scale teaching and personalized training. This provides a replicable and promotable practice plan for computer professional teaching reform.

Promotion Plan

The AI-empowered teaching system constructed in this case is not only applicable to computer majors but also quickly adaptable to other engineering majors. Its technical framework and implementation path have strong universality, providing valuable practical experience for the digital transformation of higher education.

1. Universality and Demonstration Value

Built on a university-level general platform, the case establishes a standardized AI-empowered teaching system, forming a complete closed loop of "resource integration-graph navigation-AI collaboration-data optimization". It is applicable to the full-curriculum reform of theoretical and experimental courses in computer science, and its core logic: "graph-driven, question chain-led, and teacher-student-AI collaboration", can be quickly adapted to engineering majors with high abstraction and strong practicality. The teacher role transformation and student ability training system formed by the curriculum reform also provide a reference framework for the implementation of AI+education in various disciplines.

2. Practical Promotion Paths

On-campus Promotion Path: The case's achievement agents are integrated into university-level general platforms such as Siyuan Learning Management System 2.0 and Jiaoxiaozhi AI Agent DeepEdu1.0, open to all majors in the university. Course leaders conduct teaching training and reform experience sharing for teachers across the university, encouraging multiple disciplines to learn from the case's teaching paradigm and implementation methods and set up their own AI reform pilot classes.

Cross-University Radiation Promotion: Reform achievements and practical experience are shared with universities inside and outside the province through teaching seminars and off-campus special reports. To date, 6 achievement sharing sessions have been held through cross-university reports and industry seminars, achieving initial cross-university publicity and radiation. Professor Tang Yazhe, leader of the pilot class project, delivered special reports at the 7th China Computer Education Conference (CECC) entitled "AI Empowers Computer Majors, Digital Resources Support Boundless Classrooms" and at the "2025 Seminar on the Innovative Development of AI-Enabled Computer Experimental Teaching" entitled "Construction of a New Ecosystem of AI-Driven Computer Experimental Teaching". Professor Xia Qin, leader of the Fundamentals of Programming curriculum reform, was invited to share curriculum construction experience with teachers inside and outside the university, including reports at the 10th Anniversary Summary Meeting of the Northwest University Teachers' Teaching Development Center Alliance and the Sub-forum of the Digital Intelligence Education Empowers Teaching Innovation

Seminar, the “AI+X Industry-University Collaborative Education Seminar” organized by the School of Computer Science and Technology, Xi'an Jiaotong University, Alibaba, and NVIDIA, and the “AICODING Application Practice Exploration Exchange Meeting” of the Education Innovation Workshop organized by Tecent Academy.

University-Enterprise Collaborative Promotion: Collaborating with enterprises such as Huawei, Tencent, and NVIDIA, the AI teaching tools and industrial-level practical projects in the case are integrated into the university-enterprise collaborative education system and promoted in cooperative universities and enterprise training bases to achieve the sharing of educational resources.

In summary, the AI-empowered teaching system constructed in this case is not only applicable to computer majors but also quickly adaptable to other engineering majors. Its technical framework and implementation path have strong universality, providing valuable practical experience for the digital transformation of higher education.

Case 32

Buffet-style Digital Intelligence Reading Scenario Facilitating Creative Expression in Preschool Children

Aihui Li, Yeye Zhang, Yilin Jiang

Xiaoshan District Kaiyue Kindergarten, Zhejiang, China

Background

Picture book reading serves as a crucial medium for language education in kindergartens. However, three common challenges frequently arise in daily teaching practices:

First, reading is teacher-dominated. The selection of books, timing of reading sessions, and discussion methods are primarily predetermined by educators, often neglecting children's interests and making it difficult to systematically identify and engage with their learning needs.

Second, the discussion remains superficial. Teacher-child interactions predominantly consist of simplistic yes/no questions, lacking cognitive scaffolds that guide children to engage in deep observation, reasoning, and imagination.

Third, children's ideas "cannot be expressed." Children possess numerous ingenious concepts, but due to immature skills in drawing and writing, they struggle to fully articulate their creativity. Over time, this leads to a reluctance to express themselves.

Our reflections:

Based on this, we ponder: Can digital tools transform technology from a teaching aid into a "partner" for young children's active exploration? Can smart devices discreetly document their interests and preferences, promptly address their questions and curiosity, and provide low-threshold creative expression platforms without disrupting their play and daily routines?

Therefore, we have developed a "buffet-style" digital-intelligent reading ecosystem, where digital tools serve as "invisible scaffolds" seamlessly integrated into every aspect of young children's daily lives. This approach empowers children with reading autonomy, delegates interactive engagement to AI systems, and lowers barriers to expression—effectively transitioning from teacher-led reading to self-directed learning where children independently select materials, engage in discussions, and create content.

Case Implementation Status

We first establish a foundational framework centered on the 'five key elements,' then leverage AI tools to develop three supporting scenarios, thereby creating a complete closed-loop system that spans from implementation to application and from observation to support.

1. Practical Approach: Establishing a Framework Based on Five Elements

(1) Goal Anchoring: Consolidating the Core Kernel of Thought Expression

Guided by the cultivation of core competencies in early childhood education, we establish the developmental objectives of "daring to speak, knowing how to speak, and excelling in communication." Moving beyond traditional passive language learning approaches, we focus on fostering divergent thinking and oral expression in young learners. By creating an interactive and open language learning ecosystem, we transform language acquisition into an active exploration and confident expression process, thereby comprehensively promoting the development of both divergent and logical thinking skills in children.

(2) Resource Foundation: Building a Four-Dimensional Integrated Digital Intelligence Resource Library

Integrate multilingual learning resources to establish a four-dimensional integrated resource supply system featuring "environmental integration, tool empowerment, and institutional safeguards":

Environmental Integration: Deeply integrating humanistic resources such as picture books, nursery rhymes, and traditional stories with digital resources to create an immersive, multisensory language learning environment.

(3) Tool Empowerment: Introducing interactive agents, text-to-image/video tools, and intelligent recording devices to diversify expression mediums and reduce communication barriers for young children.

Mechanism Safeguard: Establishing generative resource evaluation standards, clarifying tool usage guidelines, and implementing a dynamic iterative mechanism of "prescription-application-review-optimization" to ensure resource quality.

(4) Process Design: Constructing a Three-Stage Full-Cycle Application Model

Pre-class preparation: Teachers utilize intelligent tools to generate interactive scripts and visual materials with precision, thereby enhancing lesson preparation efficiency.

Classroom implementation: Utilize intelligent agents to create scenarios and facilitate role-based dialogues for instructional introduction. Group-based application of text-to-image tools enables language-texture conversion, achieving deep integration of listening, speaking, and drawing skills.

Post-class Extension: Utilize software to create children's "story picture books", integrate resources into an AI reading library, and extend them to area-based activities and parent-child reading sessions, achieving long-term resource reuse.

(5) Multivariate Retrospective Analysis: Establishing a Data-Driven Evaluation System

Establish a dual-dimensional evaluation system combining quantitative and qualitative approaches, conducting comprehensive analysis from dimensions such as children's expressive willingness, cognitive divergence, and work creativity. By integrating teachers' observation records, accurately diagnose the implementation effectiveness of scenarios to provide scientific evidence for scenario optimization.

(6) Continuous Iteration: Refining the Dynamic Optimization Ecosystem Closed Loop

Adhering to the principle of "evaluation-driven improvement," we dynamically adjust agent parameters and optimize resource classification and process design based on review results. Through continuous iterative children, maintaining teaching vitality and effectiveness.

(7) Implementation Strategy: Introducing Tools to Create Three Support Scenarios

Phase One: Autonomous Listening – Allowing Children to Select and Listen Independently

We integrate reading into children's daily lives.

Online, we established an 'Reading Bank' audio resource library where children can request stories of their choice. The system automatically records their selections and generates a 'reading interest profile'.

In physical classrooms, reading stations are established where children can browse picture books at any time or request stories from voice-activated interactive dolls.

Figure 1 Read the library resource repository

Figure 2 Reading Station

During this phase, the technology operates discreetly to record and respond to needs. Teachers analyze backend data to identify each child's interests, providing a foundation for subsequent support.

Phase Two: Deep Interaction – Ensuring Children Have Conversations and Engage in In-depth Discussions

When children encounter challenges or generate ideas during autonomous listening, we deploy three types of AI agents:

Listening comprehension category: When a child fails to understand a word or plot element, they may ask questions. For instance, asking 'What is Taotie?' will prompt the AI to provide explanations in child-friendly language accompanied by illustrations.

Communication expression category: Transform into a story character to engage in dialogue with children. For example, after reading "The Rainbow Fish," the child asks, "Do you regret giving away the scales?" The AI responds with a counter-question: "If I didn't give away any scales at all, do you think I could be this happy?" This guides the child to reflect on the significance of sharing.

Story creation category: Stimulating creativity. For instance, after reading "Jingwei Filling the Sea," the intelligent agent asks: "If Jingwei had modern technological friends, how would they collaborate?" The child then develops a new story based on this line of thought.

During the child's dialogue with the intelligent agent, the teacher steps aside to observe and record. After the conversation concludes, the teacher organizes group discussions or role-playing activities to extend the online dialogue into offline interactions.

Phase Three: Creative Expression – Bringing Children's Ideas to Life and Celebrating Their Achievements

We provide accessible digital tools: AI-generated images, voice synthesis, and easy animation editing, making children's creativity visible and audible.

Upon completion of the artwork, establish a display platform: generate QR codes to be posted on classroom walls, broadcast in the "Classroom Creative Live Studio," and upload to the home-school collaborative education platform. The children's creativity evolves from "being self-aware" to "being visible to all," serving as motivation for continued creative expression.

Case Implementation Status

1. Main innovative content

We have performed three "refactoring" steps:

Process Restructuring: Transitioning from "teacher lecturing → child listening" to a cyclical model of "child selection → child thinking → child creation → child demonstration". Reading is not passive reception but active exploration and creation.

Expression reconstruction: shifting from a skill-based competition of "how realistic the drawing is and how well the writing is" to an idea-driven approach of "expressing thoughts as they arise." Children may utilize language, drawing, animation, or performance—whichever method proves most convenient.

Support for reconstruction: Transition from "teachers judging a child's reading preference based on impressions" to "data revealing the child's recent interests and areas of difficulty." Teachers can provide more precise guidance to each child based on the data.

2. Technical breakthrough content

Without relying on fancy equipment, we accomplished three things using just tablets, voice devices, and a few commonly used AI tools:

Unobtrusive recording: The system automatically records children's on-demand story playback and AI interactions without interrupting their playtime.

Intelligent Response: AI can provide targeted answers and follow-up questions based on children's inquiries.

Creative transformation: Children's words and drawings can be rapidly converted into animations and stories, bringing creativity to life.

This approach is lightweight and modular, making it suitable for ordinary kindergartens without the need to purchase expensive equipment.

Figure 3 Creative Transformation

3. Breakthroughs in Application Practice Content

Children demonstrated enhanced expressive abilities. The frequency of autonomous expression increased by 40% compared to previous levels, and the number of creative works tripled. 92% of children proactively initiated creative activities and shared their creations during classroom sessions.

Teachers will provide greater support. The approach has shifted from "uniform instruction" to "identifying each child's interests and designing activities tailored to their needs."

Parents demonstrated greater cooperation. The satisfaction rate of home-school collaboration increased from 78% to 94%. Parents 'engagement significantly improved after seeing their children's works displayed.

4. Intellectual Property Status

This "buffet-style" reading model, three-stage support process, three-domain integration architecture, and AI agent application methods were all independently developed by us, forming school-based curricula and operational guidelines for use in teaching research and achievement promotion.

Promotion Value and Risks

1. Application Prospects and Existing Achievements

This approach has been implemented throughout the entire process of kindergarten operations, including morning routines, play activities, teaching activities, and home-kindergarten interactions, forming a practical implementation guide. Currently, this model has been extended to over 800 kindergartens across 30 provinces nationwide, benefiting more than 256,000 children, demonstrating strong replicability.

2. Social and Economic Value

Social Value: Through the "AI Early Childhood Education-Reading Bank" platform, reading skills are refined into four dimensions— "effective listening, expressive communication, reading proficiency, and writing enjoyment" —significantly enhancing children's imaginative abilities. The teacher-child relationship evolves from "reader guidance" to mutual support and companionship, enabling parents to clearly observe their children's growth. The accumulated reading resources have reached over 3,750 titles.

Economic Value: Low investment requirements with no need for expensive equipment, as it can be initiated using existing tablets, smartphones, and free or low-cost AI tools.

3. Demonstrative and Leading Role

This case exemplifies the implementation of a "child-centered" philosophy by automatically collecting behavioral data through the platform to generate individual competency radar charts, thereby establishing a closed-loop growth cycle of "assessment-feedback-optimization." A cumulative collection of over 2,000 online reading resources has been developed and made available for sharing with parents and kindergartens, providing replicable models for digital transformation in early childhood education.

4. Potential Risks and Responses

Technical risks: AI occasionally provides irrelevant responses, with teachers present throughout to intervene and guide promptly.

Ethical Risk: Only reading preferences and conversation content are recorded, without involving personal identity information. The data is not shared externally.

Case 33

The “Three Digital” Synergy Framework: Zhejiang‘s Provincial Practice in Driving Deep Transformation of Teaching and Learning

Educational Technology Center of Zhejiang Province, Zhejiang, China

Background and Problem Statement

Basic education worldwide is currently confronting two deep-rooted structural contradictions. The first is the highly uneven distribution of quality educational resources; the second is the inability of conventional “one-size-fits-all” classroom instruction to meet students’ diverse and individualized growth needs. The rapid advancement of artificial intelligence technology has created an unprecedented historical opportunity to resolve both contradictions.

Zhejiang is one of China’s major education provinces, home to more than 5,970 primary and secondary schools, 7.65 million enrolled students, and approximately 500,000 full-time teachers. Although the province’s overall education standards rank among the highest in the country, structural disparities in the allocation of quality resources between urban and rural areas, and across regions, remain pronounced. More than 600 small-scale schools with fewer than 100 students operate in the province, and remote mountain-area schools continue to suffer from weak teaching capacity and a shortage of high-quality curricular resources. At the same time, the dominant teacher-lecture model of traditional classrooms is ill-suited to students’ multidimensional and personalized learning needs, and “large-scale differentiated instruction” remains a core challenge yet to be resolved.

Looking at international experience, the United States has promoted open educational resources through the GoOpen initiative; California encourages schools to adopt free, editable digital textbooks and integrates instructional services through platforms such as Google Classroom. Singapore launched its Fifth Generation EdTech Master Plan in 2020, equipping all secondary school students with personal learning devices and developing the unified Student Learning Space (SLS) platform. Japan completed its GIGA School program in 2023, providing approximately 7.6 million primary and secondary school students with individual learning terminals. Experience from developed nations demonstrates that terminal penetration, platform construction, and digital textbook development constitute a critical

triangle for driving transformation in instructional models.

Since 2022, when Zhejiang was designated a national pilot province for the Smart Education Platform, the province has identified "expanding the reach of quality resources" and "advancing large-scale personalized instruction" as its twin strategic goals. Zhejiang has systematically pursued the integrated development of three pillars—Digital Terminal, Digital Space, and Digital Textbook—collectively known as the "Three Digitals" framework. This initiative has pioneered a province-wide pathway toward deep, digitally-driven transformation of teaching and learning.

Key Approaches and Practices

The Three Digitals framework constitutes an integrated ecosystem operating as a coherent closed loop of "hardware entry point – content supply – intelligent service hub." Digital Terminals serve as the physical interface and data-collection origin through which teachers and students enter the digital learning world. Digital Textbooks are the standardized, high-quality carriers of knowledge content and the primary content source for classroom interaction. Digital Space functions as the intelligent service hub connecting terminals and textbooks. Together, the three elements form a positive feedback flywheel: hardware collects data, content generates data, and the space processes and feeds data back to drive continuous optimization.

(I) Digital Space as the Central Hub: Building an Intelligent Service Platform for Large-Scale Differentiated Instruction

Since launching the Zhijiang Hui Education Plaza in 2017, Zhejiang has continuously iterated and upgraded the platform. In 2024, the province relaunched the Network Learning Space 2.0—Zhijiang WeSchool—structured around a "Five Libraries, One Circle, One Schedule" framework. This platform provides teachers and students across the province with lifelong, real-name, intelligent, and personalized digital learning services, empowering systemic transformation of teaching and learning across all stages and all dimensions. Among its seven core modules, two stand out as the most concentrated expression of Zhejiang's technical logic for enabling large-scale personalized differentiated instruction.

1. School-Based Repository × AI Agents: Realizing "One Teacher, One Agent; One Student, One Agent"

The School-Based Repository is the core module for personalized knowledge production at the school level. Teachers can upload their accumulated high-quality instructional resources and school-based curricula in bulk, enabling structured storage and comprehensive organization. Building on this deposited repository, the platform supports the creation of school-based AI agents and subject-specific tools. Each teacher can customize a dedicated instructional agent aligned with their personal teaching style, while each student can access a dedicated learning agent calibrated to their individual learning profile. This truly realizes a personalized learning ecosystem of "one agent per teacher, one agent per student," elevating AI from a mere "assistive tool" to a genuine "instructional partner."

2. Learning Schedule Module: Enabling the Dynamic, Personalized "One Student, One Timetable"

Traditional class schedules are static arrangements shared across an entire cohort. By contrast, Zhijiang WeSchool's Learning Schedule module draws on the Smart Education Platform's quality resource repository and each student's personal learning data, using digital technology to dynamically generate a bespoke timetable for every teacher and student. The system continuously analyzes students'

'behavioral data from digital textbooks, school-based resources, and online exercises, identifying knowledge gaps, learning rhythms, and interest preferences. It then pushes targeted pre-class preparation resources, flags priority content during class, and precisely matches consolidation exercises after class—forming a full-cycle, personalized learning loop spanning pre-class, in-class, and post-class stages.

Beyond these two core modules, the platform's complete service matrix includes: a Knowledge Library (more than ten thematic resource collections); a Tools Library (over twenty AI instructional tools, including Smart Chinese Language, AI Programming, and AI Q&A); a Data Library (five-domain teacher-student profiles and digital portfolios); an Activity Library (a provincial hub for educational activity aggregation and distribution); and Class Circle (a digital bridge for home-school co-education). Collectively, these components provide comprehensive support for the deep application of digital textbooks and the effective utilization of terminal data.

(II) Digital Textbooks as the Fuel: Building a Standardized and Contextualized Supply of High-Quality Knowledge

The construction of Zhejiang's provincial K–12 digital textbook system represents a systematic and forward-looking provincial-level strategic initiative in educational digitization. Far from being a simple electronic conversion of printed materials, the initiative has built a complete ecosystem integrating content development, platform services, and terminal compatibility. Its core construction agenda unfolds across three dimensions.

1. Content Development

Focused on core subjects including Chinese language and English, covering grades from primary school through junior secondary, the province has developed 37 volumes of premium digital textbooks, ensuring the high quality and standardization of resources. The textbooks feature multimodal and interactive characteristics, incorporating audio, video, interactive exercises, and assessment tools to make knowledge presentation more vivid and engaging, while providing technical foundations for contextual and inquiry-based learning.

2. Platform Services

The platform integrates resource application, learning assessment, and data analytics functions. It supports personalized learning pathway planning, voice assessment, and other intelligent aids for students, while providing teachers with learning-condition data insights to optimize instructional strategies. It also supplies data support for evidence-based decision-making by regional education administrators. These capabilities ensure that digital textbooks are used both broadly and deeply—turning them into living, actively-applied resources.

3. Terminal Compatibility

The digital textbooks are fully compatible with PCs, mobile devices, interactive whiteboards, and all-in-one classroom units, and support mainstream operating systems including HarmonyOS. This breaks down device and venue constraints, enabling seamless use across multiple scenarios: interactive classroom instruction, home-based consolidation learning, and mobile micro-learning during fragmented time slots.

(III) Digital Terminals as the Gateway: Innovating Zhejiang's Model for "Shared Prosperity in Education"

The value of Digital Space and Digital Textbooks can only be realized on the precondition of universal terminal access. Yet equipping every student with a terminal involves not only funding and technical standards, but also location-specific innovation in financing mechanisms and the mobilization of social participation. Zhejiang piloted replicable models for terminal universalization in Kaihua County, Quzhou City, and in small-scale schools across the province.

In Kaihua County, Quzhou City, without any dedicated funding, education authorities coordinated annual budget allocations, drawing on Teaching Community and education informatization transfer-payment funds as the base, and partnering with third-party corporate donations to essentially resolve the terminal needs of all students in Grades 4 through 9 across the county. This provided the province's districts and counties with a replicable model of funding integration: "government coordination + corporate donation + regional support."

For small-scale schools with fewer than 100 students province-wide, the Zhejiang Provincial Education Technology Center took the lead, with iFLYTEK Co., Ltd. donating 2,000 tablet computers to essentially resolve terminal needs for Grades 4 through 6 in all such schools. Follow-up training services were concurrently provided, and tailored application plans were designed for each school to ensure that the terminals were fully and meaningfully utilized in small-school teaching contexts.

These practices demonstrate that even in county-level localities without dedicated digital education funding, universal regional terminal coverage is achievable through diversified funding integration and a "shared prosperity in education" mechanism—ensuring that the point of equitable entry to digital education reaches even the most remote village schools.

Outcomes and Impact

(I) Comprehensive Expansion of Resource Coverage, Advancing Educational Equity and Accessibility

Through the coordinated advancement of the Three Digitals framework, Zhejiang's Smart Education Platform Zhijiang Hui has aggregated more than 15 million items of quality educational resources, covering all primary and secondary schools in the province. The 37 volumes of premium digital textbooks achieve full coverage of core compulsory-education subjects, having served more than one million teacher-student interactions in cumulative terms. On the terminal front, the Kaihua County model and the small-scale school model have inspired multiple districts and counties across the province to launch universal terminal rollout plans. More than 600 small-scale schools now provide students with digital learning conditions equivalent to those in urban schools, effectively narrowing the urban-rural digital education divide.

(II) Large-Scale Personalized Services Implemented at Scale, Bringing Differentiated Instruction to Life

The practice model combining School-Based AI Agents and Learning Schedules has gone live on Zhijiang WeSchool. Teachers can now rapidly build dedicated instructional agents based on school-based resources, while students receive personalized resource recommendations calibrated to their individual learning profiles. Leveraging more than twenty freely accessible AI instructional tools, the use of Smart Chinese Language, AI Programming, AI Q&A, AI Composition Feedback, and similar applications by teachers and students province-wide has become increasingly active. The full-cycle personalized learning loop spanning pre-class, in-class, and post-class stages has taken initial shape, and "large-scale differentiated instruction" is transitioning from a conceptual aspiration to province-wide, scalable practice.

(III) Innovation in Diversified Funding Mechanisms, Exploring a "Shared Prosperity in Education" Solution for Terminal Universalization

Zhejiang's pioneering three-dimensional linkage model of "government coordination + corporate donation + regional assistance" has demonstrated the feasibility of achieving universal regional coverage of learning terminals under constrained fiscal conditions. Kaihua County's success in equipping all students in Grades 4 through 9 without dedicated funding, and the provincial Education Technology Center's mobilization of social resources to solve the terminal challenge in small-scale schools, have together become exemplary cases for the province and the nation alike. This model shows that an equitable point of entry to digital education need not depend entirely on dedicated national fiscal appropriations—institutional innovation and social collaboration can equally deliver digital learning opportunities to the most remote village schools.

(IV) Autonomous Provincial Platform Ensures Data Sovereignty and Scalable Service Delivery

Zhejiang's decision to develop the Zhijiang Hui Smart Education Platform and Zhijiang WeSchool Digital Space through independent provincial development—rather than wholesale adoption of commercial platforms—both safeguards the security and sovereignty of educational data and achieves scalable personalized service delivery at the provincial scale. The "Five Libraries, One Circle, One Schedule" architectural design endows the platform with end-to-end service capabilities spanning resource aggregation, tool integration, learning-condition analysis, and personalized recommendation, ensuring that educational data remains within the provincial education system at all times. This pathway offers an important reference for other provinces across China, and indeed for other countries, seeking to build autonomous, controllable digital education platforms.

Case 34

AI Huixue: Advancing Personalized Education via Integrated Computing Power Sharing Applications

Educational Technology Center of Zhejiang Province, Zhejiang, China

Background

As a catalyst for technological revolution and industrial transformation, artificial intelligence (AI) is reshaping educational landscape. While it promotes its comprehensive integration into education to facilitate personalized teaching and learning, several critical bottlenecks persist during its integration into the classroom:

First, the tech-application bottlenecks. Most applications focus on shallow scenarios like sports data collection, with insufficient exploration in empowering classroom teaching and learning, and failing to delve into data-driven inquiry-based teaching. AI products are highly general, with slow conversion and high development barriers for subject-specific needs, making it difficult to effectively match supply and demand.

Second, the teacher competency bottlenecks. Teachers generally have poor AI literacy, with unsystematic specialized training. Some have misconceptions and lack application awareness and skills. Less than 10% of teachers can proficiently use AI. Learning new tools increases their burden, which leds to a significant gap between high-level policy enthusiasm and ground level implementation, therefore resulting in fragmented adoptions.

Third, the resource support bottlenecks. Most cities lack special funds for AI education, relying on limited educational technology funds, and some pilot projects face a shortage of follow-up operation and maintenance funds. A regional computing resource sharing mechanism has not been established, and self-developed schools encounter computing bottlenecks.

Finally, the ethical security bottlenecks. The collection of sensitive data from teachers and students poses a risk of privacy breaches. Open AI content may have value orientation biases, and students using AI to complete homework, etc., undermines academic integrity rules.

Figure 1 Architecture of the Supporting Service Platform for Intelligent Education Applications

Case Implementation Status

The "AI Huixue" platform takes computing power sharing, application integration, and ecological co-construction" as its core concepts and follows a three-step implementation path from "Infrastructure Consolidation" to "Capability Empowered" and "Scenario-baded Integration" consequently, systematically promoting the in-depth integration of artificial intelligence (AI) into the entire process of education and teaching:

1. Building an Integrated Educational Foundation to Break Through the Bottleneck of Computing Power Resources

Relying on the Zhejiang Provincial Education Computer Network and the Zhejiang Provincial Backbone Network of the China Education and Research Network, it comprehensively constructs an integrated provincial educational computing power private network. With the core goals of "high security, high stability, and high efficiency," it provides fundamental support for the digital and intelligent transformation of education. Leveraging the General Purpose, Intelligent, and High Performance computing of the Hangzhou Iron and Steel Group Intelligent Computing Center, it coordinates and efficiently shares the computing power resources built by operators and universities across the region. It builds a two-tier scheduling educational computing power sharing service platform and creates a unified elastic educational computing power resource pool in the province. This provides cost-effective, accessible, and self-controlled computing power resource services for educational administrative institutions, various schools, and teachers and students throughout the province, effectively addressing the challenges of insufficient computing power and an imbalanced supply structure in primary and secondary schools.

Based on the "Education Cube" data foundation, it aggregates basic data from schools across the province, teaching behavior data, and intelligent agent application data, among others. It constructs a five-level (provincial-municipal-district-county-school) educational intelligent governance system, enabling cross-departmental, cross-level, and cross-school data connectivity and efficient sharing. This solidifies a unified educational data foundation and provides a data engine to support precision teaching and intelligent management.

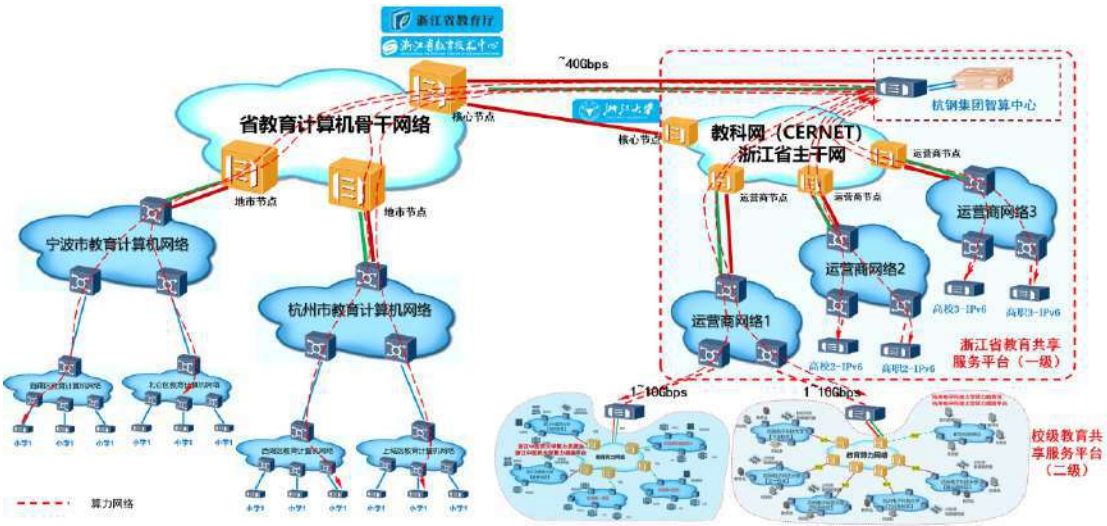

Figure 2 Zhejiang Provincial Specialized Network for Educational Computing Power and Two-Tier Computing Power Sharing Service Platform

2. Building Four Core Capability Engines to Lower the Barriers to Technology Application

Based on large models and intelligent agent technology, it constructs a one-stop full-lifecycle service system for educational intelligent agents and creates the "AI Huixue" platform. This integrates four core capability engines: an intelligent agent development platform, a training sandbox with data annotation, a knowledge base management system, and an application testing and evaluation center. It establishes a closed-loop full-chain process from "data - training - development - evaluation - application," offering a convenient and efficient service model for the education sector. In response to the four major pain points faced by teachers—"inability to use, unwillingness to use, inconvenience in use, and fear of use"—the platform innovates four solutions.

First, addressing the "inability to use" issue. By deeply embedding the intelligent agent matrix into WPS office software, teachers can conveniently access various AI tools in their daily office environment without mastering complex professional skills such as model deployment and fine-tuning evaluation. This significantly lowers the barriers to technology application.

Second, addressing the "unwillingness to use" issue. Based on the one-click intelligent agent insertion function in WPS PPT, teachers can customize their exclusive PPT teaching toolbars by combining their favorite intelligent agents. This seamlessly integrates AI functions into the regular teaching preparation process, avoiding additional work burdens on teachers and achieving "imperceptible application."

Third, Addressing the "inconvenience in use" issue. It builds a high-quality, shared, and systematic library of subject-specific intelligent agents and tools, supporting teachers in independently designing personalized intelligent agents according to their teaching needs. This forms a multi-level intelligent application system of "general + subject-specific + school-based," meeting the personalized teaching needs of different scenarios and disciplines.

Finally, addressing the "fear of use" issue: It establishes a strict intelligent agent listing review mechanism. All published applications must undergo comprehensive testing in terms of safety compliance, ethical norms, and teaching adaptability to build a robust safety and ethical defense line and ensure the safe use by teachers and students.

3. Delving into Five Application Areas to Build a Full-Scenario Service System

The platform focuses on five core educational areas—"AI-assisted learning, AI-assisted teaching, AI-assisted management, AI-assisted evaluation, and AI-assisted research"—to construct an AI application scenario system that covers the entire teaching process, serves all educational stages, and spans various disciplines. By deeply integrating six core functions—computing power supply, data support, model training, intelligent agent development, safety supervision, and achievement promotion—it builds a closed-loop service system for AI empowerment in education, achieving precise empowerment and quality and efficiency improvements through AI.

It establishes an "open, fair, equal, and shared" market-oriented operation mechanism to stimulate efficient intelligent agent development and market innovation vitality. Through ecological collaboration and standardized guidance, it promotes the standardized, orderly, and sustainable high-quality development of AI education across the province and constructs a co-constructed and shared, collaborative and innovative AI education ecosystem.

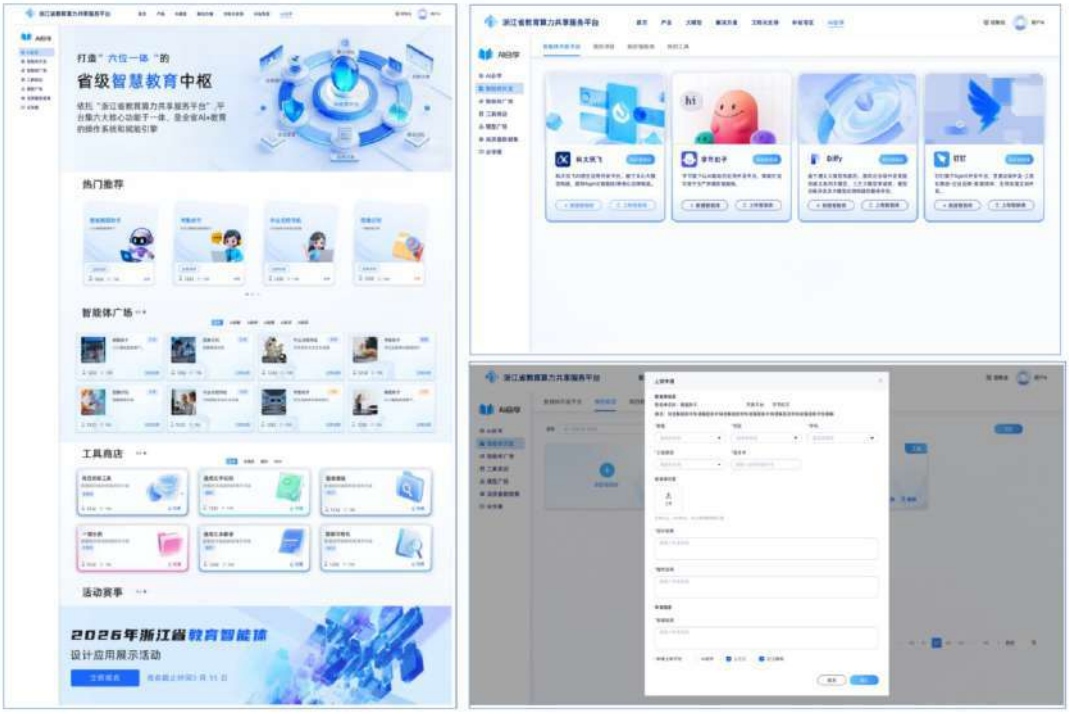

Figure 3 Zhejiang Provincial Educational AI HuiXue Platform

Case Implementation Status

Compared with similar practices, the "AI Huixue platform" boasts four unique and innovative advantages.

1. Technological Architecture

It pioneers a dual technological approach of "computing power sharing + WPS embedding," which not only resolves the challenge of coordinated regional computing power resource allocation but also significantly lowers the barriers to technology application by deeply integrating with teachers' commonly used office software. This enables a novel service model of "Decentralized Compute, Cloud-based Services."

Figure 4 Inserting Intelligent Agents during Lesson Preparation (left) and Invoking Intelligent Agents during Playback (i.e., Teaching) Mode (right)

2. Product Form

It creates a product form that combines an "intelligent agent matrix + customizable toolbar." This approach not only offers a systematic array of high-quality subject-specific intelligent agents but also supports teachers in independently developing personalized applications. It balances standardized services with individualized needs, achieving truly individualized experiences.

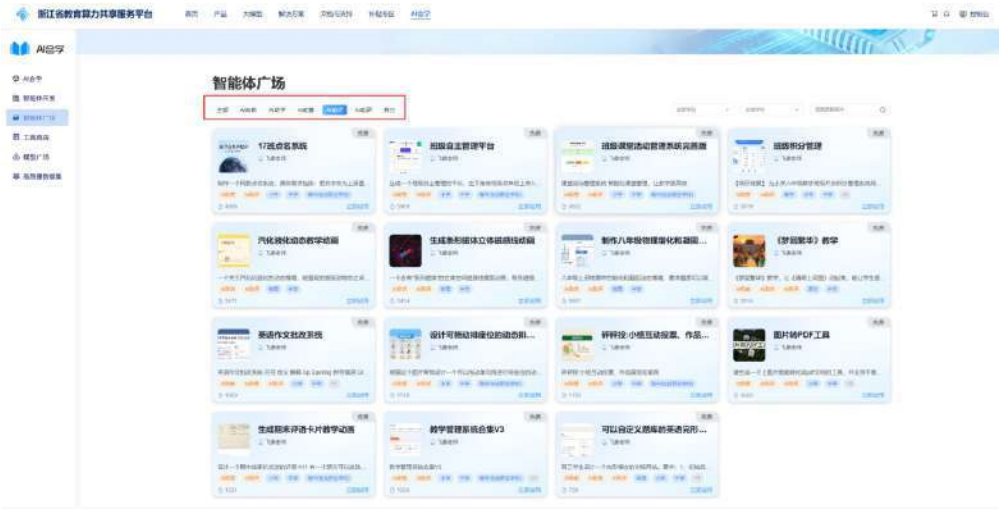

Figure 5 List of Intelligent Agents on the AI Huixue Platform

3. Ecological Mechanism

It establishes a collaborative innovation mechanism characterized by "government guidance, state-owned enterprise support, and multi-party co-construction," which connects the entire chain of "government-industry-academia-research-application." The Hangzhou Iron and Steel Group provides over 1000 PFlops of computing power to the educational sector across the province, fully leveraging the leading role of state-owned enterprises in providing technological foundations and computing power resources. Together, they tackle the development of education-specific large models and intelligent agents with distinctive Zhejiang characteristics.

Figure 6 Zhejiang Provincial Competition on the Design and Application of Educational Intelligent Agents

4. Security Governance

It sets up two layers of security defenses through "manual review/automatic detection + safety and ethical evaluation," achieving full lifecycle management that includes pre-listing review of intelligent agents and dynamic monitoring during use. This effectively ensures data security and ethical compliance, addressing the trust crisis associated with the "fear of use."

Case Effectiveness

Since its launch and operation, the platform has achieved remarkable phased results, primarily reflected in the following four aspects.

1. Significant Improvement in Teachers' Teaching Efficiency

Through the deep integration model with WPS, teachers can directly access a vast array of high-quality teaching resources within the platform, including knowledge bases, intelligent agents, and tools, during the lesson preparation and delivery process. This enables them to efficiently complete tasks such as instructional design, identifying key and difficult points, and selecting exercises, saving an average of over 40% of their lesson preparation time. For instance, Hangzhou Shengli Primary School utilizes the platform's "Wenqu Zhiyue" essay grading system, which, relying on an intelligent grading engine, provides personalized comments and suggestions. This has reduced teachers' essay grading time by 60%, allowing them to devote more attention to meeting students' individualized growth needs. At Qian Xuesen School, the AI-powered psychological "Aixin Xiaodingdang" (Loving Little Dings) helps students gradually learn to rationally face difficulties and setbacks, promoting healthier and more composed growth. Teachers can also promptly provide care and attention to students based on early warning information.

2. Remarkable Results in Students' Personalized Learning

The platform covers the entire scenario of "lesson preparation, teaching, learning, practice, testing, and evaluation." It constructs digital profiles based on students' learning behavior data to customize suitable learning content and paths for them, enabling high-quality, large-scale personalized learning. Pujia

Primary School in Hangzhou has applied intelligent agents such as "Learning Situation Analysis" and "Evaluation" in Chinese and mathematics courses, resulting in a general increase of over 10% in student participation and problem-solving abilities in the classroom.

3. Initial Formation of an Intelligent Application Ecosystem

The "AI Huixue platform" has aggregated and released over 300 educational intelligent agents, meeting the application needs across all educational stages, disciplines, and scenarios. The 2026 Zhejiang Provincial Educational Intelligent Agent Design and Application Exhibition has attracted participation from primary and secondary schools across the province as well as numerous enterprises. It is expected that over 1,000 high-quality educational intelligent agents will be added within the year, gradually realizing a resource allocation model of "innovation in one place, sharing across the province."

4. Significant Increase in the Efficiency of Computing Power Resource Utilization

Through a two-tier computing power scheduling mechanism, the cost of acquiring computing power for primary and secondary schools will be reduced by 60%. This effectively addresses the computing power bottleneck faced by schools that independently develop intelligent teaching systems and offer practical general education courses, providing a solid infrastructure foundation for the large-scale promotion of AI applications in education.

Promotion Value

The construction model and application experience of "AI Huixue" boast strong universality and exemplary value, making them replicable and promotable across the country.

1. Promotion Pathway

Following the implementation pathway of "pilot testing first, gradual promotion, and comprehensive coverage," the promotion will proceed in three stages:

Stage 1 (2026): Select 10 pilot schools in each of the 11 prefecture-level cities in Zhejiang Province for in-depth application, forming replicable school-level application models.

Stage 2 (2027): Expand the promotion to other provinces and cities in the Yangtze River Delta region, establishing regional-level cooperation mechanisms.

Stage 3 (From 2028 onwards): Promote nationwide, providing Zhejiang solutions for the digital transformation of education in different regions.

2. Localized Adaptation Solutions

Tailored to the varying levels of educational development and resource endowments across regions, three-tier adaptation solutions are offered.

Basic Version: Provides standardized computing power sharing services and a general intelligent agent matrix, enabling rapid integration and use by primary and secondary schools to meet basic AI teaching application needs. This version is suitable for regions with relatively limited educational resources.

Standard Version: Builds upon the basic version by offering regional-level data middleware platforms and intelligent agent development tools, supporting local independent development of characteristic subject-specific intelligent agents. This version is suitable for regions with moderate development levels.

Advanced Version: Offers customized computing power scheduling solutions and full-chain ecosystem services, supporting the construction of regional-level AI education application ecosystems. This version is suitable for regions with advanced educational development.

3. Expected Outcomes

Through nationwide promotion and application, three major goals are anticipated. Firstly, significantly Lower the Barriers to Regional AI Education Applications. Enable underdeveloped regions to equally access high-quality intelligent educational resources, promoting educational equity. Secondly, drive a General Improvement in Teachers' Digital Literacy. Enable over 80% of subject teachers to proficiently use AI tools for teaching, fostering innovative teaching models. Lastly, build a National Ecosystem for Sharing Educational Intelligent Agents. Facilitate the cross-regional flow of high-quality educational resources, comprehensively enhancing the level of digital development in China's education sector.

Case 35

An Applied Educational Case Study on Artificial Intelligence Literacy for Non-Technical University Students

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Case Background

This paper describes a national AI-for-All educational intervention initiated by King Abdulaziz University (KAU), in strategic partnership with the Saudi Ministry of Communications and Information Technology (MCIT) and international industry partner Microsoft, to promote artificial intelligence (AI) literacy among non-technical university students. The challenge aims to fill a fundamental gap in education: despite AI being well on its way to penetrate all professions, there are virtually no opportunities for students not majoring in computer science to receive systematic AI education.

Consistent with the directions of Saudi Vision 2030 and national digital transformation initiatives, the project embeds Microsoft AI-900: Azure AI Fundamentals into accredited university elective courses (CPCS-335 and CPCS-336) so as to prepare students from science, medical, humanities, and arts colleges to acquire a basic understanding of AI, its applications, and ethical considerations without requiring a programming background. The pedagogical model is explicitly based on Bloom's Taxonomy, reinforcing cognitive understanding through hands-on application and responsible AI values.

In the cloud-based no-code learning environment, students work with real AI services such as computer vision, natural language processing, document intelligence, and generative AI. The impetus is on project-based learning, transdisciplinary cooperation, and ethical reflection, enabling verifiable learning objectives and real-world applicability.

The program has already engaged 7,298 students at KAU, with the adoption or preparation of nine other Saudi universities actively supported by faculty capacity-building across the country. Operating under a comprehensive, all-in-kind, zero-cost scheme, the model is scalable, sustainable, and nationally replicable. This is a case study on the design, implementation, and impact of a public–private–academic partnership that has developed a scalable model for realizing inclusive AI education and workforce preparedness.

Background

Higher education systems worldwide face a critical challenge: Artificial Intelligence (AI) is reshaping every discipline, yet AI education remains largely confined to computing majors. This is the critical problem that universities across the globe have started to tackle. By aligning AI capability development with the substantive needs of future professionals across medicine, education, business, humanities, and engineering. This was done as part of a larger national collaboration between King Abdulaziz University, the Ministry of Communications and Information Technology (MCIT), and Microsoft, with the goal to drive AI capacity building and digital skills development for higher education in Saudi Arabia. At King Abdulaziz University (KAU), this need became more apparent through national priorities aligned with Saudi Vision 2030, digital skills, AI literacy, and workforce readiness. Traditional pedagogical, lecture-based models were not enough to prepare non-technical learners to master concepts, use skills, and understand the ethical considerations of AI systems. To tackle these pain points, KAU introduced an AI-for-All education reform initiative by integrating Microsoft's AI-900: Azure AI Fundamentals into an elective course at the university level (CPCS-335 for science and medical colleges and CPCS-336 for Art colleges). The purpose of the program was to break down conceptual walls, from stage one: abstraction, to apply and provide a three-way look at the topic or content (cognitivism, skills & attitude), reflected upon Bloom's Taxonomy.

The need was not simply curricular but systemic: ensuring that all students had equitable access to AI, promoting a culture of interdisciplinary innovation, and preparing graduates to use, assess, and govern AI responsibly in their professional fields. The implementation goals targeted scalability, inclusivity, learning outcomes that could be measured, and national replicability across Saudi universities

Case Implementation Status

Starting Fall 2024 through Fall 2026, nearly 7,298 full-spectrum-trained students from King Abdulaziz University (KAU) and nine Saudi universities have adopted this developed AI course, or are currently preparing to implement such a system. At King Abdulaziz University, a dedicated group of faculty members was trained to co-teach the course and oversee student projects. At the national level, over 1,500 faculty members were reached through AI literacy seminars, dissemination workshops, and implementation briefings to support widespread institutional uptake. The initiative was delivered at zero financial cost through a fully in-kind model, confirming its maturity, stability, and scalability. The initiative was made feasible by the complementary roles played within the partnership, with MCIT providing national direction and facilitation, Microsoft bringing cloud-based AI platforms and training materials to the table, and King Abdulaziz University driving academic design, delivery, and assessment. The implementation followed the steps outlined below:

1) Identify Educational Requirements:

Despite this diversity of disciplinary backgrounds and the AI literature becoming increasingly rich, we identified significant untapped demand for AI literacy among non-computing students across medical, health sciences, education, business studies, and humanities faculties. Students were interested in learning about AI applications in their fields, but wanted paths that bypassed programming prerequisites.

2) Design of the Curriculum and the Learning Outcomes:

Two university elective courses (CPCS-335 and CPCS-336) were established in the computer science department as university-level electives targeted at non-CS degree holders. During the process, it is explicitly stated that there were no prerequisites. Their learning goals cover all three domains of Bloom's Taxonomy:

- Knowledge (Remember, Understand): AI concepts, history; AI agents; ML: types of learning; NLP, Computer vision & generative AI.
- Skills (Apply, Analyze): Practical Azure AI labs, Hands-on (Vision, Language, OCR, Generative AI).
- Values (Evaluate): Ethics, bias, explainability, responsible AI, and regulation.

Individual learning objectives are correlated with specific teaching and assessment methods, such as quizzes, graded labs, projects, and final examinations. Figure 1 illustrates the overall structure of the developed curriculum, highlighting the progression of AI concepts, hands-on laboratory components, and ethical considerations, as well as their alignment with Bloom's Taxonomy learning domains and the Microsoft AI-900 framework.

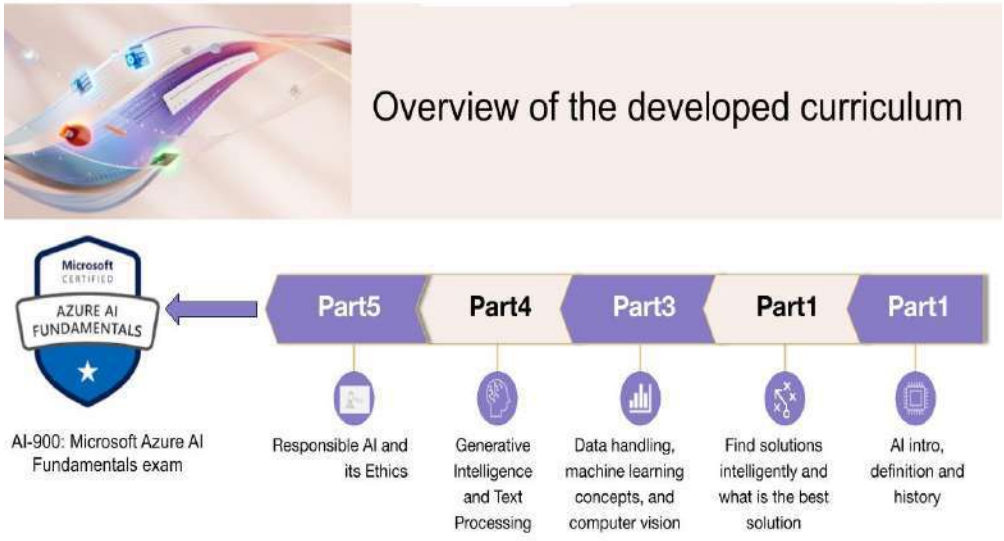

Figure 1 Overview of the course structure mapping foundational AI concepts, Azure AI labs, responsible AI and ethics, and Bloom's Taxonomy outcomes with alignment to the Microsoft AI-900 framework.

3) Labs and Hands-on:

The initiative used the following Microsoft Azure AI services as a teaching tool:

- Azure AI Vision for images.
- Azure AI Language for sentiment analysis and entity extraction.
- Azure Document Intelligence for OCR and document processing.
- Azure Generative AI for prompt engineering and ethical exploration.

Using the Azure cloud solution from Microsoft, no lab environments need to be set up (so no technical background is required), there is no unfair infrastructure inequality, and it is accessible from every device. Figure 2 illustrates a guided Azure AI Vision laboratory, where non-technical students interact with real-time image analysis services through a no-code interface.

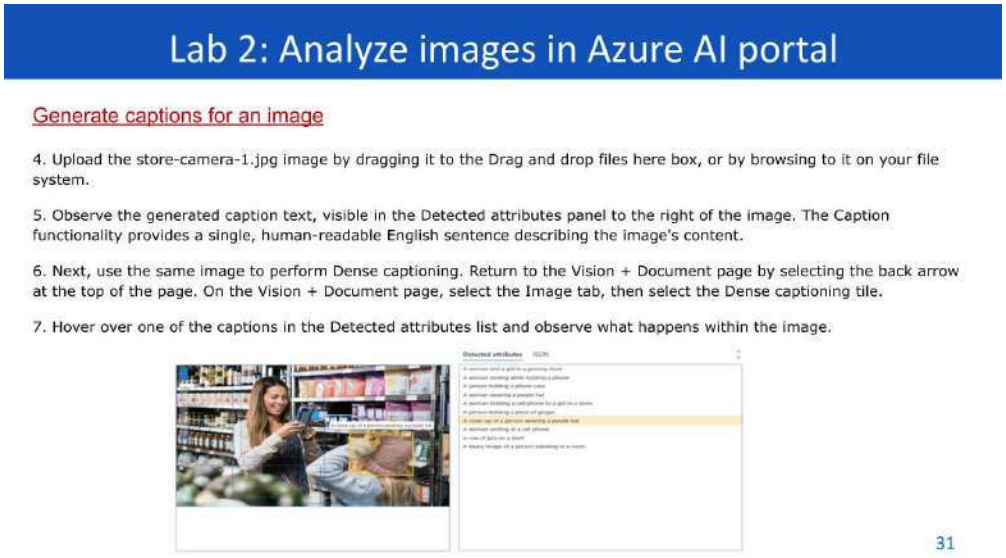

Figure 2 Azure AI Vision lab hands-on

4) Project-Based Learning:

Students collaborated in multidisciplinary teams to develop domain-specific AI applications, including:

- Mental-health sentiment analysis
- Educational feedback analytics
- Visual inspection tasks
- Text and document automation workflows

Each project required problem formulation, selecting an AI service from the Azure platform, applying the tool to a real dataset, interpreting the output, and ethical reflection.

This framework ensured that advancement from knowledge to application to evaluation is perfectly aligned with Bloom's higher-order learning outcomes. Figure 3 presents examples of interdisciplinary student project presentations, demonstrating applied AI use cases developed using Azure AI services.

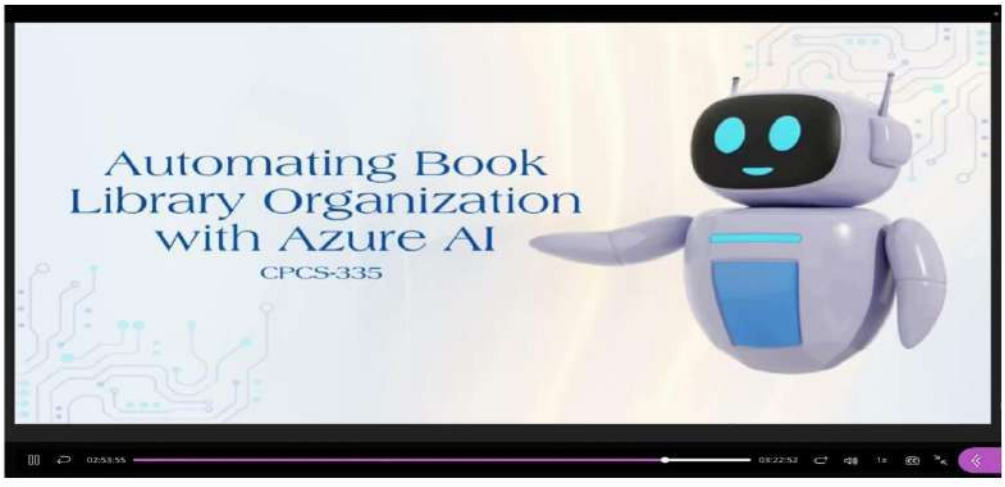

Figure 3 Student project presentation demonstrating applied AI use in domain-specific contexts.

Case Innovation and Breakthroughs

1. Main Innovation Content:

Pedagogical Innovation:

The pioneering initiative upends the classic “learn-to-code-first” model with a groundbreaking AI literacy-first, application-led model. This new model aims to enable non-experts to learn an approach and think critically about state-of-the-art AI systems, creating a more inclusive and accessible learning process.

Curricular Innovation:

CPCS-335 and CPCS-336 provide a structured course of instruction leading to the Microsoft AI-900 industry certification. Such innovative integration benefits both teaching and learning experiences and ensures that academic standards are maintained throughout, ultimately enhancing students' perceptions of educational value.

Equity Innovation:

It is the process of systematically removing barriers to entry in hardware and coding, effectively democratizing AI education and enabling a wide range of learners to participate in and benefit from unleashing AI's transformative potential.

2. Technology Breakthrough Content:

This work was not intended to develop new AI algorithms, but it did take a major step forward in educational technology, the pedagogical re-engineering of enterprise-level artificial intelligence infrastructure for non-technical learning at scale. In particular, Microsoft's Azure AI services (which were developed for professional developers and data scientists) have been methodically repurposed as no-code student-centred learning environments.

This re-engineering was implemented in a variety of concrete ways. To start, all AI interactions are low-code, allowing students with non-computational backgrounds to configure, run, and interpret AI models directly through graphical interfaces rather than programming. The second was that the Azure platform and its contained services were an appropriate classroom for students to use as a sandboxed student learning environment where they could experiment with actual AI systems while managing ethical, data security, and operational spill risks. Third, ethical and responsible AI principles were embedded in the lab workflow itself, meaning students were forced to consider bias, fairness, explainability, and societal impact as they used computer vision, language, and generative AI services.

And finally, real-time AI feedback (such as live image analysis results, text sentiment outputs, and generated responses) surfaced the time-honored static demonstration model with instant learning reinforcement and further conceptual depth. In combination, these aspects constitute a relevant technical and pedagogical innovation, situating the case at an advanced applied-educational level that addresses the traditional schism between theoretical AI concepts in academic education arenas and practical applications in AI laboratories, reflecting broader educational objectives of informatization and digital transformation.

3. Application Practice Breakthrough Content:

Major achievements include breakthroughs, such as the large-scale national deployment of AI technologies without a cost explosion, so we will not be burdened by it. Furthermore, there is a significant increase in transdisciplinary diffusion of AI across domains, including medicine, education,

and business, indicating the flexibility and relevance of the AI course across an array of sectors. Moreover, a scalable template has been carefully crafted and is now implemented across institutions to enable a harmonized approach to AI integration. And in the end, this ambitious project creates a solid foundation at the national level for developing AI literacy in higher education, serving as a model for educational challenges in ever-changing technological contexts.

4. Intellectual Property Status:

All teaching materials, full lab guides, and multiple assessments are the property of King Abdulaziz University and are under the university's control to protect IPR and educational resources. In addition, the latest Microsoft Azure tools are used in compliance with educational licensing agreements to provide dynamic, technology-integrated learning. No student proprietary information or complex algorithms are claimed to be owned, thereby guaranteeing students' privacy. The educational materials are also distributed through formal institutional agreements, allowing duplication and sharing, fostering cooperation, and expanding education across multiple formats.

Promotion Value and Risks

1. Application Prospects and Achievements:

The project has already achieved an impressive series of milestones, in particular the massive reach, which has enabled it to effectively engage 7,298 students. Also, it has been shown to be replicable across institutions, effectively proving its adaptability and utility across multiple educational landscapes. But beyond these accomplishments, the initiative has also developed a strong model for faculty capacity-building that will build on and facilitate the skills and efficacy of educators engaged. Due to the successes it has achieved, the project is now well-prepared and has a strong base for growth nationally and internationally, thereby extending its impact to more territories.

Course assessment indicates that >90% of students have successfully completed the guided Azure AI labs and >85% have submitted the final project, indicating attainment of the knowledge, skills, and value-based course objectives. Furthermore, coherent content and assessment design gave students confidence that attaining a pass would guarantee theoretical knowledge of what was required for the Microsoft AI-900, the industry-aligned AI foundation certification, even though certification sitting was optional.

2. Social and Economic Impact:

Workforce AI preparedness among non-technical job functions has become a growing focus, highlighting the importance of workers in all roles being able to handle the technological revolution. Partnerships between educational establishments and industry have proved to be a successful means of cutting the cost of training, thereby enabling access to indispensable learning for the widest possible range of people. It’s a relationship that not only helps produce innovative curricula aligned with current job-market needs but also improves the quality of the education students receive.

On the other hand, such businesses are helping the workforce thrive by improving their employability and overall digital confidence. The more people know and the more experience they gain with AI tools and technologies, the easier it is for them to find their way in the workplace. This enhanced digital fluency will give employees greater confidence as they seek new opportunities in a competitive job market. The cross-fertilization of academia-industry collaboration and talent development are keys to career-readiness in a constantly evolving employment context.

3. Demonstration and Leadership Role in Basic Education:

The case appears to be a benchmark for inclusive AI education, compellingly demonstrating how universities worldwide can and should lead national-level AI capacity-building with responsibility and foresight by interpreting "basic education" as foundational, cross-disciplinary AI literacy for non-specialist tertiary students.

4. Technical and Ethical Risks:

Technical risks: One risk explored was platform dependency, which greatly reduces adaptability and flexibility, and this was addressed early by designing a carefully engineered modular approach that provides greater versatility and decoupling.

Ethical risk: Misuse of or over-reliance on outputs generated by artificial intelligence systems is a serious concern, which is addressed head-on through the inclusion of explicit ethics modules that ensure responsible use and establish a framework for ethical decision-making.

Educational risk: Over-simplification, which can reduce the depth of educational content and weaken learning outcomes, is prudently mitigated by the use of a pre-designed assessment rubric that provides a broad framework for assessing student understanding and application of knowledge.

Other Relevant Information

1.Awards and Recognitions

Global Digital Excellence Awards 2025 – Standout Use of AI. Submitted by King Abdulaziz University. Nominated among the top three finalists.

2.Third-Party Evaluation

Feedback from students has been positive to the point that many have referred to the course as "transformational" and "the best course of the semester," noting that it significantly impacted their learning. And there has been strong advocacy and support from Microsoft Education MENA, which has strengthened the program's legitimacy. Moreover, this cutting-edge course is being considered for implementation at nine universities in Saudi Arabia, suggesting a positive trend in educational cooperation and exchange.

3.Case-related images, videos, and other materials.

For more detailed curriculum and learning objectives, together with assessment design, refer to the full course specifications for CPCS-335, which are appended to this submission. Figures 2 and 3 also show representative laboratory screenshots and student project examples that demonstrate how students apply AI knowledge in practical situations, indicating that the courses are hands-on and application-oriented.

The case has been widely disseminated in public and official media, which evidences its importance, repercussions, and visibility at the institutional and national levels within the educational field. Media access and official announcements of the initiative are available at:

Videos :

https://www.instagram.com/reel/DFKm28hIcrk/

https://x.com/MSEduMENA/status/1883897370863427737

News:

https://www.okaz.com.sa/news/local/2179252

https://www.al-madina.com/article/920808/جامعة-الملك-عبدالعزيز-تطلق-مبادرة-لتطوير-مقررات-الذكاء-الاصطناعي

https://www.spa.gov.sa/N2249061

Case 36

Key Pathways to Enhance Personalized Learning Outcomes in Mathematics for Primary School Students: An Empirical Study Based on "AI Learning Companion"

Doudou Huang

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Background

In response to the national initiatives outlined in the "Outline for Building a Strong Education Nation (2024-2035)" and the "Guidelines for Generative AI Use in Primary and Secondary Schools (2025 Edition)", Suzhou Industrial Park, as a national smart education demonstration zone, is pioneering the integration of "educational innovation + artificial intelligence". However, current implementations predominantly rely on generic technologies without discipline-specific solutions. Primary education faces multiple challenges including curriculum adaptation, emotional engagement, collaborative learning, and assessment systems, which constrain teaching quality and educational equity. Against this backdrop, our institution has adopted the research framework of Shanghai Normal University's Learning Technology (CTCL) Laboratory to launch the "AI-powered Learning" project, introducing personalized collaborative learning supported by AI learning companions.

The AI Learning Companion System leverages generative artificial intelligence to achieve cognitive baseline assessment, personalized learning resource development, human-machine collaborative instructional design, generative teaching implementation, and comprehensive evaluation. It redefines the educational logic of large-class instruction and drives digital transformation in education. This case study not only aligns with national strategies and supports regional reforms, but also provides an innovative practical model for addressing teaching challenges and achieving differentiated instruction tailored to individual needs.

Case Implementation Status

(1) Demand Analysis

Aligned with the national strategy for digital transformation in education, the school focuses on the development direction of "Smart Education+" within the industrial park. By introducing the "Yidianhui" AI learning companion system, it concentrates on subjects such as elementary mathematics and Chinese for students in grades four to six, exploring research on "personalized collaborative learning supported by AI learning companions."

Adhering to the spiral research pathway of "theoretical construction → technological development → empirical validation → iterative optimization → radiating promotion", this study focuses on the comprehensive classroom environment of basic education across all disciplines. Through tripartite collaboration among "university technical teams + frontline teachers + educational administrators", it achieves a leap from single-discipline pilot projects to full-discipline applications. The research framework is illustrated in the figure:

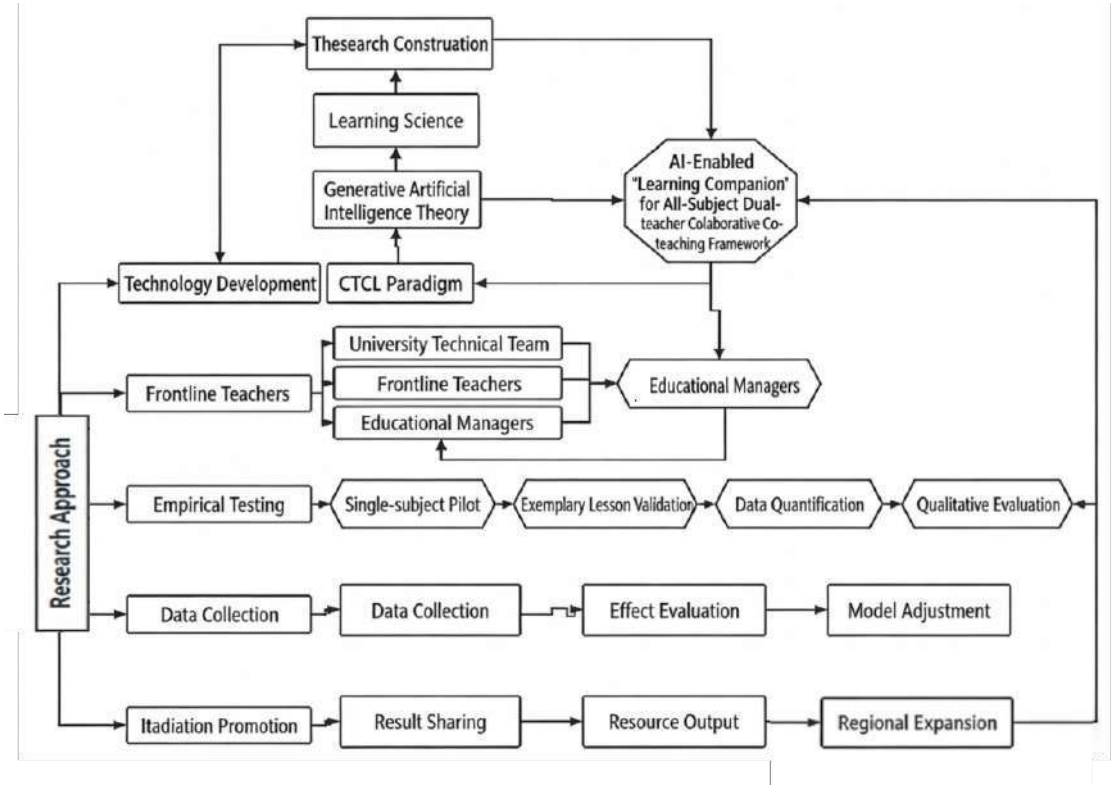

Figure 1 Research framework

(II) Technology R&D and Personalized Customization

1. AI Learning Companion System Development

Since April 2024, the university has undertaken the "AI Intelligent Learning" initiative within Suzhou Industrial Park. Led by Shanghai Normal University's Learning Technology (CTCL) Laboratory in collaboration with Zhejiang Normal University's expert team in smart education, the project introduced the "Yidianhui" AI Learning Companion System for experimental teaching. Through joint development

of this system, researchers conducted studies on personalized collaborative learning supported by generative AI. The AI Learning Companion system achieves comprehensive integration of human resources, courses, and machines, ensuring seamless process coordination and sustained implementation, thereby providing robust support for personalized instruction in elementary mathematics classrooms. With elementary mathematics as the core discipline and fourth through sixth grades as pilot cohorts, the experimental framework is illustrated as follows:

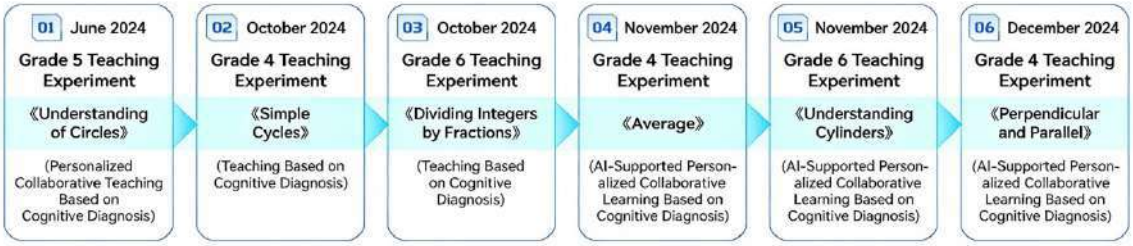

Figure 2 Experimental framework

Precise measurement of cognitive starting point

For core subjects such as Chinese, mathematics, and English in primary schools, we develop personalized learning systems incorporating multimodal resources including videos, audio materials, visual content, and VR environments. Taking "Understanding Cylinders" as an example, this article demonstrates how to implement personalized learning models by integrating educational innovation with artificial intelligence technologies. Through AI-powered tools, classroom workflows are optimized to enhance student engagement and teaching effectiveness.

Students' cognitive starting points form the foundation of personalized learning and require precise assessment and categorization. The cognitive starting point assessment process is illustrated in Figure 1, which includes the following steps: 1. Analyzing and breaking down learning content; 2. Developing first-order open-ended tests and second-order assessment instruments; 3. Creating second-order cognitive starting point assessment tools, ultimately completing cognitive starting point classification to provide evidence for personalized teaching.

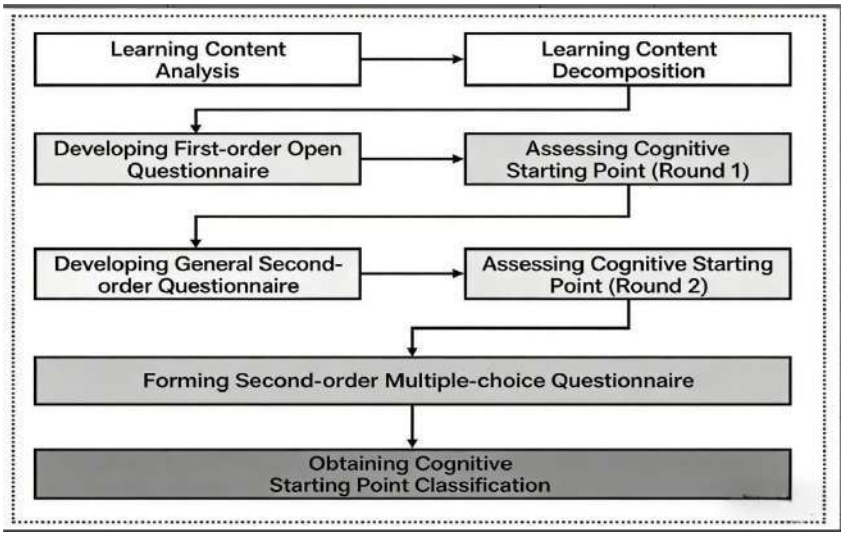

Figure 3 Flowchart for assessing cognitive starting points

Based on Gagne's taxonomy of learning outcomes, we stratified the learning content in accordance with the requirements of the "Understanding Cylinders" unit in the Compulsory Education Mathematics Curriculum Standards (2022 Edition). For instance, the detailed decomposition of learning content for "Understanding Cylinders" is presented in Table 1.

Table 1 Framework for Learning Content Analysis of

Knowledge Dimension	Serial Number	Learning Content	Cognitive Development Dimension					
			Memory	Comprehension	Application	Analysis	Evaluation	Creation
Factual Knowledge	1	Understanding of "Cylinder" in Life	√			☆		
	2	Relationship Between Solid Figures and Plane Figures	√			☆		
	3	Characteristics of Cylinder (Base, Lateral Surface)			√	☆		
Conceptual Knowledge	4	Concept of Cylinder's "Height"			√	☆		
	5	Development Drawing of Cylinder		√		☆		
	6	Development Drawing of Cylinder		√	☆			
	7	Calculation Formula for Lateral Surface Area of Cylinder		√	☆			
Procedural Knowledge	8	Calculation Formula for Surface Area of Cylinder		√	☆			
	9	Derivation of Calculation Formula for Lateral Surface Area of Cylinder			√	☆		
	10	Derivation of Calculation Formula for Surface Area of Cylinder		√		☆		
	11	Calculation of Surface Area of Cylinder			√	☆		
Metacognitive Knowledge	12	Establishment of Spatial Concept				√		☆

Table 2 Cognitive Starting Point of Students in "Understanding Cylinders"

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Through second-order cognitive diagnosis (the "what" and "why" framework), we accurately identified 18 categories of cognitive starting points. The diagnostic results reveal that students at this educational stage demonstrate clustered, categorized, and analyzable cognitive starting points in "cylinder recognition," primarily manifested as misidentification of geometric features, overgeneralization of geometric relationships, misunderstanding of measurement rules, and confusion regarding calculation formulas. Through classification, five cognitive starting point types and 18 specific content items were identified, as detailed in Table 2.

Develop personalized learning resources

Personalized learning resources are digital tools and materials developed based on learners' cognitive starting points, including videos and test questions that present learning content through multimedia formats such as text, images, and animations. Taking the "Understanding Cylinders" unit as an example, this approach incorporates knowledge classification theory to implement differentiated instructional strategies tailored to varying cognitive levels: direct intervention for factual knowledge, interactive scaffolding for conceptual understanding, procedural knowledge support systems, and metacognitive reflection techniques for awareness cultivation.

The personalized learning support system comprises two core components: an autonomous learning module tailored to students 'cognitive starting points, and an exploratory module designed to enhance cognitive development. The autonomous learning module delivers key content based on students' foundational understanding of cylindrical concepts, advancing cognitive progression through a "problem-guided inquiry → explanation → assessment" cycle while providing customized learning resources and exercises. The exploratory module reinforces knowledge retention, addresses diagnostic gaps, facilitates exploration of prevalent cognitive patterns, and cultivates interdisciplinary application skills. The system establishes a "student ID → cognitive type → learning resources" pathway to precisely align individual cognitive foundations with targeted learning content.

Implementing Classroom Teaching Innovation

AI-powered learning companion systems facilitate personalized collaborative learning through cognitive conflict stimulation and constructive resolution, thereby enhancing individualized instruction and collaborative education. This approach encompasses both conflict-driven and consensus-based interactive dialogues. Taking the sixth-grade unit "Understanding Cylinders" as an example, it includes three key components: "Introducing Cylinders," "Measuring Cylinder Height" (Lesson 1), and "Calculating Cylinder Surface Area" (Lesson 2). The study design compares classroom practices between an experimental class (Figure 2) and a control class.

The generative AI learning companion "AI Study Partner" leverages the TPLC framework for cognitive starting points to provide comprehensive support for personalized collaborative learning in elementary mathematics education. Taking the sixth-grade unit "Understanding Cylinders" as an example, it establishes cognitive starting point libraries and learning content repositories, integrates continuously optimized prompt phrases, and enhances large model retrieval capabilities to enable precise human-computer and interpersonal dialogue interactions. During lesson practices such as "Understanding Cylinders," "Measuring Cylinder Height," and "Calculating Cylinder Surface Area," the AI companion delivers real-time, targeted feedback tailored to students' actual cognitive foundations, effectively promoting cognitive development.

The teaching methodology innovatively adopts the "AI + Three-Learning Model," crystallizing an educational paradigm of "integrating digital intelligence into teaching and pursuing wisdom through learning," thereby driving deep integration of artificial intelligence with elementary mathematics classrooms.

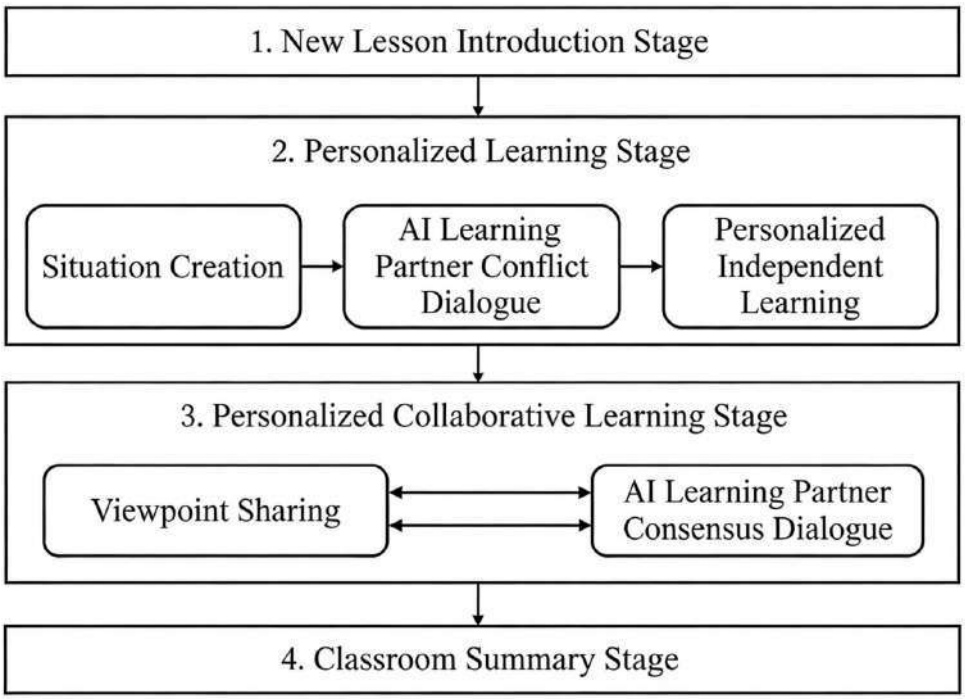

Figure 4 Personalized Collaborative Learning Process Supported by AI Learning Companion

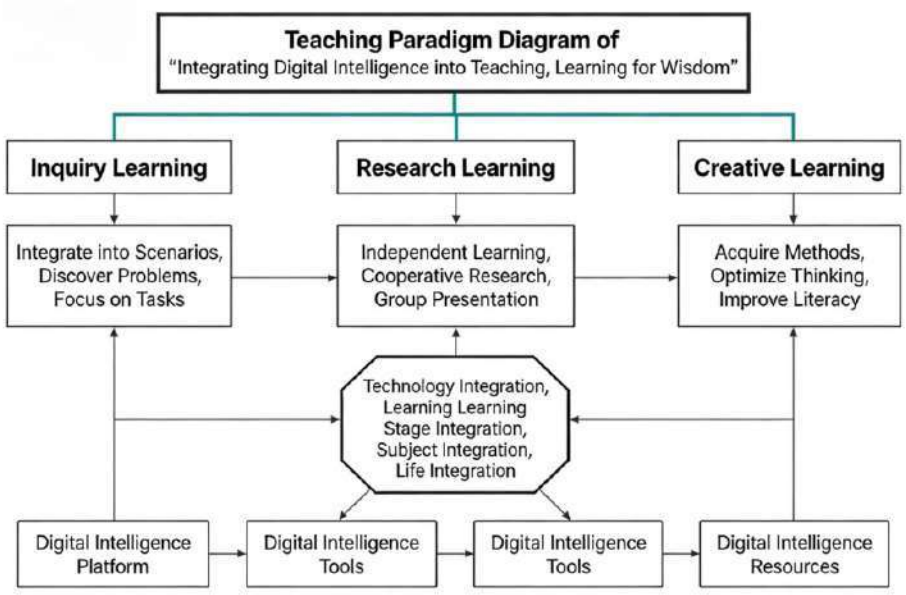

Figure 5 Teaching Paradigm Diagram

In terms of evaluation methodology, we establish a "data-driven + multi-stakeholder" framework: AI-powered learning companions collect six categories of data (cognitive, behavioral, emotional, etc.) in real-time to generate a "Learning Power Radar Chart" for formative assessment; individual progress models are developed to conduct value-added evaluation through pre-post test data comparison; collaborative learning effectiveness is assessed through dual dimensions of "individual contribution + group efficacy," forming a dynamic evaluation loop that spans the entire learning process.

Case Innovation and Breakthroughs

(1) Practical Model Innovation: Establishing a personalized learning classroom operational framework featuring "dual-teacher collaboration, interdisciplinary integration, and closed-loop operation".

This case study transcends mere technical application. The system establishes a school-based practice model supported by AI learning companions, operationalized through "dual-teacher collaboration," and deeply integrated with core subject competencies (e.g., Chinese language emotional literacy, mathematical reasoning). It implements a closed-loop process encompassing "precision diagnosis, dynamic adaptation, deep collaboration, and multidimensional evaluation," providing an actionable and replicable systematic solution for large-scale implementation of personalized learning in primary school classrooms.

(2) Technological Application Innovation: Development of AI learning companion functional modules and resource packages featuring "deep disciplinary integration and strong contextual relevance".

This technological breakthrough overcomes the limitations of general purpose technologies. Centered on addressing core competency development challenges in primary school subjects such as Chinese, mathematics, and English (including deep language comprehension and emotional understanding in Chinese, logical reasoning and problem-solving in mathematics, and real-world context application in English). Accordingly, we have developed targeted AI learning companion modules including "Deep Understanding Assistant," "Resource Matching Guide," "Collaborative Growth Partner," and "Assessment Mentor." Additionally, we established a scenario-based digital resource library tailored to subject-specific characteristics and diverse cognitive levels (e.g., mathematical reasoning micro-lectures, contextual Chinese interactions, and English dialogue generators), significantly enhancing the alignment between AI support and subject-specific teaching practices.

(3) Evaluation Tool Innovation: We developed and implemented a "Five-Dimensional Learning Power Radar Chart" tailored for personalized learning processes. This innovative approach focuses formative assessment on five core dimensions: cognition and technology, behavior and process, attitude and motivation, collaboration and role, as well as efficacy and literacy. Leveraging AI-powered learning companion systems for data collection and analysis, the system generates intuitive learning power radar charts that dynamically map students' holistic learning progress and enable developmental evaluation. These visualized insights provide actionable guidance for targeted teaching interventions and support self-directed learning strategies.

(4) Innovation in Practical Approaches: Implementing Differentiated Support in Group Learning

Dual-Teacher Collaborative Teaching Model for Core Disciplines: Establishing a "dual-teacher"

coordination mechanism to address teacher workload constraints, enabling educators to focus on cultivating higher-order competencies. Implementation Path for Scalable Individualized Instruction: Developing a "precision diagnosis, tiered task design, and dynamic parameter adjustment" framework. Through customized resource packages tailored to individual needs, this approach provides differentiated support for students with varying cognitive levels within the same classroom. The "Regional Resource Sharing Platform" further bridges the "digital divide" among students from diverse family educational backgrounds.

Promotion Value and Risks

Our school has innovatively established an "AI Learning Companion + Subject Teaching" paradigm based on the "Outline of Education Power Construction Plan (2024-2035)" and the "Guidelines for Generative Artificial Intelligence Use by Primary and Secondary School Students (2025 Edition)", aiming to enhance teaching quality and promote teacher development.

(1) AI Learning Companion: Reimagining the Primary School Mathematics Teaching Ecosystem

Addressing critical challenges in primary mathematics education such as inadequate instructional adaptation and emotional engagement, this approach employs cognitive diagnostics to precisely identify students 'learning biases. Leveraging Gagne's theory, it generates personalized resources including animated demonstrations and interactive tools, seamlessly integrated with an intelligent voice feedback system. During lessons, teachers maintain overall instructional oversight while AI learning companions collaborate through voice systems. This framework achieves three key objectives: breaking classroom silence through whole-class participation, resolving delayed feedback via real-time assessment, and preserving teaching data via AI Q&A systems. The integrated process delivers instant feedback, collaborative empowerment, and emotional encouragement, ultimately establishing a groundbreaking "human-machine co-education" model.

(2) Empirical Findings: Overcoming Challenges in Educational Technology Application

Enhancement of learning efficacy: Post-test data demonstrated significant improvements in academic performance, learning engagement, higher-order thinking, and collaborative skills between the experimental class and traditional classroom settings ($p<0.001$).

Academic breakthrough: Leveraging the CTCL Laboratory at Shanghai Normal University, this study employs empirical research to address the dilemma of 'non-significant correlation between technology and learning,' providing a scientific paradigm for large-scale individualized instruction.

(3) Radiation Leadership: From Regional Practice to International Dialogue

The school has been deeply engaged in projects such as "AI-powered Learning", "Smart Education", and "Digital Education", expanding its influence from surrounding areas to other provinces and even internationally: it has hosted digitalization inspection delegations from 12 prefecture-level cities within the province, including Wuxi and Nantong, as well as smart education inspection delegations from over 40 cities outside the province, such as Beijing's Chaoyang District, Miyun District, Anhui Province, Zhejiang Province, Qinghai Province, and Xinjiang. In May 2025, it attracted the Japan Education Informatization Promotion Association to conduct academic exchanges on "Educational Innovation + AI" at the school.

(4) Risk Prevention

1. Gradual implementation of pilot programs: Adopt a "teacher-led + AI-assisted" model in experimental classes, progressively introduce collaborative learning modules, and ensure teachers' classroom control authority.

2. Data Security Protection: Strictly standardize the scope of data collection, regularly back up teaching data to local servers, and eliminate risks of privacy leakage.

3. Balanced evaluation system: Restrict the weighting of AI scores, strengthen the core role of teacher evaluation, and maintain the authority of teaching assessment.

Other Relevant Information

1. This case was awarded the Innovative AI Competency Teaching Case at the Suzhou Industrial Park Yijia Smart Classroom Teaching Demonstration and "Joint Teaching Seminar of Three Regions and Six Zones" in October 2025.

2. This case was published in Shanghai Education in June 2025 and indexed by CNKI.

3. The research findings of this case were published in January 2026 in Educational Technology Research and indexed by CNKI.
https://aver.nwnu.edu.cn/upload/formalarticle/202601/2026011534-AI%E5%AD%A6%E4%BC%B4%E6%94%AF%E6%8C%81%E7%9A%84%E4%B8%AA%E6%80%A7%E5%8C%96%E5%8D%8F%E4%BD%9C%E5%BC%8F%E5%AD%A6%E4%B9%A0%E5%AE%9E%E8%AF%81%E7%A0%94%E7%A9%B6.pdf

Case 37

AI4Math: AI Agent Platform for Mathematics Teaching and Learning

Fudan University, Shanghai, China

Background

In undergraduate education, foundational mathematics courses such as Calculus and Linear Algebra face a structural tension between large-scale instruction and personalized support. First, students come from a wide range of majors, including science, engineering, medicine, and even the humanities. It is difficult for traditional large lectures to accommodate different starting levels and learning speeds. Second, mathematical courses involve abstract concepts, long chains of reasoning, and strict logical requirements. Students may remember results, but often struggle to understand key steps, identify errors, or connect related ideas. Besides, in large classes, instructors find it hard to continuously track each student's progress or provide targeted interventions based on learning processes.

In recent years, common large language models have shown strong abilities in language generation for educational use. However, in mathematical reasoning, they may still produce steps that are not rigorous, rely on unclear justifications, or lead to conclusions that are difficult to verify. As a result, they cannot yet serve as highly reliable teaching assistants on their own.

To address these challenges, AI4Math builds on the long-term accumulation of course materials, peer tutoring experience, and teaching data from the School of Mathematical Sciences. It aims to develop a trustworthy AI platform for teaching and learning in foundational mathematics courses. The project follows a core approach that combines knowledge graphs, high-quality domain-specific datasets, fine-tuned large models, multi-agent workflows, and formal verification. It embeds AI into key teaching scenarios, including textbook learning, problem-solving practice, process-based assessment, conceptual inquiry, and learning analytics. The goal is to provide more interpretable, higher-quality, and continuously improving personalized support within large classes, and to establish a scalable and transferable model for intelligent mathematics education in higher education.

Case Implementation Status

The AI4Math platform is based on long-term course development, online tutoring experiments, and early intelligent agent prototypes. Some of its functions have already been completed and tested in practice, while other modules are still being refined.

Table 1 AI4Math Development Timeline and Project Milestones

Time	Milestone	Status
Since 2024	Online question-bank and tutoring exploration within the university, accumulating operational experience for AI-assisted support.	Completed
2025	The multi-agent workflow won First Prize in Fudan AI Application Development Competition and entered the campus eHall platform. In the same year, the project was officially funded by the Fudan University Center for AI in Education Innovation.	Completed
Current	AI4Math integrates textbook view, knowledge graph, exercise workspace, answer evaluation, retrieval, and recommendation functions.	In iteration
Next stage	Broader pilots across foundational mathematics courses and continued refinement of digital-textbook and analytics modules.	Planned

During the needs analysis and initial development stage, the project team identified four key challenges in foundational university mathematics courses: the difficulty of making knowledge structures explicit, the difficulty of tracing proof strategies, the difficulty of identifying individual differences, and the difficulty for instructors to provide scalable feedback.

To address these issues, AI4Math team systematically organized years of accumulated resources from the School of Mathematical Sciences, including textbook commentaries, lecture notes, and structured learning materials. AI4Math team also incorporated peer tutoring experience and transformed these resources into data usable by intelligent agents. Since 2024, the project has explored online problem banks and tutoring systems within the university. In 2025, building on the award-winning multi-agent workflow project in the competition of AI application held in Fudan, the platform was integrated into the university's eHall system. This provided a direct prototype and operational experience for real-world deployment. In the same year, the project was officially funded by the Center for AI in Education Innovation in Fudan.

Figure 1 The view of the platform.
Sub Figure A: textbook cover view; Sub Figure B: in-text concept explanation and contextual question answering; Sub Figure C: knowledge-graph view; Sub Figure D: exercise set with answer evaluation.

The main technical framework of the platform is outlined as follows:

- **Systematic construction of teaching data.** The platform integrates a wide range of teaching resources accumulated over many years at the School of Mathematical Sciences. These include lecture notes and discussion materials for courses such as *Calculus* and *Linear Algebra*, textbook reviews, thousands of key exercises with solutions, more than 1,500 hours of instructional audio and video, and user interaction logs collected from earlier intelligent tutoring systems.

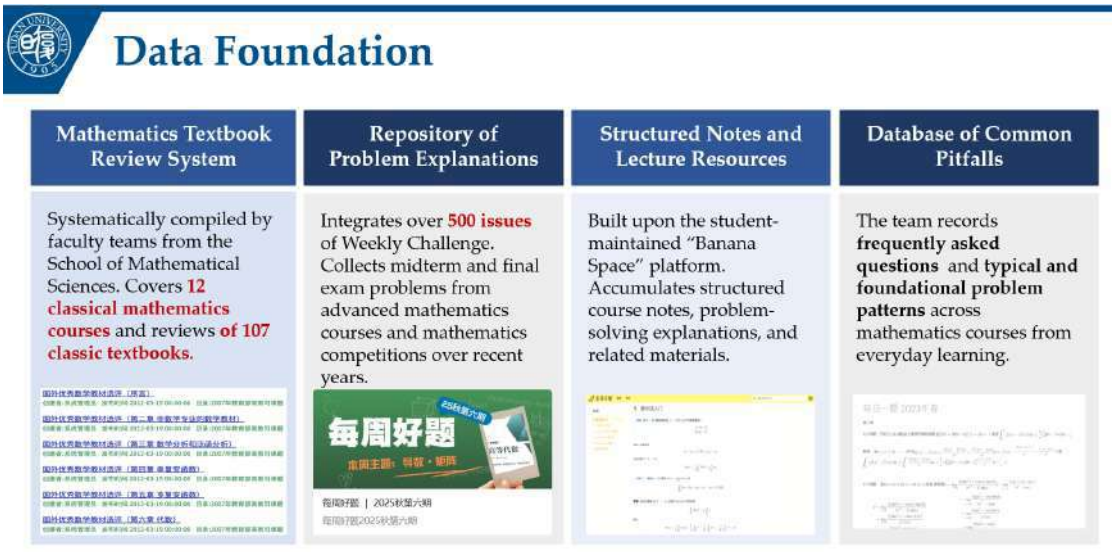

Figure 2 Four parts of data foundation

- **Construction of a multi-level mathematical knowledge graph.** Based on these data, the platform collaborates with the Public Mathematics Teaching Group and the mathematics tutorial volunteer team to build a unified, multi-level knowledge graph that integrates courses, concepts, proofs, and modes of thinking. This graph captures difficulty hierarchies across courses and explicitly links each knowledge point to representative examples and common proof strategies. It provides a clear structural foundation for subsequent intelligent analysis.
- **Fine-tuning and reasoning enhancement of large models based on the knowledge graph.** The platform adopts advanced large language models as its base and fine-tunes them using the curated mathematical dataset and multi-level knowledge graph. The focus is on strengthening the model's understanding of dependencies among knowledge points. In addition, drawing on reinforcement learning based post-training methods, the platform is further improving the model's ability to generate coherent reasoning chains and perform self-correction, ensuring rigorous and step-by-step solutions to complex mathematical problems.
- **Multi-agent workflows and core learning-support functions.** Using the fine-tuned model, the platform implements six core learning-support functions through multi-agent collaboration. Different agents, each with specialized roles, are connected through structured workflows. Students can upload images of problems to receive solution strategies, or submit their own solutions to obtain feedback on logical completeness. The platform is also integrated with the global arXiv database, enabling academic search and recommendations of frontier research papers.
- **Introduction of the Litex language and toolchain.** The platform is incorporating Litex, a minimal formal language co-developed by Fudan University and the Shanghai Artificial Intelligence Laboratory, along with its associated toolchain. Litex expresses mathematical proofs in a code-like format, ensuring that every step of reasoning is formally correct. It translates natural language solutions into machine-verifiable proofs and supports a self-improving loop from problem generation to solution and then verification. In the future, it is expected to serve as a core tool for large-scale mathematical collaboration and advanced research.

At present, AI4Math has developed a user interface that includes modules such as textbook views, knowledge graphs, problem sets, and answer evaluation. Some core functions were piloted in selected classes in Fall 2025 and received positive feedback. A more complete digital textbook experience and visualized learning analytics are still under development and will be gradually expanded to more foundational mathematics courses.

Case Innovation and Breakthroughs

The primary innovation of AI4Math lies in embedding AI throughout the entire learning process, forming a closed loop of textbook reading, knowledge connection, problem practice, process evaluation and learning feedback. It reorganizes materials that are traditionally fragmented in large lectures including textbooks, problem sets, tutoring, and teaching experience, into a continuously evolving course ecosystem. During learning, students can ask questions around specific concepts. Meanwhile, instructors can analyze learning process data rather than relying only on final answers, allowing them to identify both common difficulties and individual differences. As a result, course evaluation shifts from outcome-based to process-based, and teaching support changes from after-class remediation to continuous guidance throughout the learning process.

Therefore, the platform supports a transformation of teaching paradigms in foundational undergraduate mathematics courses such as Calculus and Linear Algebra, which are often taken across disciplines, which can significantly deepen student understanding and improve course satisfaction, while reducing repetitive tutoring work for instructors and enabling them to focus on heuristic and inquiry-based teaching. The platform can also be extended to more advanced mathematics courses, such as Ordinary Differential Equations and Functional Analysis, as well as to other disciplines including physics and chemistry. In this way, it serves as a bridge between teaching practice and technological innovation, forming a data-driven, agent-centered intelligent education loop. Beyond improving both teaching and learning, it also feeds back into academic research through forward-looking exploration, contributing a “Fudan model” to talent development and the digital transformation of education.

Compared with general-purpose large models or fragmented educational tools, AI4Math’s technical advances focus on two aspects: disciplinary structure and reliable reasoning. On one hand, the platform constructs a multi-level knowledge graph and high-quality domain dataset for foundational mathematics courses. It not only includes knowledge points, problems, and solutions, but also provides detailed annotations of proof strategies, logical dependencies, and common misconceptions. This enables the model to understand the structure of course knowledge. On the other hand, the platform adopts a combination of fine-tuned large models and multi-agent collaboration. Tasks such as retrieval, tutoring, evaluation, and recommendation are decomposed into controllable workflows. In addition, the planned integration of Litex-based formal verification will improve the verifiability of complex mathematical reasoning and reduce the risk of answers that appear fluent but lack logical rigor.

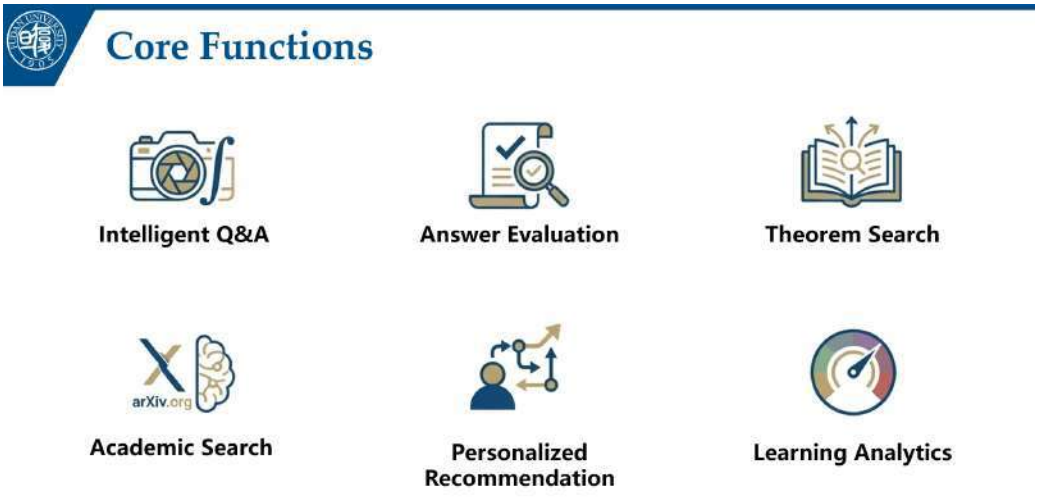

Figure 3 Core functions of AI4Math Platform

At the level of practical application, AI4Math has evolved from a resource aggregation platform into an embedded intelligent learning companion within courses. The current prototype provides a unified interface that includes textbook views, knowledge graphs, problem sets, and answer evaluation. It allows students to upload problems, ask follow-up questions about concepts, and submit their own solutions for logical completeness assessment. At the same time, it enables instructors to monitor high-frequency issues and learning data, gradually forming a data-driven diagnostic capability for large-scale teaching. The platform has now entered a stage of real-world deployment centered on course trials and iterative improvement.

In terms of intellectual property and governance, the platform's interface, workflow design, and case materials belong to Fudan University and are managed centrally by the institution. The course resources and teaching data used in the project are authorized, organized, and processed within the university's internal framework. Student interaction logs and other process data follow principles of minimal necessity and anonymization, and are used for learning analytics and model improvement. For underlying models and collaboratively developed tools based on open-source resources, the project complies with the relevant open-source licenses.

Promotion Value and Risks

Of the planned functions of AI4Math Agent, the following have been completed:

- A preliminary high-quality formalized dataset has been built, including textbooks, exercises and solutions, lecture notes, and Q&A records;
- A multi-level mathematical knowledge graph of varying difficulty levels, represented by the "Advanced Mathematics" course, has been constructed, realizing the structuring and interconnectedness of mathematical knowledge;
- An intelligent agent tool has been built, encompassing six major functions: intelligent Q&A, answer evaluation, theorem lookup, academic retrieval, personalized recommendations, and learning analysis, providing students with a personalized intelligent learning companion available 24/7;

The intelligent digital textbook module has been designed and is currently under development and testing.

Table 2 AI4Math Evidence Base and Scaling Potential

Key evidence	Current basis
Teaching resource base	About 10 courses and 50+ textbooks; 200+ papers; 1,000+ exercises and solutions; approximately 1,500 hours teaching audio/video.
First-phase validation design	6 course offerings in Mathematical Analysis and Advanced Mathematics; 690 students per year.
Next-step expansion potential	39 course offerings and 3,091 students per year across broader foundational mathematics courses.
Dissemination network	Alliances and collaborative networks with the potential to reach nearly 200 universities.

The completed parts of AI4Math Agent were piloted in some classes in the Fall 2025 semester with positive feedback; it will be piloted in more classes in the Spring 2026 semester.

Fudan University has established a construction team led and coordinated by the Center for Innovation in Artificial Intelligence Education and Teaching, encompassing faculty and students from the School of Mathematical Sciences, the School of Computing and Intelligence Innovation, the Academic Affairs Office, and the Information Office. Team members include AI education and teaching experts, senior

mathematics teachers, a volunteer team of mathematics tutors with extensive experience, information system construction experts, and a development team. The university has designated this project as a key university project, providing significant support in terms of funding, computing power, and computing servers to ensure the project's code development, data storage, and model training needs are met.

Regarding promotion, Fudan University will leverage its existing cross-regional and international collaborative innovation networks, such as the FD-QM Curriculum Quality Standard National Alliance, the Yangtze River Delta Higher Education Teachers' Teaching Development Alliance, and the Shanghai Higher Education Teachers' Teaching Development Alliance, to promote the project to nearly 200 universities both domestically and internationally. Initially, promotion will focus on Shanghai municipal universities and provincial universities in the Yangtze River Delta region. Simultaneously, AI4Math Agent has been selected as a representative case study in mathematics on the National Higher Education Smart Education Platform and will be promoted and used by universities nationwide through the platform.

The completion of AI4Math Agent will provide students taking general mathematics courses in universities across the country with a personalized, intelligent learning companion available 24/7, and offer teachers precise support for their teaching decisions. Its technological, data, process, and operational experience will be accumulated and refined to further improve existing smart course construction standards and can be extended to more mathematics courses such as ordinary differential equations and functional analysis, as well as various STEM majors including physics, chemistry, biology, and computer science.

Furthermore, from a research and product perspective, a Litex-based toolkit will be developed to construct high-quality, verifiable, and scalable mathematical formal datasets and inference environments, producing influential academic results. A collaborative framework of "large models + formal verification" will be explored to assist in completing new work or simplifying existing results in mathematics or other disciplines. Collaboration with leading AI labs or technology companies will be undertaken to develop large-scale mathematical inference models, achieving complementary advantages in computing power, engineering, and academic resources, and gaining the ability to export to universities, research institutions, and the K-12 advanced mathematics education market.

Case 38

Seeing Every Child: Personalized Learning Companion Practice of Information Technology in Primary Schools with AI Support

Changjun Sun

Hangzhou Chunhui Primary School, Zhejiang, China

Background

Primary school information technology lessons are mainly task-driven and practice-oriented. Student differences first emerge in process performance such as task comprehension, help-seeking, collaborative participation, and self-revision, rather than only in final products. Through sustained classroom observation, sample analysis, and teaching reflection within the school, we found that relying solely on teacher walkthroughs and experience-based judgment makes it difficult to identify these process-level differences in time and even harder to provide timely in-class intervention. In response to this need, the school teacher team independently developed Huibao Learning Companion, an AI learning companion tool that identifies key nodes in the learning process and provides immediate feedback and learning-status prompts, enabling teachers to detect differences earlier and offer targeted support.

Case Implementation Status

1. Process Data Collection: Building an Immediate Classroom Learning Feedback Mechanism

To compensate for the limitations of traditional walkthroughs in capturing learning details, the teacher team used Huibao Learning Companion to build a back-end data collection system. As students complete tasks, the system automatically records task progress, help-seeking frequency, collaboration traces, and revision versions without disrupting normal classroom order. Teachers clarify observation priorities before class, call up the data dashboard during class to understand overall class status, and use the records for post-lesson reflection. The student interface provides only prompts and revision suggestions matched to the current step and does not provide standard answers. This helps teachers move beyond subjective experience, bring support earlier, and conduct timely diagnosis based on objective records.

2. Individual Progression Mode: Tiered Guidance Strategies for Independent Inquiry

During independent task completion, teachers use the data dashboard to understand the distribution of class progress. In programming exercises, for example, the dashboard clearly shows that some students repeatedly attempt the same node, while others have already completed the basic requirements ahead of time. Teachers then adjust the pace of explanation, give brief whole-class prompts on common difficulties, and devote most of their attention to individual guidance. Students go through a learning cycle of attempt, encountering difficulty, receiving a prompt, and revising, gradually developing the habit of asking questions proactively and revising independently. The teacher's role shifts from uniform instruction to on-demand guidance, so students with different starting points can maintain learning momentum at an appropriate level of challenge.

Figure 1 Distribution of Class Learning Progress

3. Group Collaboration Mode: Role-Based Intervention in Group Tasks

After students enter the collaborative learning stage, the system automatically records within-group speaking frequency, task claims, and contribution to submissions. Teachers use these detailed data to intervene in time, reassign roles, or break tasks into smaller steps, reducing the chance that a few students will take over the entire task. For temporary grouping scenarios such as open lessons, the system provides a temporary cross-school grouping configuration that supports temporary group formation across schools and independent scoring while ensuring data isolation and process records. Clear division of labor and sustained interaction help students fulfill collaborative responsibilities, while teachers can more accurately judge whether effective collaboration is taking place and provide process scaffolds in time.

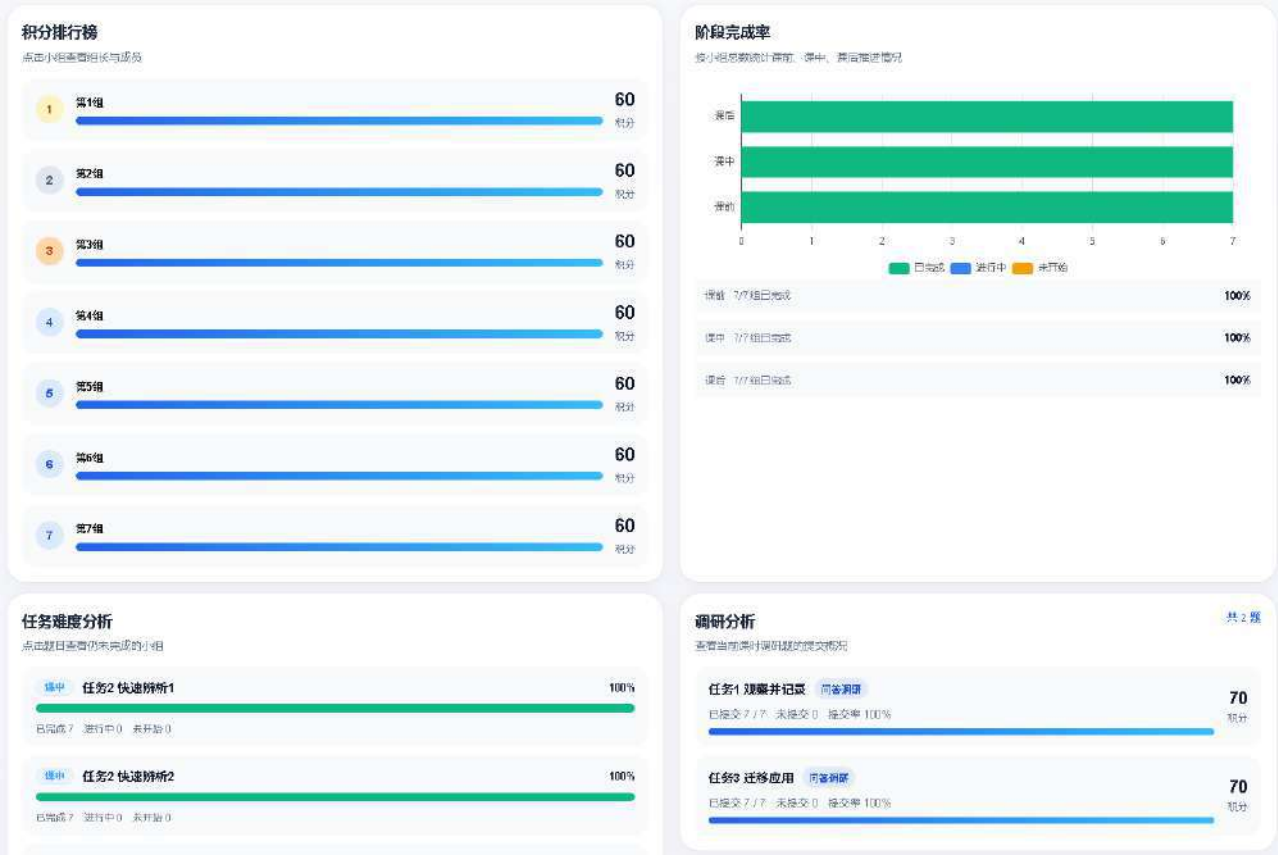

Figure 2 Group Collaboration Analysis

4. Multi-Scenario Extension: Supporting Personalized Learning in Information Technology

Information technology learning needs to unfold in authentic and diverse contexts. The system integrates a virtual science and technology museum, digital books, and the Pet House module, allowing students to choose learning pathways according to their interests. In virtual simulations, students understand abstract technical principles through interactive experiments. In the digital reading area, they broaden their technological horizons through self-directed reading. The Pet House interaction module focuses on cultivating daily digital behavior habits and awareness of information ethics. Participation traces and behavioral data from these scenarios are all brought into the same platform foundation to form continuous cross-module records. Based on multi-source data, teachers can identify students' interest tendencies and development needs and provide differentiated guidance. In this way, AI-supported learning moves beyond single-point operational guidance and becomes long-term companionship that supports students' independent inquiry across multiple contexts.

Figure 3 Digital Library and Virtual Science and Technology Museum Resources

Case Innovation and Breakthroughs

1. Classroom Support Driven by Process Evidence

This case limits AI to the identification of and feedback on learning processes. It does not replace teacher instruction or directly provide ready-made answers. Evidence of task progression, help-seeking, collaborative participation, and revision records is continuously retained, allowing teachers to judge where students encounter difficulties, what kinds of problems they face, and when intervention is needed. Compared with approaches that rely mainly on walkthroughs and experience-based judgment, the basis for classroom support becomes more concrete, and individualized support shifts from after-class remediation to in-class diagnosis and timely intervention. Its significance lies not in adding another technical tool, but in providing teachers with stable and usable classroom process evidence.

2. School-Based Iteration Supported by Independent Development

Huibao Learning Companion is independently developed, deployed, and maintained by the in-school teacher team. Through continuous iteration, it has undergone more than 500 version updates. Each iteration has remained focused on authentic classroom needs in task organization, help-seeking feedback, collaboration observation, and learning records, rather than pursuing display-oriented functions. Ongoing iteration has not increased the operational burden. Instead, it supports teachers in continuously proposing needs around classroom problems, quickly testing new functions, and making timely adjustments.

3. Evaluation Optimization under Reorganized Classroom Structures

The individual growth mode, real-name group mode, and cross-class collaboration mode correspond to three types of classroom organizational relationships and together form an organically connected functional system. These three modes respectively support individual task progression, effective group collaboration, and cross-class exchange and co-creation. As a result, the evidence teachers use to observe student learning extends from final products to process performance such as task comprehension, collaborative participation, and sustained revision. Evaluation shifts from outcome

judgment to process diagnosis, and teaching organization can make dynamic adjustments more effectively in response to learner differences.

Promotion Value and Risks

1. Foundations for Routine Implementation

This practice has been incorporated into the school's regular information technology teaching system. The tool is easy to deploy, and teachers do not need to make major changes to their existing lesson design. They only need to define data collection nodes when releasing tasks. After multiple rounds of classroom validation, a regular workflow has taken shape: observation indicators are set before class, teaching strategies are adjusted dynamically during class according to data, and instructional reflection is carried out after class based on the records. The system uses non-intrusive data collection, does not disrupt normal classroom order, and does not increase the operational burden on teachers or students. It is ready for cross-grade and long-cycle application.

2. School-Based Transfer Value

The transfer value of this case lies mainly in the implementation pathway of task release, process recording, immediate feedback, and instructional adjustment, rather than in copying a specific software form. This pathway is suitable for subject classrooms that are strongly task-driven and need close attention to learning processes. Schools can adapt the necessary functions based on their existing digital platforms, and regional teaching-research departments can also draw on its norms for data collection and differentiated intervention strategies to build practical improvement models suited to their own contexts.

3. Risks of Improper Application

During wider application, three kinds of implementation bias should be carefully avoided. First, teachers or students may become overly dependent on system prompts and weaken independent inquiry. Second, process records may be simplified into quantitative ranking or punishment tools, departing from the original purpose of formative evaluation. Third, data collection and storage may create risks related to student privacy protection. In implementation, the boundaries of technology-assisted teaching should be made clear, and data desensitization and usage protocols should be established so that process data are used only for learning analysis and teaching improvement, while safeguarding student agency and data security.

Other Relevant Information

A substantial body of outcomes has been formed around the design, application, and dissemination of Huibao Learning Companion, covering awards, journal publications, practice cases, media coverage, and student competitions.

Case 39

Integration of Art and Science to Provide Personalized Teaching and Learning

Fengping Xia

Hangzhou No.7 High School, Zhejiang, China

Project Background

1.Teaching Pain Points and Difficulties

As a time-honored senior high school featuring fine arts, we have long been constrained by three structural challenges of traditional teaching models in advancing the modernization of aesthetic education:

The structural conflict between large-scale teaching and personalized guidance

Art education requires refined instruction, especially for core courses, ranging from sketching, pencil drawing, color painting to geometric drawing, where teachers need to provide timely corrections on each student's composition, perspective and coloring. However, the imbalance in the teacher-student ratio in large classes makes it impossible for teachers to attend to the details of every student's piece of work. This leads to delayed feedback—students often have to wait several days before getting the proper feedback, thus missing the optimal time for revision. Worse still, the limited energy prevents teachers from offering differentiated advice tailored to each student's style, resulting in the homogeneous guidance, which may hinder the personalized development of some students.

Teaching and lesson preparation efficiency impaired by lack of high-level creative teaching resources

There is a severe shortage of teaching resources during the critical transition from basic modeling to advanced creation. Teachers often struggle to quickly obtain a large number of high-quality works of specific themes and styles for reference. However, traditional online resources are often of unclear copyright or mismatched styles. To address this, teachers normally spend a great deal of time creating hand-drawn demonstrations or collecting and sorting out teaching materials, which takes away the time dedicated to researching teaching methods and analyzing student learning situations. This limits the richness and forward-looking nature of the teaching content, failing to meet the requirements for innovative mindset favored by top art institutions.

Disconnected learning process data and one-dimensional evaluation system

In traditional art teaching, students' creative processes are mostly one-time physical activities without digital records, giving rise to a phenomenon called "isolated data silos". Students' growth trajectories are often unrecorded—key stages such as sketching, revision and finalization are not documented, leaving no continuous, visual, individual artistic growth portfolio and no objective basis for self-reflection. Besides, evaluations are also subjective and one-sided, relying mainly on teachers' scores for finished works and lacking quantitative assessment of process indicators such as learning attitude, ongoing efforts devoted to the learning and the tangible progress made in the originality. This not only leaves teaching reflection without data support but also makes home-school communication lack intuitive and scientific evidence for learning outcomes.

2. The Necessity of Applying AI Technology

The groundbreaking progress of Generative Artificial Intelligence (AIGC) provides a key technological solution to the three core pain points in traditional art education: delayed feedback, resource scarcity and subjective evaluation, with its necessity reflected in the following three dimensions:

Establishing an instant (real-time) feedback mechanism: Computer vision and image generation technologies make it possible to produce second-level artwork diagnosis and provide optimization proposals, filling the gap in after-class tutoring.

Achieving unlimited resource supply: AIGC can generate a massive variety of high-quality reference materials of different styles at a comparatively low cost for the purpose of stimulating students' creative mindset, thus breaking the bottleneck of scarce traditional teaching resources.

Pushing the Transformation of Data-Driven Decision-Making: AI enables the full collection of learning behavior data, transforming vague artistic perception into a visualized competency profile, providing a scientific basis for precision teaching.

Implementation Process

1. Specific Measures

Our school has built a fine art teaching platform named "Colorful AI", creating an intelligent art education ecosystem via the integration of art and technology.

Precise modeling to enhance AI's artwork recognition and revision capabilities

Our project team has collected a large number of high-quality art works and teaching samples to train AI models for various types of painting—including sketching (masterpiece re-creation, proposition-based drawing from memory), geometric drawing, still life, portrait, color still life, landscape and master painting styles. A multi-dimensional training dataset has been set up to improve AI's ability to recognize and revise works of different styles, compositions and techniques.

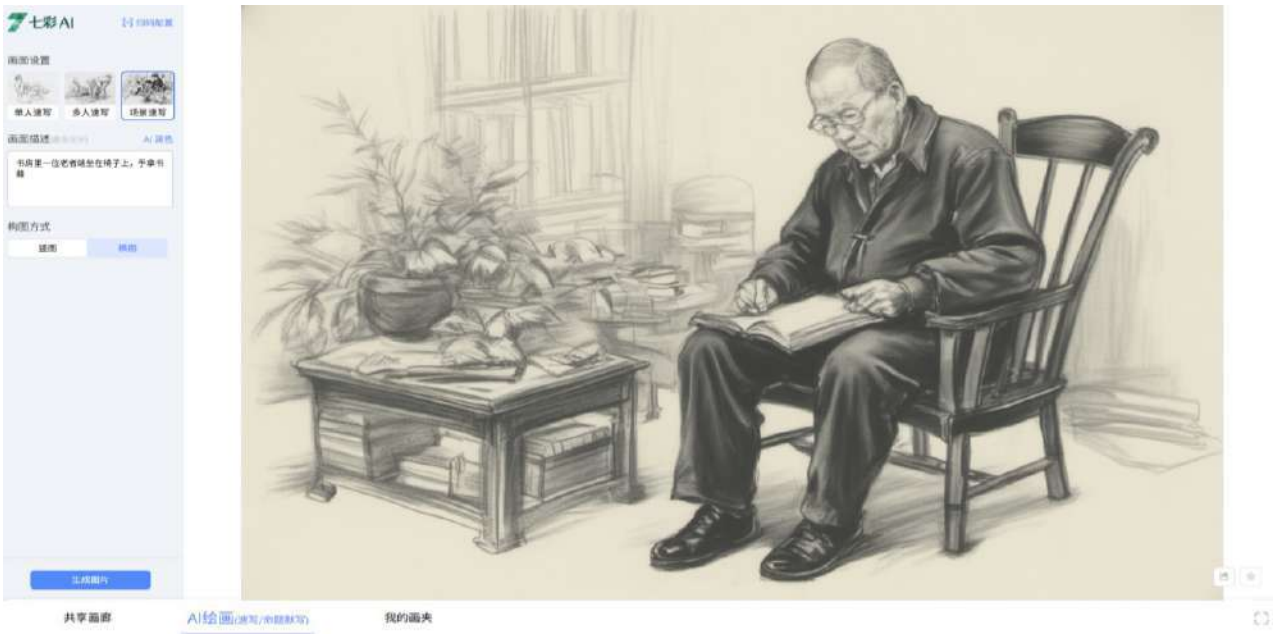

Figure 1. Sketch / Proposition-based Drawing from Memory — Scene Sketch

Integrated teaching to drive in-depth integration of AI and classroom teaching

Teachers use AI artwork revision as a teaching aid to guide students to observe, compare and reflect, enhancing their aesthetic ability and painting skills. AI feedback serves as a starting point for teaching, with teachers guiding an in-depth understanding to enhance the pertinence and effectiveness of instruction.

Personalized growth through the filing of students' art growth portfolios

With seamless collaboration between teachers and students, a new interaction path is established, where the system automatically records all students' assignments and comments from AI and teachers, forming a complete teaching closed loop of "assignment - submission - feedback - refinement". Personalized growth trajectories are generated to support the phased achievement display and ability assessment, facilitating students' ongoing progress and self-motivation.

2.Technical Solution

2.1 Technical Types

The project empowers all art teaching scenarios with precision through an in-depth integration of multi-modal technologies:

Generative Artificial Intelligence (AIGC): Based on the Stable Diffusion framework, a customized cluster of LoRA (Low-Rank Adaptation) models has been fine-tuned, covering the entire spectrum of art teaching—from basic modeling (geometric drawing, still life, portrait, color still life, landscape sketching) to advanced creation (proposition-based drawing from memory, masterpiece re-creation, master painting styles, creative design). Targeted training enables high-fidelity style transfer and image generation.

Large Language Model (LLM): It parses semantic connotations and assists in generating creative descriptive words, ensuring that the designed works combine artistic aesthetics with innovative logic. This effectively helps overcome students' difficulty in understanding assignment requirements and their slowness in artistic conception, providing a high-quality thinking framework for design examinations.

Computer Vision (CV): Deep learning algorithms are used for image feature extraction to automatically identify and quantitatively analyze key indicators such as compositional balance (e.g., center of gravity, density), color harmony (e.g., coloring unity, contrast) and brush stroke richness. Based on quantitative data, the system accurately locates problems in artworks, providing teachers with objective auxiliary scoring criteria and students with clear directions for further refinement.

2.2.Application Mode

The platform adopts a five-tier architecture to cover the entire teaching process:

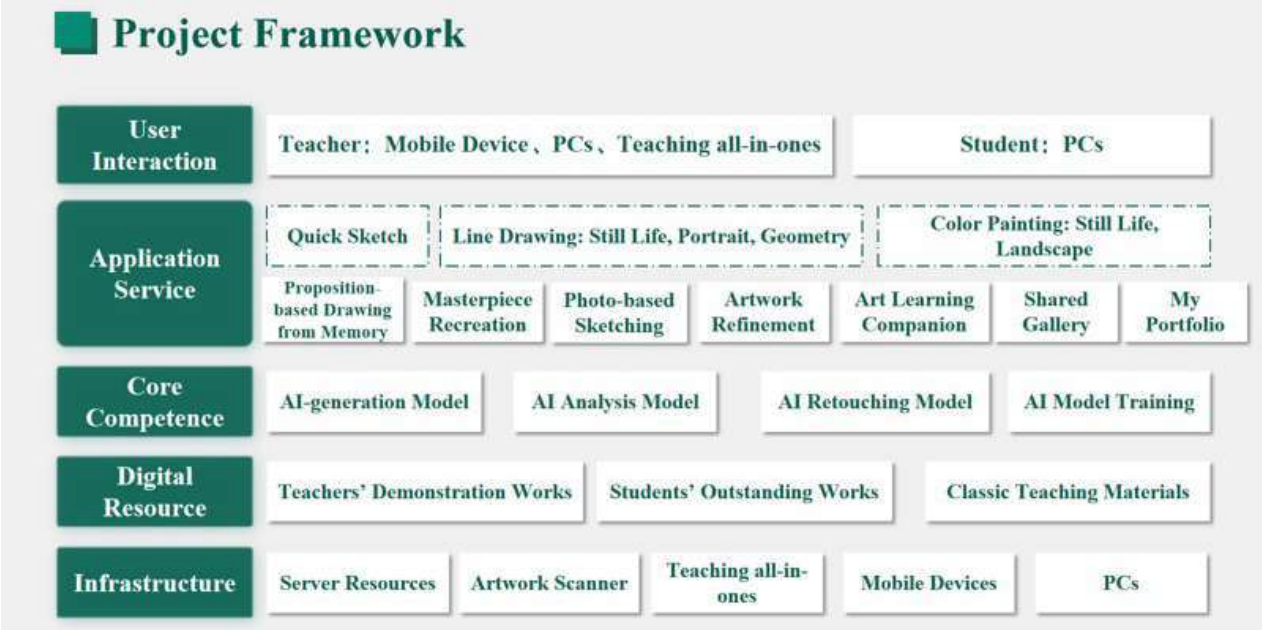

Figure 2. Project Framework

Infrastructure Layer: Centered on a high-performance server cluster, it provides sufficient computing resources for high-load tasks such as AI model training, image generation and real-time optimization. It also integrates hardware including artwork scanners, teaching all-in-ones, mobile and PC terminals, connecting data collection and interaction channels across various teaching scenarios.

Digital Resource Layer: A rich school-based art resource library is built by gathering teachers' demonstration works, outstanding students' works and classic teaching materials. These resources not only provide a high-quality data foundation for AI model training but also guarantee the richness of educational content.

Core Competence Layer: It relies on AI generation, analysis and retouching models, as well as a model training mechanism. These technologies work together to realize intelligent material generation, automatic artwork revision and personalized optimization, greatly improving the teaching quality and efficiency.

Application Service Layer: Tailored to specific teaching scenarios, it offers three core modules (sketching, pencil drawing, color painting) with various functions including proposition-based drawing from memory, masterpiece re-creation, photo-based sketching and artwork refinement. It also integrates services such as an art learning companion, a shared gallery and "my personal portfolio" to cover the entire teaching process from pre-class preparation, in-class interaction to after-class feedback, enhancing teacher-student interaction and collaboration.

User Interaction Layer: Teachers can manage teaching via mobile devices, PCs and teaching all-in-ones, while students conduct independent learning and submit assignments through mobile terminals, ensuring efficient and convenient information exchanges as well as effective teaching and learning communications.

3. **Implementation Steps and Timeline**

Phase 1: Foundation Building and Core Function Launch. The basic architecture of Colorful AI has been completed, with server resource environment configured and seamless integration with existing hardware such as artwork scanners. Core modules including proposition-based drawing from memory, masterpiece re-creation, artwork refinement, an art gallery and my personal portfolio have officially been launched, connecting the entire link of "collection-storage-basic creation". This meets the basic digital learning and work management needs of teachers and students, advancing the project's initial implementation from scratch.

Phase 2 (2025): In-depth Model Training and Formation of a Teaching Closed Loop. Based on the first year's operational data, the underlying algorithms are deeply trained and optimized. Specialized large models covering all scenarios of pencil drawing (still life/portrait/geometric) and color painting (still life/landscape) are added to significantly improve the AI-generation accuracy and style restoration. An accompanying intelligent teaching assistant "Art Learning Companion" is launched to restructure the teaching process, enabling one-click assignment release, automatic multi-format collection, AI intelligent artwork revision and real-time feedback. Hence, a complete closed loop of "teaching-learning-practice-evaluation" is formed accordingly, which embeds AI deeply into daily teaching, greatly reducing teachers' marking burden and improving the frequency and pertinence of students' practice.

Innovation Highlights

1.Unique Advantages

The core advantage of this case is the construction of China's first art intelligent education model matrix with "full-discipline coverage, full-scenario connection and full-dimensional support", breaking the fragmented limitations of current AI art tools that only focus on single-style filters or partial auxiliary functions. Based on tens of thousands of high-quality teaching samples and professional works, the project has deeply trained and integrated seven categories of vertical domain-specific models, for example:

Basic modeling layer: Geometric, still life and portrait models that accurately identify structural perspective, light and shadow volume and facial proportion.

Color expression layer: Color still life and landscape models that diagnose tonal relationships, the influence of ambient colors and spatial levels.

Creative expression layer: A dual-engine for sketching (including masterpiece re-creation and proposition-based drawing from memory) and masters' painting styles, supporting one-click conversion of students' line drafts into masters' styles or generating composition schemes that meet the assessment logic required by art college entrance examinations.

This full-spectrum model system, covering "from pencil drawing to color painting, from realism to creation, from techniques to styles", achieves all-round intelligent coverage of the art discipline. More

importantly, the human-machine collaboration mechanism of “AI initial evaluation + teacher re-evaluation” ensures the efficiency while preserving the humanistic warmth of art education, truly making the technology a “full-subject teaching assistant” rather than a replacement for teachers.

Project Outcomes

1. Students’ all-round growth

Since the project’s implementation, students have achieved all-round progress in artistic literacy, innovative ability and academic performance. With the support of the full-chain model training (from geometry and still life to portrait, color painting, landscape, sketching and master styles), students’ basic modeling ability has been significantly enhanced, with a more solid understanding of structure, proportion and perspective. Their color perception and expression abilities have improved markedly, enabling them to better grasp tonal relationships and spatial levels. In creative expression, through modules of the masterpiece re-creation and proposition-based drawing from memory, students have overcome the limitations of traditional copying, dared to try personalized compositions and stylized expression, and their creative initiative has been greatly enhanced.

In multiple mock tests and school-based and external art exhibitions, participating students have outperformed the control group that did not use the system, especially showing stronger adaptability and creativity in open-ended questions and style transformation tasks. Many students have their AI-assisted portfolios selected for high-level artistic talent training programs and have won numerous outstanding awards in youth art innovation competitions nationwide. Most importantly, students generally mention being “no longer afraid of making mistakes in painting” and “more willing to explore new painting methods”, with their learning motivation shifting from passively completing tasks to actively expressing themselves, realizing a profound transformation from “mastering skills” to “awakening to beauty”.

2.Teachers’ Development in Profession

Teachers are transforming from traditional “knowledge transmitters” to “learning designers” and “creative guides”, with simultaneous improvement in professional competence and professional identity. This system automatically completes most initial assignment evaluations and learning situation analysis, freeing teachers from repetitive marking work and allowing them to devote more energy to personalized tutoring, curriculum development and teaching strategy optimization.

Relying on the visual ability maps and class learning situation reports provided by the platform, teachers can accurately identify common weak points and individual differences among students and adjust teaching priorities accordingly in a timely manner—for example, developing special micro-courses or hierarchical exercises for problems such as confusion between warm and cold hues and loose composition, significantly improving in-class interaction efficiency and teaching pertinence. Meanwhile, team members have shared practical experience in regional teaching and research activities and applied for educational informatization research projects. Most teachers believe that intelligent tools have effectively boosted their teaching confidence and innovation willingness, which have become a core driving force in promoting the high-quality development of art education.

3.Improvement in Teaching Quality

Teaching quality has undergone a systemic upgrade from “experience-driven” to “data-supported”, from “uniform teaching” to “hierarchical customization”, and from “result-oriented evaluation” to “process tracking”. The implementation effect of art courses across the school has improved significantly, with student participation and satisfaction rising steadily. Parents generally remark that their children have a keener interest in learning and more willingness to paint often at home.

More importantly, the teaching quality evaluation system is no longer limited to a single score or grade, but a comprehensive evaluation framework covering “skill mastery, creative activity and aesthetic participation” has been built. This truly establishes a new quality education paradigm for the future that respects individuality and encourages innovation, providing a replicable and sustainable practical path for the transformation of aesthetic education in the new era.

Scalability

1. Universality and Demonstration Value

The “full-spectrum art intelligent education model matrix” built in this case has a high degree of disciplinary universality and model demonstration value. It is modularly designed based on the common competency dimensions of art education—modeling, color, composition and style expression. Thus it can be seamlessly integrated into the existing curriculum systems of schools at different stages and of different types.

Whether it is an art-focused class in a key urban middle school or a basic aesthetic education classroom in a rural school, sub-modules such as “geometry diagnosis”, “color still life analysis” and “master’s painting style transfer” can be flexibly invoked according to actual needs, realizing“on-demand access and progressive upgrading”. Its implementation paradigm of “human-machine collaboration and co-education by AI and teachers” ensures the technical efficiency while preserving the humanistic warmth of art.

2. Feasible Promotion Paths

To ensure the smooth implementation of the project in schools in different regions, a gradient promotion path is designed: For schools willing to adopt the model but with limited resources, a “lightweight pilot” is supported with a cloud-based SaaS service that requires “zero deployment and instant use”. The platform is pre-installed with basic model packages covering core teaching scenarios such as geometry, portrait and color still life. Schools do not need to configure local servers or high-performance terminals and can access the platform only through a browser. With a standardized teacher training system, teachers can quickly master core functions and achieve a seamless transition from “zero foundation” to “regular application”, greatly reducing trial and error costs and lowering the entry threshold.

3. Expected Outcomes

With the large-scale promotion of this project, far-reaching effects are expected to reach at three different levels:

For students: More individuals will have access to personalized, visual and amusing art learning experiences. Especially in areas lacking professional art teachers, AI will become an “ever-lasting aesthetic education companion”, significantly enhancing students’ aesthetic perception and creative mindset.

For teachers: Grassroots art teachers across the country will be freed from tedious work and shift to more valuable tasks such as teaching design, emotional guidance and cultural inheritance, with simultaneous space expansion of their professional accomplishment.

In the long run: This model will not only serve art education itself but also foster a new generation of talents with cultural confidence, innovative ability and digital literacy by pursuing the path of “cultivating people through beauty and inspiring wisdom through skills”.

Case 40

Tsinghua University: Disciplinary Knowledge Engine Empowers Personalized Learning

Online Education Center, Tsinghua University, Beijing, China

Background

Large language models (LLMs) have now become an integral part of everyday academic life, and their rapid adoption has posed practical challenges for universities. Three key limitations are particularly prominent in teaching scenarios.

First, the problems of fragmented knowledge and AI hallucinations are acute (Farina et al., 2025; Jiang et al., 2024). While general-purpose LLMs boast extensive knowledge coverage, they have obvious shortcomings in professionalism and accuracy within specific disciplinary fields, making them highly prone to "model hallucinations"—generating content that contradicts disciplinary facts and lacks logical coherence (Alansari & Luqman, 2025; Zhang et al., 2025).

Second, teachers and students face the practical challenge of accelerating the shift from the passive, instrumental use of LLMs to active learning empowerment through these tools (Capraro et al., 2024; Razafinirina et al., 2024; Nguyen, 2026). A core issue lies in breaking the inefficient application patterns—such as superficial information retrieval and mechanical content replication—among teachers and students, and leveraging the core capabilities of LLMs to advance the implementation of problem-oriented personalized training.

Third, inadequate disciplinary development and low collaborative efficiency are pressing issues that need to be addressed (Yan & Qianjun, 2025). Each university needs to build a dynamically updatable, discipline-specific knowledge system based on its own disciplinary strengths, ensuring that AI-generated content aligns with the latest disciplinary advances, the university's knowledge frameworks, and its academic evaluation criteria. Meanwhile, promoting the joint development and sharing of high-quality educational resources is also imperative.

The Disciplinary Knowledge Engine (DKE) proposed in this paper integrates curated course materials, structured representations of conceptual relationships, and a set of programmable pedagogical rules, which constrain the model's reasoning and response logic. This paper elaborates on the design philosophy of this architecture and presents details of the pilot application of the DKE implemented at Tsinghua University.

Case Implementation Status

1. Architecture Overview and Technical Solution

The DKE adopts a three-layer decoupled architecture consisting of a Model Layer, an Engine Layer, and an Application Layer. Each layer has a distinct role and communicates with the others through stable APIs. The Model Layer provides access to multiple LLMs via a unified interface, handling provider-specific APIs, routing, caching, and fallback mechanisms. This allows downstream components to interact with LLMs through a common text-in/text-out interface.

The Engine Layer is the core of disciplinary specialization, encompassing the knowledge processing pipeline, dual knowledge base, hybrid retrieval pipeline, and pedagogical rule engine. The Application Layer includes end-user applications relying on the engine, such as student-facing Q&A tools, learning path generation, classroom interaction modules, and instructor-facing assessment generation tools.

This layered separation has proven crucial in practice: it enables the team to update models without rebuilding the knowledge base, and allows departments to share infrastructure while retaining their own disciplinary assets and pedagogical configurations.

1.1 Model Layer

The Model Layer abstracts the heterogeneity of upstream model providers. Incoming requests from the Engine Layer are routed through a Model Router, which selects an appropriate model based on a configurable policy. This policy can incorporate university-wide defaults, department-level preferences, cost constraints, and task-specific requirements.

During the pilot phase, the layer provided access to GPT-4o (OpenAI, 2024), Claude 3.5 Sonnet (Anthropic, 2024), GLM-4 (GLM, 2024), and DeepSeek-V2 (DeepSeek-AI, 2024). It also supports response caching for deterministic queries, token-level usage tracking, and automatic failover when a provider is unavailable. Before results are passed to the Engine Layer, outputs from different providers are normalized into a common internal format, reducing the impact of provider-specific changes on the rest of the system.

1.2 Engine Layer

Engine Layer comprises four core modules: first, the Knowledge Processing Pipeline, which processes course knowledge in heterogeneous formats such as PDF textbooks and slide decks through four stages of ingestion, cleaning, chunking and embedding, generates vectors using the BGE-M3 model and stores them in the Milvus vector database. Chunking adheres to document structure and preserves complete logical units for mathematical and scientific content. Second, the Dual Knowledge Base combines a vector-indexed document store with a structured knowledge graph. The former supports semantic retrieval and is suitable for "what" questions, while the latter depicts relations such as “is_a” and “prerequisite_for” between concepts. The graph is constructed via automatic generation plus expert review, with triple data in the graph bidirectionally linked to evidence in the document store. Third, the Hybrid Retrieval-Augmented Generation (RAG) Pipeline, which first classifies queries by type and retrieval mode (vector-primary, graph-primary, hybrid) through a Query Classifier, with the hybrid mode being the mainstream in the pilot. It conducts parallel retrieval, performs reciprocal rank fusion and deduplication, then assembles structured prompts that require the model to answer based on evidence, cite sources and state cases of insufficient evidence explicitly. Fourth, the Programmable Pedagogical Rule Engine, which regulates the interactive behavior of the model through pedagogical rules applied

before and after content generation. The engine is equipped with a visual authoring interface, enabling teachers to customize rules after a short training session without coding.

1.3 Application Layer and API Design

The Engine Layer exposes its capabilities through a set of RESTful APIs. The Knowledge Q&A API accepts a natural-language question, an optional user context object, and a scope parameter identifying the relevant knowledge base. It returns an answer, source citations, a confidence score, and related concepts derived from the graph. The Learning Path API accepts a student profile and a target learning objective and returns an ordered sequence of concepts and supporting resources. The Assessment Generation API accepts a knowledge point, a target Bloom level, and an item format, then returns candidate items with answer keys and rubrics. The Classroom Interaction API generates discussion prompts, polling questions, or short quizzes for integration with the Rain Classroom teaching platform. All APIs are protected through OAuth 2.0, rate-limited at the department level, and instrumented for usage logging and analytics.

2. Implementation Steps and Timetable

The project followed a phased rollout strategy of “Central Coordination and Department-led Implementation.” This division of labor ensures that departments retain disciplinary and pedagogical control, while the central team provides the necessary R&D power, tooling, and deployment consistency. The pilot began in the Spring 2024 semester with three initial departments: Environment, Industrial Engineering, and Integrated Circuits. In March 2025, the university launched the second batch of construction, expanding to 20 pilot sites across a diverse range of disciplines. These included STEM fields (e.g., Mechanical Engineering, Computer Science, Mathematics, Chemistry), Social Sciences (e.g., Public Policy, Finance), and Humanities and Arts (e.g., Foreign Languages, Marxism, and Fine Arts). As of late 2025, the DKE has been successfully deployed across 259 courses, reflecting a significant scaling of AI-enabled education.

Case Innovation and Breakthroughs

This research proposes three key innovations in the construction of the disciplinary knowledge engine, covering technological-pedagogical integration, talent cultivation and evaluation reform, and inter-institutional resource collaboration.

1. Innovative integration of technological frameworks and pedagogical resources

This research adopts a deep integration paradigm of high-quality disciplinary knowledge graphs and LLMs. First, massive multi-source and heterogeneous disciplinary resources undergo in-depth mining, systematic integration, and authoritative validation to construct a foundational knowledge graph—one that covers core disciplinary domains with explicit logical correlations and fine-grained knowledge representation.

On this basis, targeted professional upgrading and optimization are applied to general-purpose LLMs, transforming them from "generalist" models to discipline-specific "specialists." Ultimately, an intelligent knowledge service carrier is developed, capable of providing professional, targeted support for the implementation of disciplinary teaching practices, personalized learning guidance, and exploratory research on scientific and technological innovation.

2. Innovations in the process of talent cultivation and the paradigm of educational evaluation

Leveraging the technical support of the DKE, in-depth research is conducted on the construction of

problem-oriented personalized learning processes, and diverse learning scenarios are designed and developed to systematically cultivate students' higher-order thinking abilities.

Meanwhile, to address the inherent limitation of traditional evaluation models—prioritizing learning outcomes over the learning process—this research takes the reform of the credit recognition mechanism as a critical breakthrough. It further explores the comprehensive integration of core evaluation dimensions—including students' learning process performance, attainment of higher-order thinking competencies, and learning achievement outputs—into a unified evaluation system.

A scientific, quantitative, dynamic, and multi-dimensional credit recognition mechanism is thus established, reshaping the value of academic credits in measuring and incentivizing the development of students' comprehensive abilities.

3. Innovative mechanisms for interdisciplinary and inter-institutional resource collaboration

Aiming at the prominent challenges of resource silos and insufficient collaborative sharing in higher education institutions, this research carries out in-depth exploration on a unified framework and core technical standards for the co-construction and sharing of cross-university and interdisciplinary educational resources. An engine cluster development model characterized by benchmarking leadership and characteristic supplementation is constructed: taking the advantageous disciplinary resources of various universities as the core driving force, the model guides and drives more higher education institutions to participate in the co-construction and sharing of disciplinary knowledge bases. It also encourages each university to develop its own distinctive disciplinary advantages, thereby forming a disciplinary knowledge engine cluster with complementary strengths and comprehensive coverage of multiple disciplines and research fields. This model effectively breaks the predicament of educational resource silos, realizes large-scale integration and efficient radiation of high-quality educational resources, maximizes the educational value and social benefits of such resources, and thus provides a robust technical and resource support for the construction of a new paradigm of talent cultivation in higher education.

Case Effectiveness

We evaluated the DKE along three dimensions: factual performance, user experience, and academic engagement.

1. Answer Accuracy and Hallucination Reduction

To assess the DKE's factual reliability, we conducted a blind test and a comparative benchmark.

In the evaluation conducted by the Department of Industrial Engineering, the Disciplinary Knowledge Engine demonstrated higher accuracy in curriculum matching, stronger knowledge traceability, and more stable application effects in learning path planning. For learning path planning tasks, the engine generates traceable recommendations, achieving a 98.8% accurate curriculum matching rate—outperforming the optimal performance of general large models (95.8% for Claude-sonnet-4-6 and 94.6% for GPT-4o-mini).

To examine the generalizability of the DKE, we further extended the evaluation to four additional departments. As illustrated in the multi-departmental evaluation, the DKE improved answer accuracy by 4–8 percentage points across different fields. In Environmental Science, accuracy increased from 89% to 95%, while in department of Automation it improved from 95% to 99%. In Software Engineering, the improvement was rising from 84% to 92%. In Chemistry, accuracy increased from 73% to 77%(Figure 1).

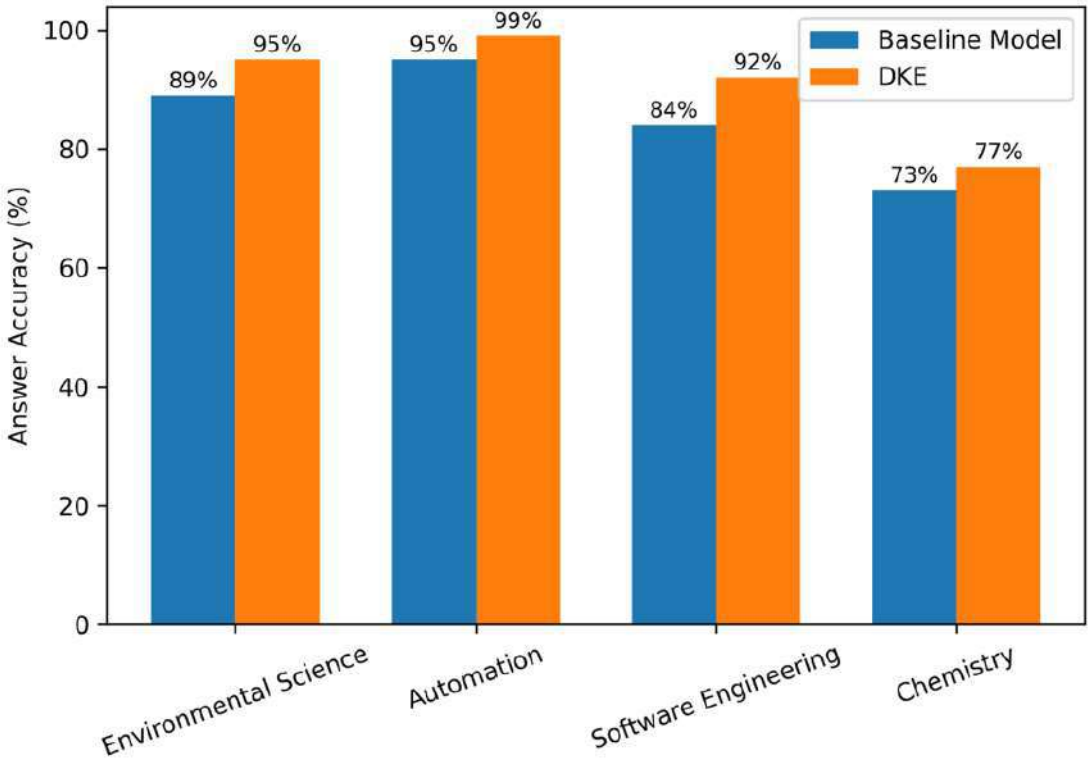

Figure 1 Cross-departmental comparison of answer accuracy between the baseline model and the DKE.

2. User Experience

To evaluate the user experience of the DKE, quantitative survey data were collected from a diverse cohort of over 600 students—spanning undergraduate, master's, and doctoral levels—across various departments. The results indicated high levels of satisfaction, with 90% of respondents reporting that the engine provided tangible academic assistance. Beyond these metrics, semi-structured interviews and open-ended survey responses revealed how the DKE functions as a cognitive scaffold rather than a mere information repository.

3. Academic Engagement

One notable indicator is the increase in system participation during high-stakes academic periods(Table 1). In the Department of Automation, which enrolls more than 1,300 students, the weekly active user rate increased from a baseline of approximately 30% to 82.1% during the final examination week. Additional evidence of sustained engagement is observed in disciplinary learning contexts. In the Department of Foreign Languages, students enrolled in Writing and Critical Thinking courses accumulated more than 729 hours of interaction with disciplinary agents across 4,460 recorded exchanges. Similarly, in the Department of Mathematics, specialized agents processed approximately 500 inquiries per day, providing real-time, step-by-step scaffolding for quantitative problem solving in ways that extend beyond the capabilities of unenhanced large language models.

diverse academic domains.

Table 1 Engagement Metrics Observed During the DKE Pilot Deployment

Department	Metric	Value
Automation	Weekly active rate (baseline)	30%
Automation	Weekly active rate (exam week)	82.1%
Foreign Languages (Writing and Critical Thinking)	Total interaction hours	729 hours
Foreign Languages (Writing and Critical Thinking)	Recorded interactions	4,460
Mathematics	Average daily inquiries handled by agents	≈500 per day

Generalizability

The DKE points toward a middle path in educational AI. Rather than relying on general-purpose models as they are, or building fully specialized models for each discipline, institutions can place a layer of retrieval, structured knowledge, and pedagogical control around existing LLMs. This approach does not eliminate the need for human judgment. It depends on it. But it gives universities a way to use LLMs while preserving curricular alignment, source transparency, and some measure of instructional control.

On May 20, 2025, Tsinghua University signed agreements with 80 universities across China to jointly build the DKE and advance the digital development of higher education. Meanwhile, drawing on Tsinghua's experience and its three-layer architecture, more than 80 disciplinary knowledge engines have been built for universities nationwide.

For universities considering similar efforts, three practical points stand out. First, organizational design matters: the separation between domain expertise and central technical support was essential to the pilot. Second, a narrow initial scope is preferable to comprehensive ambition. Early success depended on starting with courses that had stable materials and engaged instructors. Third, structured knowledge was worth the extra effort. The graph layer was not necessary for every query, but it contributed most in exactly the kinds of questions that matter in teaching: those involving prerequisites, conceptual contrast, and multi-step understanding.

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Case 41

From AI Literacy to AI Creation: An Institutional Pathway to Personalized Teaching and Learning Through the Pearson AI Certification Framework

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Introduction: Bridging AI Policy Frameworks and Classroom Practice

Artificial intelligence (AI) has rapidly evolved from a specialist technical field into foundational infrastructure shaping knowledge production, labor markets, civic participation, and education ecosystems. As generative AI tools become widely used in classrooms and workplaces, global discussions around digital literacy, academic integrity, and future employability continue to intensify. Yet as AI adoption accelerates, education systems still face a structural question: how can students' AI capabilities be defined, developed in stages, assessed, and validated in a systematic way?

UNESCO's AI Competency Framework for Students provides, for the first time, a globally aligned structure for student AI competencies. The framework is built around four interrelated dimensions—Human-centred mindset, Ethics of AI, AI techniques and applications, and AI system design—and is organized into three progression levels: Understand, Apply, and Create. It emphasizes that AI education should not only build technical proficiency, but also cultivate critical judgment, responsibility, and sustainable design principles.

However, publishing a policy framework does not automatically translate into changes in teaching practice. Education systems urgently need practical tools that convert competency standards into measurable learning outcomes, adaptive learning pathways, and scalable credentialing mechanisms.

This section uses Pearson's AI certification pathway—particularly Generative AI Foundations and the IT Specialist: Artificial Intelligence credential—as a case to examine how AI-driven education transformation can be implemented as an institutionalized, measurable, and scalable teaching practice. The case illustrates how structured certification routes, personalized diagnostic analytics, and self-paced digital coursework can enable AI education practices aligned with international competency frameworks.

Conceptual Framework: The Logic of Personalized Learning in AI Competency Development

Personalized teaching and learning has traditionally been closely associated with differentiated instruction and adaptive tutoring systems. In the context of AI education, personalization becomes more complex because students enter the classroom with markedly different levels of digital experience, prior AI use, and ethical awareness.

A competency-based personalization system needs three core structural components:

1. A clearly defined competency framework
2. A transparent diagnostic mechanism
3. An iterative feedback loop that supports continuous improvement

The UNESCO framework provides the first component by systematically defining the progression of AI competencies. Pearson's certification programs, through their Objective Domains (which can be understood simply as exam blueprints) and their detailed score reporting, operationalize the latter two components.

In this model, personalization does not rely solely on algorithmic recommendations. Instead, it is achieved by making the competency structure transparent so that learners and teachers can clearly identify progress across specific skill dimensions—supporting data-informed instructional interventions and individualized growth-path design.

Implementation Pathway: From Framework Alignment to Measurable Outcomes

1. Visual Alignment with the UNESCO Competency Architecture

To clarify the structural correspondence, Pearson developed a visual mapping model between its certification pathway and the UNESCO AI competency framework.

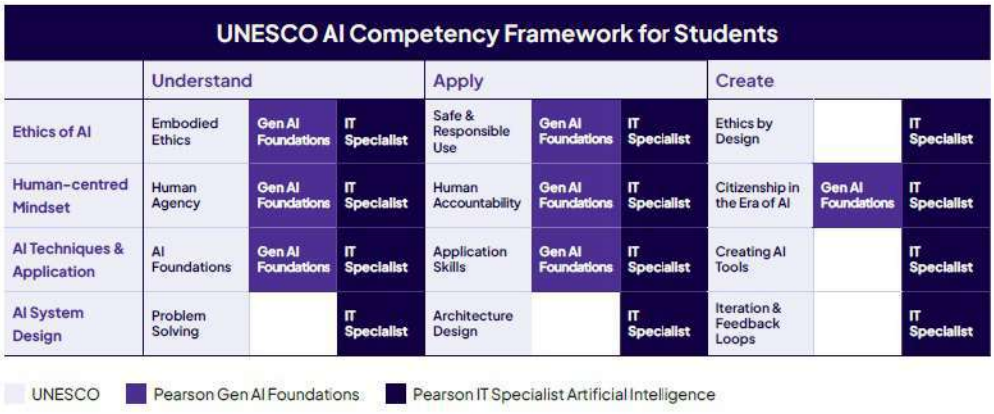

Figure 1 Mapping between the UNESCO AI Competency Framework for Students and the Pearson AI Certification Pathway (Adapted from the Pearson–UNESCO alignment guide).

The diagram indicates that:

- Generative AI Foundations covers the "Understand" and "Apply" levels, with an emphasis on AI ethics, a human-centred mindset, and applied AI techniques.
- IT Specialist: Artificial Intelligence extends further into the "Create" level, focusing on AI system design and lifecycle management.

This mapping demonstrates that Pearson's certifications do not operate in isolation; they function as practical instruments for implementing globally recognized competency standards.

2. A Technical Crosswalk Between UNESCO Competency Modules and Objective Domains

To further illustrate the technical correspondence, the table below presents a detailed match between UNESCO competency modules and Pearson certification Objective Domains.

Table 1 Technical Mapping Between the UNESCO AI Competency Framework and Pearson Certification Objective Domains.

UNESCO dimension	Progression level	Competency module	Generative AI Foundations (exam coverage)	IT Specialist: Artificial Intelligence (exam coverage)
AI ethics	Understand	Embodied ethics	Privacy, bias, and intellectual property awareness	Governance and regulatory compliance
	Apply	Safe and responsible use	Prompt optimization and ethical constraints	Data-bias identification and risk assessment
	Create	Ethical design	—	Safety planning, adversarial risk analysis, and stakeholder validation
Human-centred mindset	Understand	Human agency	AI limitations and hallucination risk	Explainability and sensitivity testing
	Apply	Human responsibility	Output evaluation and responsible use	Performance metrics such as accuracy and overfitting analysis
	Create	AI citizenship	—	Monitoring, drift detection, and lifecycle oversight
AI techniques and applications	Understand	AI fundamentals	Transformers, GANs, and diffusion models	Problem classification
	Apply	Applied skills	Prompt engineering and multimodal applications	Feature engineering and train/test splitting
	Create	Creating AI tools	—	Model training and workflow design
AI system design	Understand	Problem definition	Tool–task matching	AI problem definition and domain identification
	Apply	Architecture design	—	Infrastructure planning and pipeline integration
	Create	Iteration and feedback	—	Monitoring, feedback loops, and impact evaluation

This technical mapping suggests that:

- The competency progression structure is preserved in full
- Ethical competencies are embedded within technical modules
- Coverage spans the full AI lifecycle

Personalized Learning in Practice: A Student Scenario

Consider the example of a secondary-school student, “Meilin.” When she enrolled in an AI elective, she already had some prompt-engineering skills, but had limited understanding of model architectures and mechanisms of bias.

Through LearnKey modular courses, she repeatedly studied topics related to Transformers and training mechanisms. A CertPrep diagnostic report showed that she was comparatively weak in ethical analysis. Based on this insight, her teacher organized small-group discussions to strengthen awareness of bias and responsible use.

After passing Generative AI Foundations, she received a detailed score report confirming significant improvement in the ethics domain. She then progressed into the IT Specialist: Artificial Intelligence learning pathway, studying data engineering and model evaluation—completing the transition from an AI user to an AI creator.

This pathway clearly reflects UNESCO’s “Understand–Apply–Create” progression logic.

Note*: LearnKey is Certiport’s online video-course product line under Pearson. Students can tailor their learning in modular, self-paced units based on their needs.

Note**: CertPrep Practice Test is Certiport’s practice-test system. It offers both mock-exam and learning modes, helping candidates understand their readiness and improve their pass rate.

Evidence of Impact

1. Quantifiable Competency Attainment

Certification scores provide internationally standardized validation of competencies and, through Objective Domain breakdowns, support institution-level data analysis. Below is a sample score report from a candidate who took Pearson’s Generative AI Foundations exam. In addition to the overall score, it includes percentage performance by Generative AI Foundations Objective Domain, helping candidates identify gaps and target improvement to strengthen learning outcomes.

2. Learning Engagement

LearnKey and CertPrep online platforms increase access to learning. Repeated practice behaviors indicate a mastery-oriented learning mode. Below is a reference screenshot of the LearnKey Generative AI Foundations course (Chinese version).

3. Employability Alignment

Employer demand for AI skills continues to grow, and certifications are becoming a bridge between education and employment.

4. Ethics and Responsibility

The certification pathway embeds bias identification, data governance, and safety planning into technical assessments, and safeguards academic integrity through a secure testing environment. This is consistent with UNESCO’s human-centred and responsibility-oriented principles for AI education.

5. Scalability

With platform-neutral design, cloud deployment, and support from a global testing network, the certification pathway can be integrated into national AI education strategies.

6. Conclusion

AI education transformation requires structural coherence across competency frameworks, instructional design, assessment mechanisms, and ethical governance. Pearson's Generative AI Foundations and IT Specialist: Artificial Intelligence certifications demonstrate how the UNESCO competency framework can be translated into a system that is measurable, personalized, and scalable. In the AI era, true personalization is not only about content recommendations—it is about making competency growth visible and accountable.

Case 42

MAIC: A Novel AI Multi-Agent Classroom for Self-Directed Learning

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Background and Significance

Artificial intelligence is reshaping not only educational tools but also the organization of teaching and learning. *China's Outline for Building an Education Powerhouse (2024–2035)* calls for AI-enabled curriculum reform, teacher digital competence, cloud-based schooling, and data-driven educational governance. Against this background, digital education is moving from content digitization toward the deep integration of AI across the full instructional process.

However, three challenges remain prominent. First, large-scale education still struggles to respond effectively to learner diversity. Second, generative AI can improve efficiency but may also encourage cognitive offloading if students rely on AI for reasoning and expression that should remain their own. Third, high-quality digital course production often places heavy burdens on teachers. MAIC was developed to address these challenges in an integrated way.

MAIC, short for Massive AI-empowered Course or Multi-Agent Interactive Classroom, reconceptualizes AI as coordinated classroom infrastructure rather than as a standalone chatbot. Under teacher guidance, it connects course preparation, adaptive personalization, classroom interaction, collaborative learning, and instructional improvement. Its broader aim is to move digital education from resource delivery to effective, scalable, and learner-centered teaching.

System Design and Core Architecture

MAIC consists of three closely connected layers: AI-native course preparation, adaptive personalization, and multi-agent classroom learning.

First, teachers upload slides, textbooks, exercises, documents, videos, and audio materials. Through multimodal parsing, knowledge-base construction, script generation, quiz generation, and pedagogical agent creation, the system transforms raw materials into structured and reusable instructional assets. MAIC therefore functions not only as a learning tool but also as a scalable course-authoring environment.

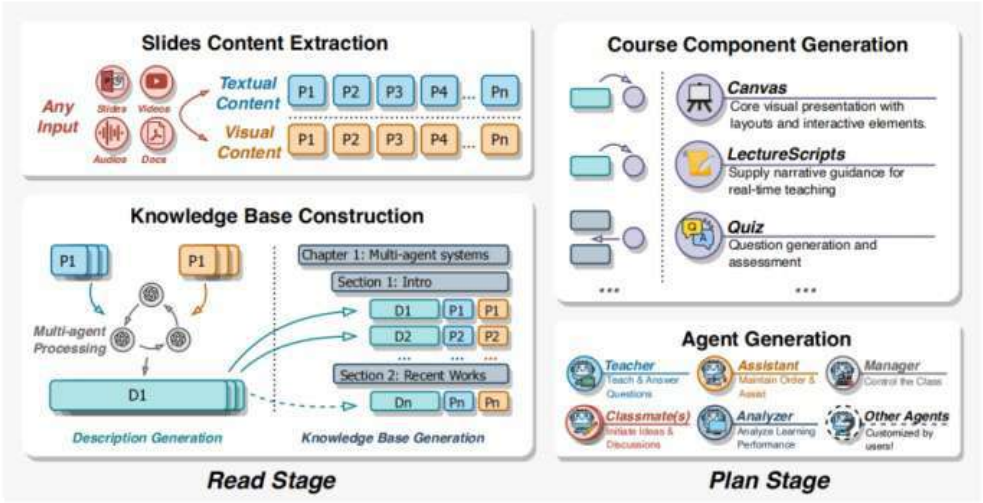

Figure 1 Illustration of the course preparation workflow of MAIC-Craft

Second, MAIC builds learner profiles through conversational interaction, capturing academic background, interests, and learning characteristics. These signals are converted into structured tags and used to personalize instructional scripts at the token level. As a result, personalization is embedded directly into teaching content and delivery rather than being limited to recommendation or feedback.

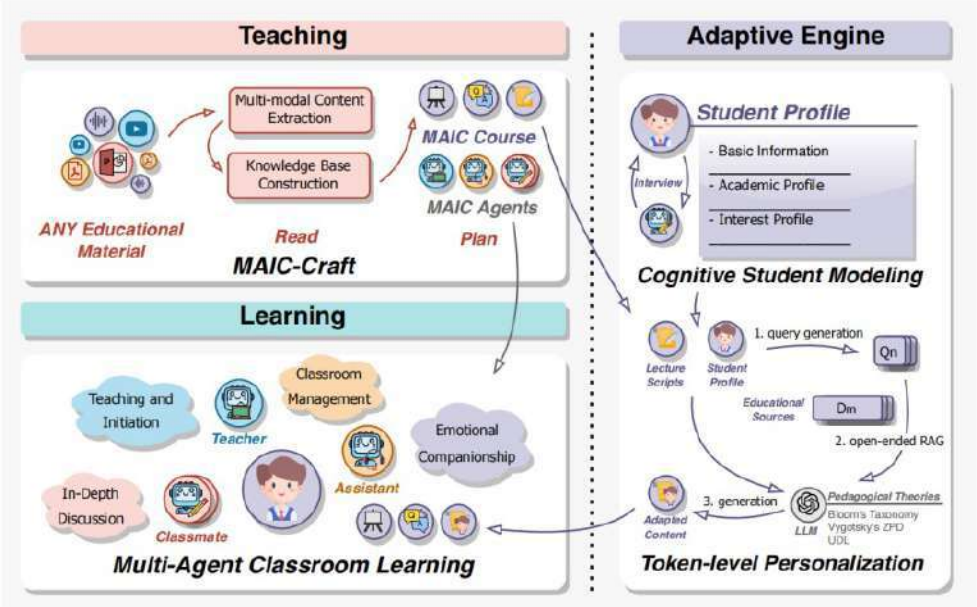

Figure 2 Illustration of the conceptual structure of MAIC

Third, MAIC organizes classroom learning through multiple AI roles. The AI teacher explains concepts and initiates questions, AI teaching assistants provide support, AI classmates stimulate discussion, and a manager agent coordinates interaction based on dialogue history and slide context. This design enables a structured classroom environment centered on teaching, discussion, emotional support, and classroom management.

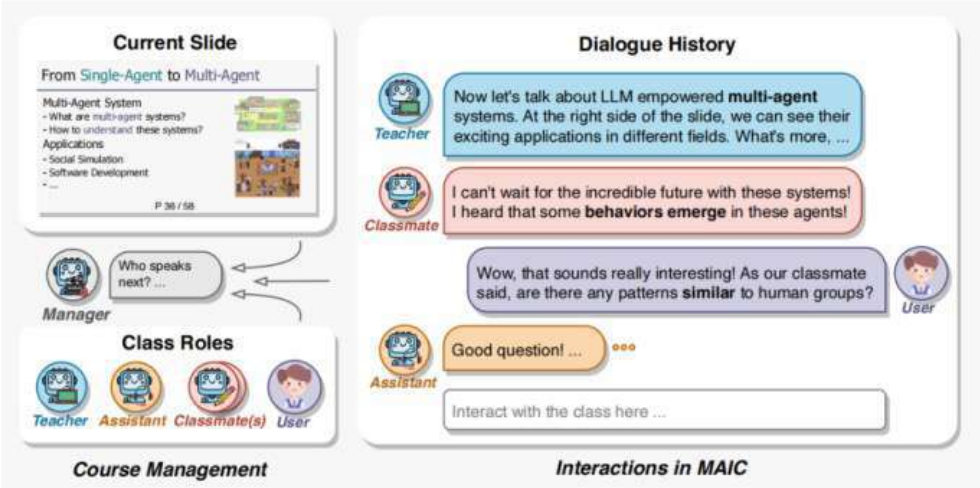

Figure 3 Illustration of the classroom learning environment of MAIC

Beyond lecture-based learning, MAIC also supports project-based tasks such as coding, group discussion, virtual experiments, and report writing. By preserving students' responsibility for planning, coordination, and verification, the system aims to enhance efficiency without replacing learner agency.

Distinctive Innovations

First, it redefines the unit of scale in digital education. Unlike MOOCs, which scale through standardized content delivery, MAIC scales through structured interaction by organizing multiple agents around one learner.

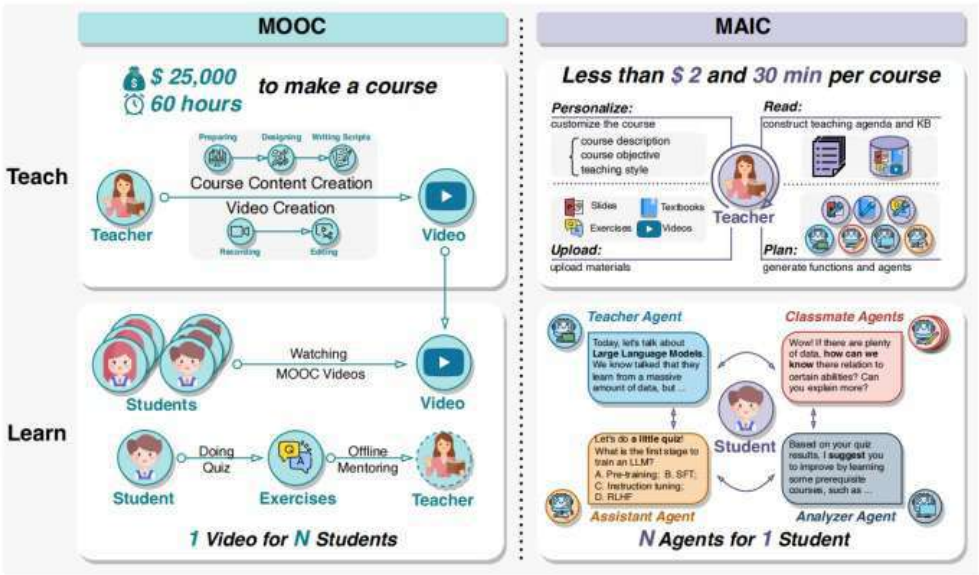

Figure 4 MOOC V.S. MAIC from the aspects of teaching and learning

Second, it provides full-process integration. It combines course generation, personalization, classroom orchestration, collaborative learning, and iterative course improvement within one unified framework.

Third, it embeds pedagogical constraints into personalization. Adaptation is guided not only by learner data but also by educational principles, including Bloom's Taxonomy, the Zone of Proximal

Development, and Universal Design for Learning.

Fourth, it balances AI assistance with learner agency. Rather than maximizing automation, MAIC is designed to preserve students' active role in reasoning, expression, and problem solving.

Research Evidence

The educational value of MAIC is supported by evidence from instructional generation, classroom implementation, learning analytics, and controlled research.

In course-production tasks, MAIC-Craft achieved the strongest overall performance in lecture-script generation, ranking highest in both automated evaluation and human judgment on consistency, readability, and coherence. Expert evaluation across multiple university courses also showed strong results in personalization relevance and learner engagement.

	Automated Evaluation				Human Evaluation		
Method	Content	Coherence	Pedagogy	Overall	Consistency	Readability	Coherence
Iterative Processing	3.68	3.72	3.75	3.72	1.47	1.48	1.31
Direct Prompting	3.73	3.74	3.78	3.75	–	–	–
Teacher Refined	–	–	–	–	2.12	2.16	2.25
MAIC-Craft	**3.86**	**3.89**	**3.92**	**3.89**	**2.44**	**2.37**	**2.44**
w/o visual	3.61	3.77	3.68	3.69	–	–	–
w/o context	3.84	3.66	3.84	3.78	–	–	–

Note: Automated scores (1–5 scale), human ranking (1–3 scale, higher better). "–" represents no evaluation conducted. **Bold score** represents the best performance.

Figure 5 MAIC-Craft core technology validation results

Method	Ablation	Acc (%)	Cla (%)	Coh (%)	Eng (%)	Nat (%)	Rel (%)	Overall (%)
Human-authored	-	55.5	56.5	<u>57.9</u>	35.9	33.8	33.8	45.5
Ours	-	**77.8**	**75.5**	**76.2**	**87.0**	**86.0**	**92.2**	**82.4**
w/o retrieval	System	53.7	53.0	53.4	<u>67.3</u>	<u>69.0</u>	<u>65.7</u>	<u>60.3</u>
GPT-4o	Model	55.9	56.8	57.2	55.8	54.1	54.8	55.9
OpenAI-o1	Model	<u>57.1</u>	<u>58.2</u>	55.2	54.0	57.1	53.4	55.8

Note: Acc (accuracy), Cla (clarity), Coh (coherence), Eng (engagement), Nat (naturalness), Rel (relevance). We compare our system against human-authored content and show two ablation settings: 1) system-level (w/o retrieval augmentation) and 2 model-level (LLM backbones with retrieval augmentation). The <u>Underlined</u> indicate the second best performance.

Figure 6 Evaluation across Six Pedagogical Dimensions

Learning analytics further showed that in-class interaction frequency and message length were positively associated with academic performance. Even after controlling for baseline achievement, average message length remained a significant predictor of final exam results. Students also reported stronger acceptance of generative AI and perceived gains in abstract and critical thinking.

	$\mu(\log(\text{MsgNum}))$	$\mu(\log(\text{MsgLen}))$
AvgQuiz	0.341***	0.202*
FinalExam	0.346***	0.333**

Note: Values shown in the table are normalized.

Figure 7 Correlation of Students' Message-Aware Behavior and Test Results.

	β	SE	95% CI	t	p
(Constant)	25.46		[19.13 31.79]	8.02	<0.001
AvgMsgLen	0.14	0.25	[0.02 0.26]	2.36	0.021
Baseline	2.02	0.43	[1.46 3.36]	4.05	<0.001

Figure 8 Regression Results of Final Exam on the Length of Messages

In classroom pilots at Tsinghua University, MAIC was implemented for over three months in two courses and involved more than 500 student volunteers, generating over 100,000 behavioral records. Among 319 students who completed the courses, 86.3% actively interacted with AI agents. Questioning and idea initiation accounted for most student participation, indicating that the system supported rather than weakened learner agency.

In a related randomized controlled study involving 213 university students in Beijing, AI teaching agents significantly improved both perceived control and learning performance. Taken together, these findings suggest that MAIC supports meaningful participation and measurable learning gains.

Social Impact

MAIC has already generated significant social impact through deployment, institutional adoption, and public-platform integration.

By March 9, 2026, the platform had 126,133 registered users, including 7,584 campus users and 101,398 users from the National Smart Education Public Service Platform. Total slide-learning page visits exceeded 8 million, and total platform interactions exceeded 20 million. These figures show that MAIC has moved beyond pilot experimentation into large-scale public use.

Within the university, MAIC has supported more than 50 courses across 11 departments, including 16 fully implemented courses and 5 credit-bearing courses. More than 500 teachers had opened teacher-side accounts, and some had already integrated the system into real teaching involving nearly 3,000 students.

Its influence also extends beyond a single institution. The project has received more than 800 collaboration intentions from 31 provincial-level regions in China, demonstrating strong dissemination potential. Its expansion from university pilots to national higher-education and K–12 smart education platforms further highlights its public-service value.

In March 2026, MAIC was selected as an exemplary case of safe and beneficial AI in education, further confirming its wider educational and social significance.

Scalability and Transferability

MAIC shows strong scalability because it is cross-disciplinary, publicly extensible, and modular. It has already been used in courses across computer science, education, political studies, psychology, medicine, and engineering, suggesting broad disciplinary applicability. Its integration into national higher-education and K–12 platforms shows its relevance beyond university pilots. In addition, its modular structure allows institutions to adopt the system as a whole or in stages according to local conditions.

Overall, MAIC provides a scalable and pedagogically grounded model for AI-enabled educational transformation. It demonstrates how large-model-driven agents can support course creation, classroom interaction, learner agency, and high-quality teaching at scale.

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Case 43

Universidad Internacional de La Rioja (UNIR): RAG-Tutor in Dialogic Learning for On-demand Student Interaction

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Case Brief

This project generates a tool that enhances DIALOGIC LEARNING, what is the process through which a student learns based on the conversation that he or she makes with data sources (the corpus). As a complement to memorization, or procedural learning (where a series of steps that must be followed are listed), dialogic learning focuses on inquiry, exploration, and the curiosity of the student. It is, therefore, a tool that enhances the student's capacity for constructive thinking and critical analysis, as a complement to other transversal competences. Dialogic learning also supports functional diversity, with real-time adaptation to learning styles, ways of expression, along with competence and cognitive levels.

Background

This project designs a privacy-preserving multilingual assistant that acts as a tutor for students. The system is implemented using a RAG architecture (Retrieval Augmented Generation) that solves students' doubts and questions using the educational content provided by the professor for the course, in a private environment, both for sources and for user interaction. The main objective is to create a tool, RAG-Tutor, that adapts content to student needs and as a result enhances and facilitates the learning process by personalizing the answers and providing mechanisms for human-machine collaboration.

This project is built on recent advances in LLMs (Large Language Models), Retrieval-Augmented Generation (RAG), and privacy-preserving approaches, to build a tutor architecture that provides relevant answers within the context of the documentation of a course. In general, the goal is to design tutoring systems that can facilitate the learning process for online students.

Key objectives:

1.Designing a multilingual privacy-preserving RAG-based architecture that allows students to ask questions and clarify doubts without compromising sensitive information.

2.Ensuring scalability and adaptability of RAG-Tutor to different courses

The main contributions to Dialogic and On-demand learning are:

1)Contextualized and Adaptive Content Delivery: RAG-Tutor dynamically contextualizes learning content for specific needs. By applying Retrieval-Augmented Generation, RAG-Tutor can present just-in-time information adapted to each student's progress enhancing on-demand learning.

2)Student-Centered Approach: RAG-Tutor is designed with a student-centered approach, putting learners' goals, interests, and challenges in the core of the system. It identifies knowledge gaps while presenting content in a personalized and accessible way.

3)Self-Directed Exploration and Lifelong Learning: RAG-Tutor allows students to engage with educational material on their own and as per their needs and interests. It enables self-directed learning with real-time and context-aware responses.

The project is mainly aimed at two groups: first, students, from any educational level and with any profile or competence level or area of study. Since the corpus (database made of multiple sources) will be generated according to the academic subject and specific documents, any student can benefit from this project that supports dialogic learning. The second group is professors. Thanks to RAG-Tutor they can compile, using various sources, any type of resource that is appropriate to form the corpus to be used by the student. In addition, the resource feeding is implemented dynamically, in such way that the professor can upload, integrate, and remove sources on the run. This feature facilitates the ability to adapt and continuously update the content provided to the student.

Implementation Process

The project uses qualitative and quantitative approaches. The qualitative evaluation is based on user interviews to evaluate user satisfaction with RAG-Tutor. Quantitative methods involve metrics such as accuracy of responses, latency, and the efficiency of information retrieval using RAG-Tutor.

Tools:

1. LLMs and AI Libraries: The implementation of local LLMs is built on OpenAI ChatGPT, Ollama, HuggingFace, LangChain and AWS among others.
2. Document Ingestion and Indexing: PyPDFLoader or a similar library is used for document ingestion, while Chroma, or a similar option, is used for embedding and indexing the fragments.
3. Development Tools: Python is the language for back-end development.
4. Privacy: To ensure privacy, RAG-Tutor is designed to operate on local servers and/or public cloud.

Timeline:

1. Phase 1: Basic Tutor

- Develop the back end and front-end of a tutor and embed it in Moodle.

2. Phase 2: Privacy and Memory Integration
- Provide support for local LLM deployment to preserve the privacy of interactions.
- Use LangChain to enable RAG-Tutor to remember previous interactions with the student and to use them in creating contextually appropriate responses

3. Phase 3: Retrieval-Augmented Generation (RAG)
- Develop document ingestion, embedding, and indexing mechanisms
- Design and implement the retrieval of information.
- Design and implemented the generation of answers using the context of the information retrieved,

4. Phase 4: Use Case Deployment
- Implement a RAG-Tutor for a course on a specific topic (possibly introduction to Operative systems or Introduction to Python)

5. Phase 5: Evaluation and Testing
- Evaluate answer quality and latency considering different LLMs.
- Evaluate the impact of embedding and indexing in the quality of the answers.
- Evaluate quality of answers and usability from the user's perspective.

Innovation and Breakthroughs

LLM-based education applications move beyond expert systems in two important ways: they codify vastly greater amounts of unstructured knowledge, and they can maintain conversational interactions with students. These capacities enable students to interact with LLM-based applications on an on-demand basis, providing information, suggestions and guidance on almost any topic at relatively little cost to the institution or the student.

The research is based on the use of RAG architectures, a state-of-the-art Generative AI technique that combines LLMs and document ingestion. RAGs provide relevant information because they resolve the context in which the LLM must operate. This context is given by identifying from the educational documents the relevant pieces of information for the question being solved. The LLM then considers that context (i.e. the relevant pieces of information) to provide a relevant answer. In general, this type of architecture leads to a reduction in hallucinations.

During document ingestion the information (PDF files, ppts, video files, etc.) are indexed in a vector database to later be used to provide context. This step is performed only once if the information to be handled by the RAG does not change. The information that is part of the vector database remains constant during the process. The second phase consists of producing answers to student questions using the input files (stored and indexed in a database) to provide context. Based on the question or query launched by the student, this statement is used to search the database where the elements being asked about to appear. This provides several "chunks" of information that can be used to provide the answer. Once these relevant "pieces of information" have been identified, this information is combined with the user's query in a prompt for the LLM.

The LLM combines context information with its language generating ability to produce a relevant response. Potentially the system can present not only the answer but highlight the sources of the information that has been used, creating a link between the answer and the original educational information that can be very useful for the student.

Effectiveness Proof

Currently, the International University of La Rioja (UNIR) is the largest online university in Spanish in the world. It is also part of an education group, called Proeduca, with nine higher education centres in Europe, Latin America and the United States. In total, a collective of 165,000 students and more than 10,000 professors. They are the main beneficiaries of this project. Through RAG-Tutor, our students and professors can learn and teach in a more efficient way, providing innovative and creative solutions to the problems and case-studies presented, which develop transversal skills that are essential for the proper incorporation into the labour market, or for the improvement of the current employment situation.

Likewise, the Research Institute UNIR iTED keeps a network of over 300 research partners on five continents. In addition, it collaborates with dozens of communication channels and news agencies around the world. In this sense, RAG-Tutor maintains a dissemination plan, one for the general public, and one more specific for the academic community, which is designed exponentially in the markets where the university operates. This network involves social media and social networks on a global scale.

Finally, UNIR iTED collaborates in this project closely with NetDragon, a leading Chinese technology and eGames company, which supports and help disseminate a significant part of RAG-Tutor in the Asian market.

Case 44

AI-Integrated Deep Learning for Numeracy Transformation: Study Case from Indonesia

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Universitas Swadaya Gunung Jati, Indonesia

Background

The rapid diffusion of generative Artificial Intelligence (AI) has intensified global discussions regarding its role in mathematics and numeracy education (Montenegro-Rueda et al., 2023; Memarian & Doleck, 2023). While AI systems such as ChatGPT offer adaptive explanations and real-time problem-solving assistance, researchers caution that technological exposure alone does not guarantee conceptual understanding or sustained learning gains (Kasneci et al., 2023). International policy frameworks further emphasize that AI integration must be pedagogically aligned and ethically governed rather than implemented as a standalone technological solution (OECD Secretariat & Education International, 2023; UNESCO, 2023).

In Indonesian secondary education, persistent numeracy challenges within large classrooms. These structural conditions often reduce opportunities for individualized scaffolding and reflective reasoning. At the same time, students are increasingly exposed to AI tools without structured guidance on prompt construction, output evaluation, or responsible use.

Persistent numeracy challenges in secondary education have prompted increasing exploration of technology-enhanced learning environments. Research on immersive and open-ended digital mathematics instruction demonstrates that structured technological mediation can strengthen students' problem-solving abilities and conceptual reasoning (Pramuditya et al., 2022). Similarly, game-assisted mathematical literacy environments have been shown to enhance engagement and reasoning depth when instructional design remains central (Hamidah et al., 2025). These findings suggest that technological integration becomes impactful only when embedded within deliberate pedagogical structures rather than implemented as standalone tools.

A preliminary diagnostic survey revealed moderate overall AI literacy. However, students demonstrated weaker competencies in prompt construction and in critically evaluating AI-generated

responses. The findings suggest that while technological familiarity exists, pedagogical mediation remains necessary to transform AI exposure into meaningful learning support.

Accordingly, this case addresses a central question in Artificial Intelligence in Education (AIED): how can AI be orchestrated within a structured deep learning framework to strengthen numeracy outcomes while maintaining ethical and instructional integrity?

Case Implementation Status

The implementation of AI-integrated deep learning at Subang Government High School began with a structured demand analysis aimed at identifying both pedagogical and technological readiness gaps. Rather than assuming that generative AI adoption would automatically enhance mathematics learning, the school conducted classroom observations, teacher consultations, and a baseline AI literacy survey (n = 54). Persistent numeracy challenges included uneven conceptual mastery and limited formative feedback opportunities conditions frequently noted in large classroom settings. The diagnostic survey indicated moderate AI literacy (M = 3.01), with comparatively lower competencies in prompt construction and critical evaluation of AI outputs. This distinction between functional AI use and critical AI literacy echoes emerging frameworks emphasizing evaluative competence over mere technological familiarity (Veldhuis et al., 2024; Mills, 2024). The demand analysis therefore clarified that instructional scaffolding not technological access alone was the primary intervention need.

The technology exploration phase did not involve developing new AI systems, but rather pedagogical customization of existing generative AI tools. ChatGPT was selected due to its dialogic reasoning capacity, which has been identified as both promising and pedagogically sensitive in educational contexts (Kasneci et al., 2023; Montenegro-Rueda et al., 2023). To mitigate risks of overreliance and uncritical acceptance of AI outputs, teachers collaboratively designed structured prompt templates aligned with numeracy competencies and deep learning principles (Fullan et al., 2017). Prompt engineering was explicitly taught, reflecting recent calls to integrate structured prompt literacy into educational practice (Lee & Palmer, 2025). AI was thus positioned not as an automated solution provider, but as a guided cognitive partner.

The role of AI in this implementation aligns with emerging evidence that AI-enabled systems can function as formative assessment mechanisms, supporting both learning achievement and self-regulated learning when carefully integrated into instructional processes (Liao et al., 2024). Moreover, the utilization of ChatGPT in mathematics learning is found to foster students' self-regulated learning, although it concurrently does not yield a significant reduction in mathematics anxiety (Delima et al., 2024). In this case, AI interaction was sequenced after independent problem-solving attempts, ensuring that technology reinforced rather than replaced conceptual reasoning.

The implementation followed a phased model emphasizing instructional sequencing. Students first engaged in independent problem-solving to activate conceptual reasoning. Guided AI interaction was then introduced, with teachers modeling analytical prompts and facilitating comparison between student reasoning and AI-generated explanations. Non-AI reinforcement activities were subsequently implemented to consolidate understanding without technological mediation. Finally, structured reflective dialogue encouraged students to critique AI responses and discuss ethical dimensions of generative AI use, consistent with international guidance advocating human oversight and responsible governance (UNESCO, 2023; OECD Secretariat & Education International, 2023).

The utilization of ChatGPT through predefined prompts facilitates students' cognitive engagement and awareness of the instructional content. To maintain pedagogical oversight, students are required to present their findings sequentially before the class. Throughout this phase, the teacher serves as a facilitator, providing necessary scaffolding to ensure that students' explorations remain strictly aligned with the core substance of the curriculum. Beyond this procedural execution, application optimization occurred iteratively throughout the research. Teacher feedback informed adjustments to prompt scaffolds, timing of AI integration, and the balance between AI-supported and independent tasks. This cyclical refinement reflects the broader understanding that AI integration must be pedagogically orchestrated rather than technologically driven (Giannakos et al., 2024). The case demonstrates that sustainable AI adoption in secondary numeracy education depends on demand-informed design, instructional customization, and continuous optimization within a human-centered framework.

In this framework, the application of ChatGPT is not an isolated activity but is strategically coupled with collaborative contextual problem-solving and interactive assessments via Wordwall. These three stages operationalize the core pillars of deep learning in education: mindful learning, meaningful learning, and joyful learning (Apandi, 2024). Specifically, the ChatGPT phase is designed to cultivate student consciousness and awareness of instructional content, fostering a mindful learning experience. Subsequently, the contextual problem-solving component enables students to bridge mathematical theories with real-world applications, thereby facilitating meaningful learning. Finally, the Wordwall quizzes introduce a competitive yet engaging atmosphere, ensuring a joyful learning environment that enriches the classroom dynamics. Furthermore, the implementation of this deep learning framework effectively facilitates differentiated instruction, as the adaptable nature of AI-driven prompts and collaborative tasks allows for the personalization of learning to accommodate diverse student needs, interests, and readiness levels. Collectively, this integrated deep learning framework forms a cohesive pedagogical structure that significantly bolsters students' numeracy skills.

Case Innovation and Breakthroughs

1. Main Innovation Content

The primary innovation of this case lies not in the creation of new artificial intelligence systems, but in the redesign of the instructional model governing AI use. While generative AI tools such as ChatGPT have been widely discussed for their capacity to generate explanations and solutions (Kasneci et al., 2023; Montenegro-Rueda et al., 2023), their classroom integration often remains technologically driven rather than pedagogically structured. This case introduces an AI-integrated deep learning model in which instructional sequencing, teacher mediation, and reflective reasoning precede technological interaction.

Grounded in deep learning pedagogy emphasizing conceptual understanding and knowledge transfer (Fullan et al., 2017), the model repositions AI from an answer-producing mechanism to a cognitive amplifier. Students are required to attempt contextual numeracy problems independently before interacting with AI. Guided prompt engineering sessions are then used to scaffold analytical questioning, aligning with emerging scholarship advocating structured prompt literacy in formal education (Lee & Palmer, 2025). The innovation therefore resides in pedagogical orchestration: AI becomes embedded within a human-in-the-loop design rather than functioning as an autonomous instructional agent..

This innovation builds upon broader trajectories of digital mathematics education research, including virtual reality–supported mathematical communication environments that enhance students' conceptual articulation and digital reasoning skills (Pramuditya et al., 2025). Such advancements underscore the role of AI-driven pedagogical resources as potent, student-centred instructional tools with the capacity to optimize and reshape the educational experience significantly (Chin & Ming, 2024). However, the present model extends these approaches by integrating generative AI within a human-in-the-loop deep learning framework, emphasizing reflective evaluation and structured prompt engineering.

A second innovation concerns the integration of critical AI literacy into mathematics instruction. Rather than treating AI as neutral technology, students are explicitly trained to evaluate AI outputs, identify potential inaccuracies, and reflect on limitations such as hallucination and overgeneralization (Kasneci et al., 2023). This aligns with evolving frameworks distinguishing functional AI use from evaluative AI literacy (Veldhuis et al., 2024; Mills, 2024). By embedding evaluative dialogue within numeracy lessons, the model advances both mathematical reasoning and digital criticality simultaneously.

2. Technology Breakthrough Content

From a technological standpoint, the case does not claim algorithmic innovation at the level of system architecture. Instead, its breakthrough lies in pedagogical customization and contextual adaptation of existing generative AI technologies for secondary education environments with moderate digital readiness. In many developing education systems, AI implementation precedes governance and instructional alignment (OECD Secretariat & Education International, 2023). This case demonstrates a structured pathway for responsible AI adoption without requiring advanced infrastructure or proprietary platforms.

The technological contribution can be understood as an instructional-layer breakthrough rather than a computational-layer breakthrough. Through structured prompt templates, sequenced AI interaction phases, and integration with non-AI reinforcement platforms, the case operationalizes international guidance advocating ethical and supervised AI integration (UNESCO, 2023). The value of this approach for educational informatization lies in its replicability: schools with limited technological capacity can implement AI-supported deep learning using accessible tools, provided that instructional design remains central.

In terms of industry-level positioning, the model aligns with emerging perspectives that generative AI's transformative potential depends on pedagogical orchestration rather than technical sophistication (Giannakos et al., 2024). By demonstrating measurable numeracy gains without dependence on advanced AI literacy levels, the case challenges assumptions that digital transformation requires high baseline technological competence. This reframing contributes to more inclusive models of digital transformation in secondary education.

3. Application Practice Breakthrough Content

The most significant breakthrough occurred at the level of classroom practice. Empirical findings indicated that baseline AI literacy did not significantly predict numeracy gains. This insight suggests that instructional structure and teacher scaffolding, rather than technological familiarity, served as the primary drivers of improvement. Such findings are particularly relevant for domestic basic education contexts where digital readiness levels vary widely.

The case advances three practical breakthroughs. First, it demonstrates that AI can be sequenced after

conceptual activation, thereby preventing passive reliance. Second, it integrates non-AI reinforcement stages to ensure cognitive internalization. Third, it institutionalizes reflective critique of AI outputs as part of mathematics learning. These elements collectively transform AI from a shortcut mechanism into a structured reasoning tool.

For the development of domestic basic education, this model provides a scalable framework for AI adoption that prioritizes equity. The absence of significant gender disparities in learning outcomes indicates that structured mediation can mitigate unequal technological familiarity. Moreover, by embedding ethical reflection within regular instruction, the model supports responsible digital citizenship alongside academic improvement. This dual focus aligns with broader goals of sustainable educational digital transformation.

4. Intellectual Property Status

The instructional design model developed in this case referred to as the AI-Integrated Deep Learning Framework constitutes an original pedagogical configuration created under a research initiative. This model is founded on the idea that successful AI integration in education depends on a thorough understanding of pedagogical roles and responsibilities, ensuring its effective and ethical use. It also suggests that deep learning not only improves students' conceptual understanding but also promotes meaningful reflective learning practices. The framework integrates structured prompt engineering pedagogy, phased AI interaction sequencing, and reflective AI evaluation within a secondary numeracy curriculum.

At present, no proprietary software or patented algorithm has been developed as part of this implementation. The technological tools utilized (e.g., generative AI platforms and digital reinforcement applications) remain third-party systems operating under their respective usage licenses. The intellectual contribution of this case resides in the instructional design model, pedagogical sequencing framework, and structured prompt templates developed by the research team.

Ownership of the instructional model and its associated teaching materials is retained by the implementing institution under national research grant regulations. Future dissemination may include publication, teacher training modules, or potential copyright registration of instructional materials, subject to institutional policy.

Promotion Value and Risks

The AI-Integrated Deep Learning model demonstrates strong potential for scalable application within Indonesian secondary education contexts characterized by moderate digital readiness. Its operational structure, centered on teacher-mediated orchestration, structured prompt engineering, phased AI interaction, and non-AI reinforcement, enables implementation without reliance on advanced infrastructure or proprietary systems. By leveraging accessible generative AI tools within a curriculum-aligned instructional framework, the model offers a feasible pathway for broader adoption across comparable public secondary schools.

From a national policy perspective, the case aligns closely with Indonesia's educational transformation agenda, particularly within the *Merdeka Belajar* framework promoted by the Ministry of Education, Culture, Research, and Technology (Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi Republik Indonesia, 2022). National reform efforts emphasize strengthening foundational competencies, including numeracy, as a strategic priority for improving learning equity and overall

education quality. Furthermore, Indonesia's medium-term development roadmap underscores digital transformation and human capital development as key drivers of long-term economic competitiveness (Badan Perencanaan Pembangunan Nasional, 2020). By enhancing numeracy outcomes through structured AI-supported pedagogy, the present case contributes directly to these national priorities, linking classroom-level innovation to systemic development goals.

Economically, the model represents a cost-effective approach to educational digital transformation. Rather than requiring capital-intensive technological procurement or proprietary AI development, it maximizes impact through pedagogical redesign and teacher capacity building. This approach aligns with international recommendations advocating sustainable and equitable AI integration in education systems (OECD Secretariat & Education International, 2023; UNESCO, 2023). Strengthened numeracy competence is strongly associated with workforce productivity, adaptability, and innovation capacity. Consequently, scalable AI-mediated numeracy improvement may contribute indirectly to Indonesia's broader digital economy ambitions and long-term human capital advancement.

As a demonstration case, the model offers a replicable framework for responsible AI integration in basic education. It illustrates how systematic demand analysis, pedagogical customization, and iterative application optimization can transform generative AI capabilities into structured classroom practice. By reframing digital transformation as pedagogy-driven rather than technology-driven (Giannakos et al., 2024), the case assumes a potential leading role for other Indonesian schools navigating AI adoption.

Nevertheless, several risks must be acknowledged. Technical risks include inaccurate or hallucinated AI outputs and dependency on external platforms (Kasneci et al., 2023). Ethical risks involve data privacy concerns, cognitive outsourcing, and academic integrity challenges (UNESCO, 2023). Unequal teacher readiness may also create variability in implementation quality. To mitigate these risks, the model embeds structured human oversight, reflective evaluation phases, transparent prompt practices, and non-AI reinforcement cycles.

Recent research further suggests that effective AI integration depends significantly on teacher mindset and structured professional preparation, rather than tool-only exposure (Tran et al., 2025). Without adequate pedagogical training, AI adoption risks becoming superficial or inconsistent across classrooms. Therefore, scalable promotion of this model requires parallel investment in teacher AI literacy development and instructional design capacity building. Overall, the promotion value of this case lies in demonstrating that inclusive, pedagogy-centered AI integration can simultaneously advance national educational reform, economic development priorities, and responsible digital governance.

Other Relevant Information

Supporting Materials

Comprehensive supporting documentation has been developed to enhance transparency, replicability, and dissemination of the case. These materials structured prompt engineering templates, sample numeracy learning modules integrating AI interaction, reinforcement activity designs using Wordwall, statistical summary reports derived from non-sensitive data, and classroom implementation photographs.Multimedia documentation, including classroom implementation images and instructional artifacts, may be provided via secure cloud storage or as separate attachments upon request. All materials comply with institutional ethical approval procedures, including student consent requirements and

national data protection guidelines.

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Case 45

How an International Organisation Dedicated to Higher Education Supports Universities in Integrating AI: the AUF's Inclusive and Multilingual Approach Across 120 Countries

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Agence Universitaire de la Francophonie (International French Organization)

Introduction

The Agence Universitaire de la Francophonie (AUF), an international non-governmental, non-profit organisation, works on behalf of nearly 1,100 higher education and research institutions in 120 countries. Although it is neither a university nor a research centre, it occupies a unique position that enables it to engage simultaneously with governments, institutions, faculty members and students, within linguistic, cultural and economic contexts that reflect the diversity of the French-speaking area.

The integration of AI into higher education and research faces a threefold divide: generational, with students spontaneously adopting generative AI whilst faculty members often lack the guidance to oversee its use; technological, with sometimes significant inequalities in equipment and connectivity between and within countries; and skills-related, due to unequal access to training depending on geography and working language.

These divides or gaps are documented, notably in the *Global Digital Education Development Index* (*China National Academy of Educational Sciences*, 2025) and in the work of Van Dijk (2020). They are part of the systemic transformations driven by AI in education (Holmes et al., 2019) and of an imbalance in research that is largely technology-centred, where pedagogical practices remain under-explored (Zawacki-Richter et al., 2019). These divides are particularly acute in the French-speaking world, where the diversity of national contexts exacerbates inequalities in access.

As early as 2021, even before generative AI made its public debut in the form of a prototype available

free of charge online (ChatGPT – November 2022), the AUF had incorporated AI into its 2021–2025 four-year strategy (AUF, September 2021). But the real turning point came at the 2th edition of the Francophone Science Conference in Cairo (Egypt, October 2022), where the Francophone Artificial Intelligence Research Network (RéFIA) was launched and the Manifesto for Francophone Scientific Diplomacy was adopted – spearheaded by the AUF and co-signed by 43 countries – before being presented a month later at the 18th Francophonie Summit in Djerba (Tunisia). This document commits the signatory governments to anticipating changes in education systems in the face of global challenges, of which AI has now become the most pressing, as highlighted by Schleicher (2024) and Tawil & Miao (2024) in the first issues of Frontiers of Digital Education.

To address these colossal challenges, the AUF is implementing a three-pronged strategy designed to engage all stakeholders within its ecosystem: raising awareness and supporting policymakers, developing the pedagogical skills of academic staff and students, and supporting research on and through AI.

The Table 19.1 outlines the AUF's most significant initiatives across the six categories of the WDEA call (WDEA, 2025).

1. Raising awareness and supporting government leaders

The AUF works in partnership with national governments and ministries to accelerate investment, facilitate the adaptation of regulatory frameworks and create the conditions for the sustainable integration of AI into higher education systems. Thanks to its international status and its privileged relations with the political authorities of Francophone member countries, the AUF is well-placed to leverage this influence. The Manifesto for Francophone Scientific Diplomacy (2022) forms the foundation for this; the Conakry Declaration (2025) is its operational extension for Africa. This approach is part of the global movement towards digital education governance described in the Shanghai Call for Cooperation on Digital Education (Ministry of Education of China, 2024) and UNESCO's work on human-centred digital transformation (Tawil & Miao, 2024).

The 4th AUF Pan-African Conference, held in Conakry (Guinea) in April 2025 on the theme 'Digital Transition and Pedagogical Innovations', brought together nearly 100 leading decision-makers and stakeholders, including ministers from six countries (The Gambia, Mauritius, Guinea, DRC, Chad, Guinea-Bissau) and delegations from 13 countries.

Discussions were structured around a ministerial panel, a panel of virtual university presidents on the state of e-learning, and a presentation by experts on the AUF's digital solutions. The discussions converged on a strong recommendation: to strengthen the training of teacher-researchers in AI tools, covering both their educational uses and the ethical issues they raise regarding the training of future decision-makers (Missa & Poamé, 2024). The conference concluded with the adoption of the Conakry Declaration, setting out three political commitments: to promote ambitious digital public policies, to foster the upskilling of human resources, and to strengthen sustainable funding for the digital transition in education. This cycle dedicated to inter-African dialogue (Ziguinchor 2022, Praia 2023, Banjul 2024, Conakry 2025) is the only French-speaking initiative to regularly bring together ministers, university presidents and international experts around a shared agenda incorporating AI, and demonstrates a sustainable political momentum that can be replicated in other regions of the world.

Table 1 AUF initiatives in the WDEA categories (P = primary, S = secondary)

Project / Initiative	"Personalise Teaching & Learning"	"Innovate Classroom Instruction"	"Transform Assessment & Evaluation"	"Optimise Management & Services"	"Enable Immersive & Practical Learning"	"Pioneer New Frontiers in Education"
Francophone Network for Research on Artificial Intelligence (RéFIA)						P
South-South Mobility Programme dedicated to AI						P
DRMO Project (Middle East)	S	P				
Regional service areas and programmes		P				S
IFIC[1] / FOAD[2] / APPRENDRE[3]	P	P	S			
EUSEEDS (Interreg NEXT MED) [4]		S		S		P
Conakry Declaration				P		P
Hackathons Creative competitions		S			P	
International conferences						P

[1] - Francophone Institute for Distance Learning (IFIC)
[2] - Open Distance Learning Courses (FOAD)
[3] - Support for the Professionalisation of Teaching Practices and Resource Development (APPRRENDRE)
[4] - Enable, Upgrade and Spread Employability, Entrepreneurship and Digital Skills (EUSEEDS project)

2. Developing teaching skills

The educational challenge posed by AI is twofold: it is not only a matter of learning how to use these tools, but also of developing a critical perspective on their applications and ethical risks, in line with the comprehensive approach advocated by UNESCO (2021, 2023) and the 'critical fronts' identified in the Digital Education Fronts 2025 (Frontiers of Digital Education, 2025), notably "AI Empowering Personalised Learning" and "Human-AI Collaboration Reshaping the Digital Education Ecosystem". This requirement applies both to academic staff, who are seeing their professions transform, and to students, who must master a new tool and whose employability is increasingly dependent on their proficiency in these technologies. The AUF is responding with two complementary approaches: a far-reaching institutional transformation –we will look at a project developed in the Middle East – and large-scale open online courses (MOOCs) via its digital platforms.

The first approach is illustrated by the project "Supporting the integration of AI in higher education in the Middle East", led by the AUF's Middle East Regional Directorate and funded by the French Ministry for Europe and Foreign Affairs (MEAE). Launched in 2025 in Egypt, Lebanon and Palestine, the project has trained 2,700 faculty members across 13 partner universities, established 13 Learning Labs as sustainable institutional frameworks embedded within each institution, and organised a regional gathering of 140 faculty members in Beirut (Lebanon). Furthermore, a study on AI skills in local labour markets is guiding curriculum revisions in the three countries. The main innovation lies in the Learning Lab model: unlike one-off training, this initiative is sustainable, has a physical presence, a trained team and shared resources. In addition, the Enable, Upgrade and Spread Employability, Entrepreneurship and Digital Skills (EUSEEDS) project, co-funded by the European Union (Interreg NEXT MED), supports 24 universities in five countries (Cyprus, Egypt, Jordan, Lebanon and Palestine) on digital skills and employability.

The second approach focuses on massive open online courses (MOOCs). In early 2026, the AUF launched, via the Francophone Institute for Distance Learning (IFIC), the first online certification course dedicated to the educational uses of generative AI, developed in collaboration with the Télé-Université du Québec (TÉLUQ). Accessible to all faculty members and trainers with no technical prerequisites, entirely online and requiring around ten hours of study, it awards a digital certificate authenticated via blockchain. This course forms part of a wider initiative: the IFIC catalogue offers seven diploma or qualification courses in AI and several techno-pedagogical pathways.

Meanwhile, the programme to Support the Professionalisation of Teaching Practices and the Development of Resources (APPRENDRE), funded by France via the French Development Agency (AFD), is rolling out certified MOOCs on AI in 26 countries, including specific modules on the assessment of learning through AI. AFD funding marks the recognition of educational AI as a lever for development in the Global South.

A recent call for projects by IFIC also encourages the ethical integration of AI into French-speaking higher education, with an emphasis on regional cooperation. This distance learning programme is reinforced by the AUF's network of 150 Service Centres, spread across some 50 countries, which act as local hubs. In 2025, for example, 460 AI-related activities and 1,300 hours of training were delivered. In regions with few or no French speakers, workshops on AI for teaching French and in French have, for example, been organised by AUF Asia-Pacific. Over the period 2021–2025, AUF Service Centres have benefited a total of nearly 1,000,000 people.

3. Supporting research in AI and using AI

Over 95% of global scientific output is in English (Céspedes et al., 2024). This is also highlighted in the Digital Education Fronts 2025 report, which identifies "Global Co-Governance: Redefining Ethical Boundaries in Digital Education" as one of the ten "critical fronts" in the field (Frontiers of Digital Education, 2025). Building a Francophone community of researchers able of generating their own knowledge and contributing to this global governance is a prerequisite for the scientific sovereignty of the Francophone world. The RéFIA, described above, brings together 25 founding institutions across 15 countries (Africa, Europe, the Americas, the Middle East). Over three years, the AUF has helped to structure a coherent ecosystem: the 2023 South-South mobility programme dedicated to AI supported 11 PhD students and 5 postdoctoral researchers in 13 countries of the Global South; the first international conference in Bucharest (June 2024) brought together researchers from over 20 countries; a series of webinars on generative AI has been running since 2024; the first Prize for the best French-language thesis in AI was launched in 2025; and the network has contributed to setting up the GENESIS project as part of the European Gen AI for Africa programme (health component), illustrating the transfer of research towards concrete societal challenges. The fact that RéFIA predates the democratisation of conversational agents based on large language models is a strong argument for its legitimacy: the scientific Francophonie embraced AI out of an early strategic conviction. The model comprising the scientific network, doctoral mobility programs, thesis awards and societal impact initiatives appears readily transferable to other linguistic alliances facing Anglophone dominance, in line with the WDEA's international cooperation objectives (WDEA, 2025).

Conclusion

The three areas presented – political governance, faculty members training and scientific research – form a coherent ecosystem within the AUF's missions: the 2022 Manifesto and the 2025 Conakry Declaration create the political conditions for states to invest in the digital training of their faculty members; the IFIC training courses, those of the APPRENDRE Programme and the Service Centres (CEF; CNF; LMP; FabLab) equip academics and students with these now essential skills; the RéFIA is dedicated to generating the knowledge that will ultimately inform training programs and guide decision-makers.

Since 2021, the AUF has trained nearly 4,000 academics, including 2,700 in the Middle East; rolled out AI training programmes in 26 countries, including an inaugural certification course in partnership with TÉLUQ in 2026; mobilised 43 countries around the Manifesto for Francophone Scientific Diplomacy; and created the first Francophone AI research network.

The French-speaking community can serve as an alternative space for AI knowledge production, fostering diverse approaches and the digital sovereignty of Global South countries, directly contributing to the Global Digital Compact's (United Nations, 2024) goal of reducing digital divides and promoting equitable access to technology for all, as well as SDG 4 on inclusive and quality education. These initiatives can serve as a solid foundation for deeper partnerships with the WDEA, supporting higher education institutions most vulnerable to the triple digital divide.

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Case 46

Maximizing Faculty Productivity and Student Outcomes through an AI-Closed-Loop System

Dalia Ahmed Yousef

Ain Shams University, Egypt

Case Brief

This case presents a comprehensive, AI-enhanced educational ecosystem implemented to transform the teaching and learning lifecycle. By integrating Four distinct applications ASU2Learn eLibrary Kotobee authoring tool for interactive e-book authoring and formative assessment, ASU2Test Qorrect e-exam system for intelligent question banking and summative evaluation, Microsoft Copilot for secure, privacy-compliant academic assistance, the institution has created a seamless digital environment, and Customized AI chatbots for eLearning technical support and tutor assistance. And closing this loop with a micro-certification framework of developing AI competencies for teachers to enable them to use technology and teaching and assisting students. This ecosystem automates the generation of outcome-based assessments, personalizes student support, and significantly increases faculty productivity while ensuring data sovereignty and academic integrity.

Background

Pain Points & Issues: Higher education institutions face a "Trilemma" of challenges:

1.Assessment Burden & Quality: Creating high-quality, valid, and reliable assessment items that map accurately to Intended Learning Outcomes (ILOs) is time-consuming. Manual creation often leads to repetitive questions or a lack of cognitive depth.

2.Static Content: Traditional textbooks are static and fail to provide immediate feedback, leading to passive learning experiences.

3.Data Privacy & AI Equity: While Generative AI is popular, public tools pose severe risks regarding data privacy, intellectual property, and equity of access for students and faculty.

Necessity & Objectives: The implementation of this ecosystem was necessary to transition from traditional instruction to a Smart, Outcome-Based Education (OBE) model. The primary objectives are:

- To Automate Assessment: Integrating Customized AI Chatbots as tutor assistants and technical support agents and leveraging AI to generate specific formative and summative questions based on

instructor-defined parameters (difficulty, skill, cognitive level).

- To Enhance Engagement: Transforming static content into interactive e-books with embedded AI assessments.
- To Provide Secure Assistance: Utilizing a university-licensed AI assistant (Copilot) to support research and content creation without compromising institutional data or user privacy.
- Advancing AI Literacy through Mandatory Micro-certification: Ain Shams University Embraces the IIOE Initiative of Micro-certifications framework in the mandatory faculty development requirements for promotion of faculty members.

Case Implementation Status

Demand Analysis & Strategy: The implementation began with a needs assessment which identified a gap in AI tools that could handle complex academic taxonomies. The university adopted a multi-layered approach to address this:

1. Layer One: Interactive Content using customized agents and chatbots & Formative Assessment via (ASU2Learn eLibrary kotobee authoring tool), an AI-powered authoring tool, to transform standard curriculum materials.

- Implementation: Customization, deployment of the system then training of Faculty members to utilize the eLibrary Authoring Tool to create interactive e-books.
- AI Application:

1- Customized AI agents and AI Chatbots integrated into Learning Management Systems (LMS) and eBooks efficiently resolving common student and instructor queries about navigation, submissions, and access, AI assistants transform educational content and lab manuals into interactive learning partners.

2- The AI question or content generator. At the end of every learning unit, the AI analyzes the content and generates specific content (text, Audio, Media) or Formative Assessment questions based on specifications set by the professor.

- Outcome (Assessment for Learning): This ensures that students receive immediate feedback on their understanding of the specific cognitive skills and knowledge content of that unit, reinforcing learning before high-stakes exams.

2. Layer Two: Precision Summative Assessment (ASU2Test) For high-stakes examinations and standardized testing, the electronic exams system was implemented to manage Item Banking.

- AI Application: It utilizes AI to offer "Intelligent Question Generation." Unlike simple randomization, the AI builds questions based on a matrix of:

oDifficulty Level: (Easy, Medium, Hard).

oTargeted Skill: (Recall, Analysis, Application).

oBloom's Taxonomy: Ensuring the exam measures the correct level of thinking (e.g., Critical Thinking vs. Basic Skills).

- Workflow (Assessment of Learning): Professors input the parameters, and the AI drafts items that map directly to the Course Intended Learning Outcomes (ILOs), ensuring high construct validity. Then the professor reviews and approves or declines the items generated by AI.

3. Layer Three: Secure Productivity & Research Support (Microsoft Copilot) To support the daily workflow of the academic community, the university rolled out Microsoft Copilot under a secure University License (Microsoft 365).

- Privacy First: A critical implementation detail is the "Commercial Data Protection" standard, ensuring that no query data or uploaded content (lectures, unpublished research) is trained on by the public model or leaks to the international web.
- Faculty Usage: Used for summarizing lectures, converting long texts into presentation points, and analyzing academic data (exam results/surveys) to automatically generate performance reports.
- Student Usage: A tool for "Self-Regulated Learning." Students use it to explain complex concepts, summarize academic papers, suggest research structures, and create flashcards for studying within a controlled environment

4.Level Four: Faculty Development of AI literacy in Teaching and Learning

- Implementation: Ain Shams University has implemented the UNESCO-ICHEI International Institute of Online Education (IIOE) AI micro-certification courses as a mandatory requirement for academic promotion. This pioneering policy directly aligns national and institutional strategies to systematically upskill faculty, ensuring they possess the foundational and applied knowledge to integrate artificial intelligence into pedagogy and research.
- Outcome: By mandating these certified, standardized courses, the university is incentivizing professional development and guaranteeing a consistent baseline of AI competency across its academic staff. This initiative positions Ain Shams at the forefront of educational transformation, actively building a tech-savvy professoriate equipped to foster a new generation of innovators and solidifying Egypt's competitive edge in the global digital economy.

Case Innovation and Breakthroughs

1. Main Innovation Content:

The primary innovation is the "Closed-Loop AI Ecosystem." Most institutions use disparate tools; this case demonstrates a unified workflow. Content is consumed and self-tested via ASU2Learn eLibrary; knowledge is formally verified via ASU2Test E-Exam System; and the gap between learning and understanding is bridged by Copilot. All these tools are offered along with a pioneering policy, forming a core component of a dedicated faculty development and AI literacy program. This creates a synergy where AI is not just a chatbot, but an infrastructure layer supporting the entire academic process.

2. Technology Breakthrough Content

- Arabic NLP Capabilities: Both ASU2Learn eLibrary kotobee authoring tool and ASU2test Qorrect e-exam system have achieved significant breakthroughs in Natural Language Processing (NLP) specifically for the Arabic language. While global models often struggle with Arabic academic nuance, these tools generate grammatically correct and contextually accurate assessment items in Arabic.
- Cognitive Mapping Algorithms: The technical ability of the E-exam system to generate questions based on specific cognitive dimensions (e.g., "Generate a question testing Critical Thinking in Chapter 3") represents a leap from standard keyword-based question generation.
- Secure Enterprise AI: The deployment of Copilot represents a breakthrough in Educational Data autonomy, allowing the benefits of Large Language Models (LLMs) without the privacy risks associated with public AI tools.

3. Application Practice Breakthrough Content

- Shift to Competency-Based Assessment: The practice allows the university to move away from

"assessment of memory" to "assessment of competency." By using AI to target specific skills, we ensure exams are testing what students can do, not just what they remember.

- 24/7 Personalized Tutoring: Through customized chatbots and Copilot, every student effectively gains a private tutor that understands the context of their specific university courses, democratizing access to academic support.

4. Intellectual Property Status

- ASU2Learn eLibrary Kotobee authoring tool& ASU2test e-exam Qorrect system: The university operates under institutional licenses and hosted on premise. The generated content (question banks and e-books) remains the sole Intellectual Property of the university and the respective faculty authors.
- Microsoft Copilot: Under the Enterprise license, the university retains full ownership of all prompts and responses. Microsoft does not claim ownership of the content created, nor is the data used to train foundation models.

Promotion Value and Risks

1. Application Prospects & Scalability: This model is highly scalable. It is currently applied across 21 Faculties. The operation model is centralized at the Education Strategies and Research Center but decentralized in execution (faculty create content). This model can be easily replicated in any Higher Education institution looking to modernize their assessment strategy.

2. Social and Economic Value

- Economic: This model achieves tangible economic savings by reducing reliance on printed materials and improving the efficiency of faculty members through the automation of assessment and review processes. This, in turn, lowers long-term operational costs
- Social: This model advances educational equity by offering intelligent, always available learning resources that help close achievement gaps and ensure all students—regardless of background—have equal access to high quality AI support tools and modern, technology enhanced educational opportunities.

3. Demonstration & Leading Role: This case represents a demonstration model that sets new standards for digital transformation, shifting the educational process from “traditional digitization” to “artificial intelligence as an infrastructure.” It provides a roadmap for integrating standalone tools into a unified, harmonious ecosystem, enhancing the quality of educational outcomes and positioning the institution as a leader in responsible innovation.

4. Potential Risks

- Technical Risks: Dependence on stable internet connectivity for cloud-based AI processing. This is mitigated by the university by strengthening its network infrastructure and providing offline access options for selected content features via the ASU2Learn eLibrary Kotobee authoring tool application to ensure uninterrupted learning
- Ethical Risks: The risk of "AI Hallucinations" (generating incorrect answers). This is mitigated by the "Human-in-the-Loop" approach, where professors must review and approve all AI-generated questions in Qorrect/Kotobee before they reach students.
- Academic Integrity: Students over-relying on Copilot to write essays. This is managed through clear AI usage policies and using Qorrect for secure exams that AI cannot interfere with.

Other Relevant Information

1.Case Award Status

Figure 1 Composition of the American Open. University educational system.

Figure 2 The "Higher Education Digitalization Pioneer Case Award" organized by UNESCO-ICHEI- December 2023 and 2025

Third-Party Evaluation

eLearning system student satisfaction survey 2025:

6858 student response

Analysis of the Prominent Highlights Endorsing E-Learning System Efficiency Based on the survey data which showed:

- High Response Rate: The survey garnered a relatively high number of responses (6858 student response). This indicates a high level of student awareness, engagement, and willingness to provide feedback on the e-learning system, which itself is a sign of an active and utilized platform.
- Wide Faculty Participation: Responses came from a vast majority of the university's faculties, with particularly high numbers from Education (2761), Law (1330), Commerce (402), Engineering (245), and Science (302). This demonstrates the system's deployment and relevance across diverse academic disciplines.
- High satisfaction with device ownership (97%) and internet access (87%), indicating good student

readiness for e-learning.

- Platform usability and institutional support (training, technical help, resources) received 67–82% agreement, showing reasonable but improvable support.
- Interaction and materials access scored highly (82–85%), meaning students find the platform functional for communication and content.
- Overall trend: Majority of students are satisfied with the e-learning infrastructure, but there is room for improvement in advanced tools (VR), consistent internet quality, and technical support.

eLearning system teachers' satisfaction survey 2025:

890 Teacher Response

Analysis of the Prominent Highlights Endorsing E-Learning System Efficiency based on the survey data which showed:

- 85.6% Agree with High confidence in basic digital literacy among
- 81.9% Strong positive perception of e-learning's value in enhancing education.
- 54.4% Most disagree it's a financial burden, though a notable minority (20%) feels it is.
- 71% Agree on the efficiency of training.
- 73.8% Agree that Platform activities align well with course outcomes.
- 75.6% have Strong belief in immersive tech for practical skill acquisition.
- 73.8% agree that communication tools (forums, chat) work well.
- 78.8% see that attendance tracking tools are effective and less time consuming.
- 80.0% acknowledge a rich variety of e-assessment options.
- 81.9% agreed that E-learning experience significantly boosted digital skills, Positive impact on teaching pedagogy and effectiveness (78.1%) and Strong desire to continue and expand tech integration (81.9%).

Numbers of Trainees in AI Courses (from Launch November 2025 -January 2026) and currently rising.

Table 1 Numbers of Trainees in AI Courses

Course Title	Total Participants
Introduction à DeepSeek et applications pratiques dans l'enseignement [Egypt]	22
Generative AI-Enabled Human-Machine Collaborative Learning [Egypt]	26
[أساسيات الذكاء الاصطناعي التوليدي في التعليم العالي Egypt]	295
Fundamentals of Generative AI in Higher Education [Egypt]	163
AI in Education: A Journey Through the Future Classroom【Egypt】	180
Visual Storytelling with Generative AI in the Classroom [Egypt]	15
[تطبيقات الذكاء الاصطناعي في التعليم والتعلم Egypt]	711

التدريس باستخدام الذكاء الاصطناعي: نصائح عملية وأمثلة توجيهية [Egypt]	339
Introduction to DeepSeek and Practical Applications in Teaching [Egypt]	180
AI + Medicine: Applications and Breakthroughs [Egypt]	240
AI + Education: Ushering in a New Era of Education [Egypt]	95
Teaching with AI: Practical Tips and Prompts [Egypt]	622
Co-Design Engaging Courses with Generative AI [Egypt]	128
Total	3016

Attachments

Please find screenshots of the AI applications used in ASU2Learn and ASU2Test systems and The IIOE Teacher Micro-certification Courses in the drive link below:

https://ainshamsedu-my.sharepoint.com/:f:/g/personal/esa_elearning_asu_edu_eg/IgBmipTinCNFT6Q0PcZCYcT_AW-tNPCukRyD3JMyPZc1V_g?e=BBpgNh

Case 47

Smart Learning Comprehensive Service Platform: A New Paradigm of AI-Empowered Personalized Learning in Higher Education

Beijing Institute of Technology, Beijing, China

Background

Higher education stands at a crossroads. Technology advances rapidly and knowledge expands exponentially, yet traditional systems struggle to keep pace. Curricula update slowly and personalized needs remain unmet—especially in emerging fields like Embodied AI and Low-Altitude Engineering where comprehensive training frameworks have yet to form.

The *Smart Education of China · Higher Education (Smartedu)* has aggregated remarkable resources—over 100,000 courses, 30,000 textbooks, and 1,000 virtual simulation experiments. Yet resource abundance does not guarantee learning effectiveness. The real challenge lies not in finding content, but in navigating it, connecting it, and aligning it with individual learning goals.

Since 2019, Beijing Institute of Technology (BIT) has pioneered integrated learning platform development. *MOOC123*, the nation's first one-stop MOOC platform, provided foundational experience for *Smartedu* infrastructure. Building on this, BIT developed the *Smart Learning Comprehensive Service Platform* under the National Key R&D Program. The platform integrates deeply with *Smartedu*, creating an always-available "Super Learning Companion" and "Personal Mentor". This transforms education from "what teachers teach" to "what students want to learn and how to learn efficiently", making scaled personalized education a reality.

Case Implementation Status

In November 2023, the National Key R&D Program launched the project "Knowledge-Empowered Multi-Space Collaborative Smart Learning Technologies and Application Demonstration", running through October 2026. At its core lies the Smart Learning Comprehensive Service Platform,

systematically integrating knowledge graphs, artificial intelligence, and immersive interaction to address deep-rooted educational challenges.

The platform embodies BIT's "Five-Dimensional Integration" philosophy and "Four-Profile Unity" talent development framework. Its five-layer architecture—data, engine, service, function, and platform—coordinates five engines working in concert.

The Knowledge Graph Engine connects directly to the Smartedu, linking over 20,000 courses clustered into over 1,400 coherent learning themes using BIT's proprietary ToCTopic technology. The AI Engine integrates DeepSeek large language models for natural language interaction grounded in structured knowledge. The Learning Enhancement Engine tracks real-time behaviors enabling dynamic competency profiling. The Multi-Evaluation Engine generates learner portraits through radar charts and rose diagrams based on professional competency indicators. The Immersive Interaction Engine blends human-computer, teacher-student, and peer engagement, breaking temporal and spatial constraints.

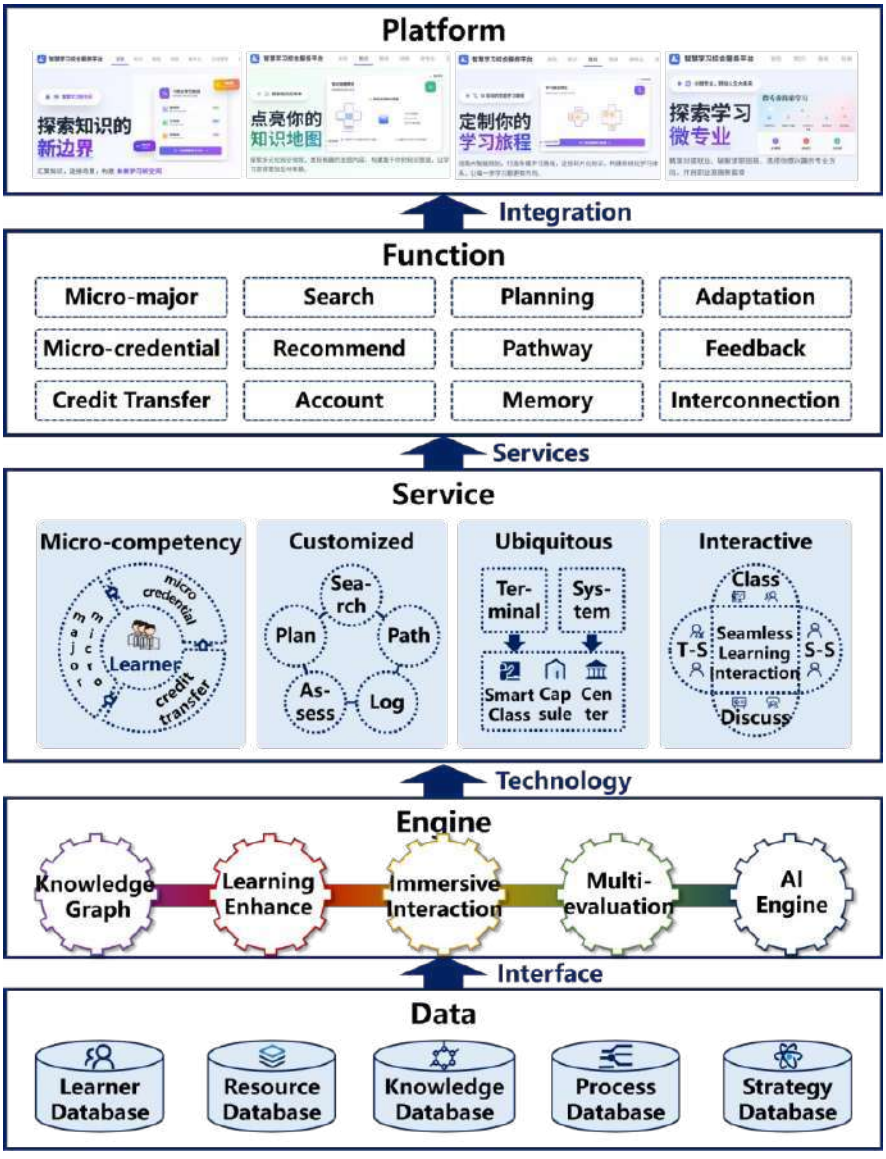


Figure 1 Structure of the Smart Learning Comprehensive Service Platform

Four core services emerge from this foundation. Students input learning goals and receive intelligently planned paths visualized as knowledge maps. During learning, they query AI agents anytime, choosing preferred explanation styles. The platform monitors status continuously, pushing foundational content when students struggle and advanced materials when they excel. All behaviors generate personal competency profiles, making growth visible.

The Immersive Interaction Engine enables rich collaboration—real-time Q&A, group discussions, screen sharing. Cross-device support allows seamless switching between phones, tablets, and computers, with progress, notes, and favorites syncing in real time. This achieves ubiquitous learning anytime, anywhere—the complete technical realization of "Four-Profile Unity".

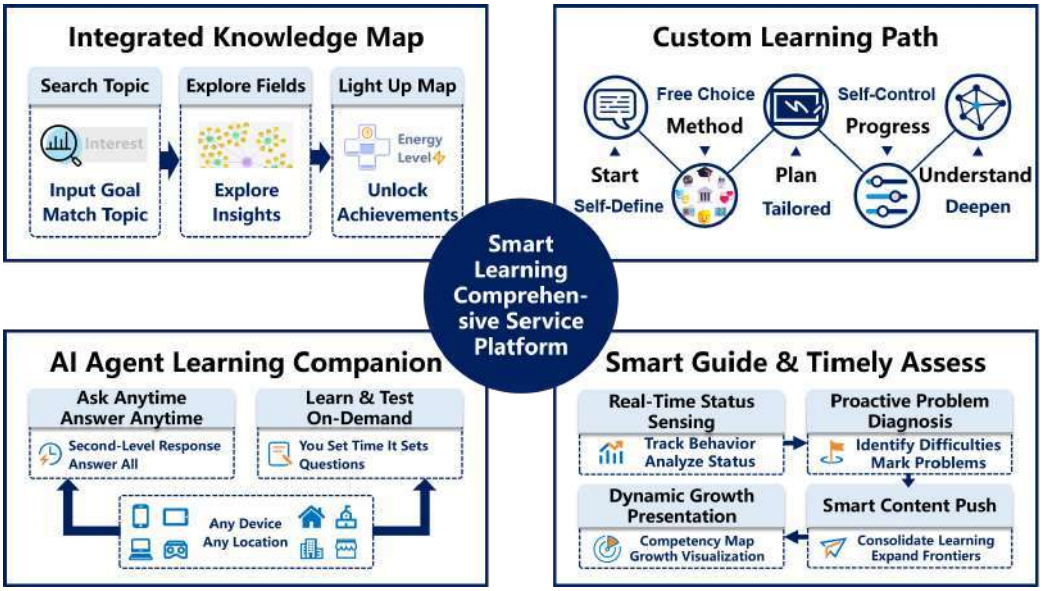


Figure 2 Four core services of the Smart Learning Comprehensive Service Platform

The pilot launched at BIT in March 2025, integrating with the national platform's account system. BIT's 173 high-quality courses now feature on the national platform, with course offerings and enrollment ranking among China's highest. Over 10,000 students have been served. The platform is preparing to join the Smartedu testing ground, supporting the Ministry of Education's "Future Learning Center" initiative.

Case Innovation and Breakthroughs

1. Educational Philosophy and Teaching Model

The platform establishes a "Learn-Assess-Adjust" closed-loop paradigm, addressing the pain point of "abundant resources, scarce precision services". Rather than listing courses, it transforms massive resources into personalized content adapted to each student's pace. Learning processes are evaluated in real time, plans dynamically adjusted—overturning the traditional "one exam per semester" logic.

Learning autonomy returns fully to students, breaking the standardized "uniform pace, uniform content" model. By centering on personal goals to craft exclusive plans, the platform tackles the longstanding challenge of balancing "large-scale education" with "personalized development".

A full-chain integrated education model dismantles isolated "knowledge, ability, literacy, quality" cultivation. Student growth weaves throughout the entire journey, moving beyond "only textbook knowledge without comprehensive capabilities"—a fundamental upgrade in education itself.

2. Key Technological Breakthroughs

Automated Knowledge Graphs semantically organize *SmartEdu* courses, establishing horizontal and vertical connections across courses and knowledge points. This solves manual annotation dependency, enabling knowledge representation to evolve with resource iterations. The breakthrough ranks at the industry frontier in automation and semantic depth.

Dynamic Industry Competency Acquisition parses competency requirements from recruitment platforms in real time. Cross-modal semantic alignment maps industry requirements to course knowledge points, keeping curricula synchronized with industry development. This establishes the pathway: "industry demand - competency requirements - curriculum optimization".

Real-Time Learning Navigation tracks behaviors and models knowledge states, perceiving mastery and cognitive status dynamically. Integrating reinforcement learning with knowledge tracing, it pushes remedial content during difficulties and extension knowledge during excellence. This transforms "uniform pace, uniform content" into intelligent navigation adapting "to each individual, to each moment".

3. Application Scenario Innovations

Seamless cross-device integration eliminates classroom and fixed-device limitations. Phones, tablets, and computers switch seamlessly with real-time syncing—enabling learning anywhere, anytime.

Figure 3 Multi-Terminal Collaboration and Omni-Scenario Learning Support

Immersive learning-application integration overturns "four years of study before work". Professional learning blends with career scenarios, students understanding real-world applications—significantly boosting motivation.

Real-time feedback-driven evaluation replaces "one exam determines all". Every action receives immediate feedback. Weak areas trigger supplementary content; excellence triggers extensions—shifting from "grading" to "helping learn better".

4. Intellectual Property and Achievement Assurance

A robust IP portfolio supports the platform: 8 filed national invention patents, 11 registered software

copyrights, 13 published academic papers. All rights belong to BIT, providing comprehensive technical and theoretical support for continuous iteration and large-scale deployment.

Promotion Value and Risks

The platform demonstrates robust scalability and significant social impact. Its modular design adapts flexibly to different institutional contexts and infrastructure levels, enabling replication across diverse higher education scenarios. Currently preparing to join the *Smartedu* testing ground, the platform supports the Ministry of Education's "Future Learning Center" initiative. Notably, its technical solution has been adopted by Serbia's smart education aid project, laying foundations for digital education promotion across "Belt and Road" countries. By leveraging AI to deliver scalable personalized learning, the platform enhances education quality and promotes equity. The "Learn-Certify-Employ" closed loop strengthens learner motivation and competitiveness, driving educational transformation.

Five key risks require attention. Technology Dependency requires model redundancy backup and continuous optimization given reliance on large language model stability and data infrastructure. Data Privacy demands strict encryption, access control, and anonymization compliant with Personal Information Protection Law and Data Security Law. Algorithm Transparency necessitates audit mechanisms and explainability frameworks to ensure recommendation decisions remain traceable. Recommendation Bias is mitigated through diversified training datasets and regular bias detection. Ethical Governance requires an AI-in-education ethical framework and review committee for continuous responsible application assessment.

Other Relevant Information

Platform: https://synet.smartedu.work/synet

Case 48

Hongyan AI: A Boundaryless Smart Education Consortium for Primary, Secondary and Tertiary Schools to Boost Rural Education Revitalization

Beijing University of Posts and Telecommunications, Beijing, China

Background

Rural education in remote areas of China (e.g., Changshun County in Guizhou, Haixi Tibetan Autonomous Prefecture in Qinghai) faces severe structural challenges due to geographic and economic constraints, including insufficient high-quality educational resources, unprofessional teaching teams, and rigid teaching methods. Rural students lag in disciplinary literacy, physical and mental development, and quality education, failing to meet diverse social talent demands. Notably, rural children suffer from serious mental health issues: 25.2% have depression, 25.7% anxiety, and 33.2% insomnia, with left-behind children facing higher psychological trauma risks. Rural schools lack professional mental health educators and effective intervention mechanisms.

To address these pain points and implement China's national education digitalization strategy, BUPT launched the Hongyan AI project, aiming to build a boundaryless smart education support system through a university consortium. The project integrates interdisciplinary advantages of various universities, provides low-cost and high-quality digital educational resources for disadvantaged groups in rural areas, bridges urban-rural education gaps, and promotes educational equity and rural education revitalization.

Figure 1 The launch of Hongyan AI project

Case Implementation Status

1. Participant Selection

The project builds a boundaryless cloud education platform empowered by digital intelligence, forming a two-way empowerment cycle between tertiary, primary and secondary schools. It has attracted over 2,000 teachers and students from more than 20 universities (e.g., Communication University of China, Beijing Normal University) and provided nearly one million cloud-based teaching services for over 20,000 primary and secondary school students in 7 provinces across China, covering underdeveloped educational regions such as Yilong County in Sichuan and Horqin Right Front Banner in Inner Mongolia.

2. System Architecture Design

Centered on solving the shortage of human, material and financial resources in rural education, the project constructs a large-scale resource sharing system by integrating scattered educational assistance resources via an information-based education platform, realizing a resource aggregation effect of "1+1>2". BUPT leverages its artificial intelligence (AI) research strength to build a teaching and research integrated platform empowered by large models, supporting live interactive teaching, group learning, course on-demand and personalized tutoring. The platform opens large model calling interfaces and digital human rendering engines to university research teams, lowering the R&D threshold of smart education applications. Universities with strengths in education, art and physical education develop discipline-specific smart teaching applications on the platform, forming a virtuous circle of university teaching, research and rural education assistance.

3. Smart Application Development

Initiated by the "Hongyan Guoyin" AI Mandarin teacher co-created by BUPT and Communication University of China, 20 universities have built AI education applications (e.g., AI teachers) based on the platform's smart education infrastructure, covering disciplinary tutoring, language expression, psychological care, sports skills and performing arts. These applications have been deployed in rural schools, allowing students to interact with virtual teachers through dedicated classrooms and "magic

mirrors" for Mandarin learning, table tennis training and psychological counseling, and have been featured by major media such as China Central Television.

4. Characteristic Curriculum Construction

Targeting the shortage of quality education resources in rural areas, the project builds a "information platform + community content co-creation" supply model. University teachers and students teams collaborate with primary and secondary school communities to customize diversified teaching resources (live courses, recorded videos, graphic materials) for after-school tutoring, club activities and literacy classes. These resources are delivered to rural classrooms via customized terminals and classroom screens, offering courses such as speech workshops, English corners, calligraphy classes and science and technology exhibitions. BUPT has also developed AI science popularization and practical training courses for primary and secondary students, covering Python programming, AIGC, digital humans and other content, greatly improving rural students' scientific literacy.

Up to now, the project has provided over 100,000 after-school tutoring sessions, launched more than 5,000 online courses (with over 100,000 cumulative video plays), and organized over 100 offline assistance activities, enriching rural quality education and winning wide recognition from students, parents and local education departments.

Figure 2 Hongyan AI Characteristic Curriculum

Case Innovation and Breakthroughs

1. Main Innovation Content

Educational model innovation: The project creates a "1 Smart Infrastructure + N Characteristic Modules" consortium assistance model for smart education. BUPT builds a unified AI-empowered smart education infrastructure, while partner universities develop discipline-specific smart teaching modules, realizing integrated and intelligent development of rural education assistance. It breaks the temporal and spatial barriers between primary, secondary and tertiary schools through cloud classrooms and AI teachers, building a boundaryless cloud education space.

Resource guarantee innovation: A human resource guarantee model of "one opening, one standardization, one reduction" is proposed – opening the platform to attract national university volunteers, standardizing training to ensure service quality, and reducing human resource pressure via technological innovation. A diversified funding guarantee mechanism is established, including public welfare funds, social donations and government special support, with earmarked funds for platform operation and technological R&D.

Teaching resource supply innovation: The "information platform + community content co-creation" model integrates AI technologies such as digital humans and large models to form a full-chain intelligent tool system for teaching resource development, realizing precise delivery of high-quality resources to rural schools and effectively bridging the urban-rural quality education gap.

2. Technology Breakthrough Content

The project achieves key technological breakthroughs in the integration of AI and education: BUPT builds a rural education assistance platform integrated with teaching and research, empowered by a self-developed educational large model that supports rapid development of high-quality teaching content and provides real-time intelligent tutoring services. The open digital human rendering engine and large model calling interface lower the R&D threshold of smart education applications, enabling rapid development and deployment of AI teacher applications by various universities. The innovative smart teaching model reduces the consumption of human, material and financial resources in the teaching process by 60% while ensuring the same teaching quality, realizing cost optimization of education assistance via technological innovation. These technological achievements are at the advanced level in the domestic education informatization field, providing a solid technical support for the digital transformation of rural education.

3. Application Practice Breakthrough Content

The project realizes the large-scale aggregation and efficient allocation of educational assistance resources, integrating the interdisciplinary advantages of over 20 universities and providing continuous human, material and financial support for rural education, solving the core dilemma of resource shortage in rural education assistance.

It innovatively combines AI technology with rural basic education practice, deploying a variety of AI education applications in rural schools and realizing personalized teaching and all-round quality education for rural students, effectively improving rural students' disciplinary literacy, physical and mental health and scientific quality.

The project forms a two-way empowerment mechanism between tertiary, primary and secondary schools: it provides rural schools with high-quality educational resources, and offers university students

and teachers a platform for innovative practice and ideological and political education, realizing the organic integration of university talent training, scientific research and rural education revitalization.

The project has covered tens of thousands of rural students, with remarkable application effects, and its replicable and promotable education assistance model provides a practical reference for the digital transformation of basic education in underdeveloped areas.

4. Intellectual Property Status

The core technological achievements of the Hongyan AI project, including the educational large model, digital human rendering engine and smart education platform system, are independently developed by Beijing University of Posts and Telecommunications and its cooperative university research teams, with independent intellectual property rights. Relevant software copyrights and technical patents are being applied for and registered in accordance with the law, and the intellectual property rights of characteristic course resources and smart teaching applications developed by each participating university belong to the corresponding development teams with mutual authorization for project application and promotion.

Promotion Value and Risks

1. Application Prospects and Achievements

The project has covered over 20,000 rural students in 7 provinces, providing 500,000+ after-school tutoring, psychological counseling and quality training services, and launching 3,000+ co-created cloud courses by university and primary/secondary school teachers and students. The "platform + alliance" operation and management model has been initially formed, with strong scalability and replicability, and is expected to be promoted to more rural areas in China and even other developing countries with similar educational development challenges.

2. Social and Economic Value

Economic value: The AI-driven smart teaching model reduces the resource consumption of education assistance by 60%, realizing low-cost and high-efficiency rural education assistance. The diversified funding mechanism ensures the sustainable operation of the project with low operational costs.

Social value: The project effectively improves the quality of rural education, promotes educational equity, and helps rural students achieve all-round development, laying a solid talent foundation for rural revitalization. It also cultivates a large number of young college students with a sense of social responsibility, demonstrating the social value of university talent training and scientific research.

3. Demonstration and Leading Role

The project creates a new paradigm of university consortium-based digital intelligence education assistance for rural education revitalization, providing a replicable and promotable solution for developing countries to promote educational equity via information technology. Its "Smart Infrastructure + Characteristic Modules" architecture, open and shared resource integration model, and demand-oriented education application development path set a benchmark for the digital transformation of basic education, and provide important reference for integrating social educational resources and innovating education models via intelligent technologies.

4. Potential Risks

Technical risks: The operation of the smart education platform relies on stable network infrastructure; rural areas with poor network conditions may face problems such as delayed online teaching and

unstable application operation. The educational large model and AI teacher applications need continuous algorithm optimization to avoid inaccuracies in teaching content and tutoring services.

Ethical risks: The collection and use of rural students' learning and psychological data may involve privacy protection issues; improper data management may lead to data leakage and abuse. The long-term use of AI teachers may reduce the frequency of face-to-face interaction between teachers and students, which may have a certain impact on the emotional communication and social ability development of rural students.

Other Relevant Information

1. Case Award Status

To be updated (the project has received extensive attention and recognition from the education sector and society, and relevant awards are being applied for). In addition, the project has been awarded the Best Global Poverty Reduction Case by the United Nations, which fully affirms its important role in promoting rural education development and helping poverty reduction through education.

第六届全球减贫案例征集活动

证 书

北京邮电大学：

贵机构提交的《红雁AI教育共育项目——北京邮电大学数智教育帮扶案例》荣获“第六届全球减贫案例征集活动”最佳减贫案例，并将收录进南南合作减贫知识分享网站——中外减贫案例库及在线分享平台。

特发此证，以资鼓励。

IFAD

中国国际减贫中心

2. Third-Party Evaluation

The project has been featured and reported by major mainstream media in China, including China Central Television, Guizhou Radio and Television Station and Beijing Satellite TV, receiving positive public opinion feedback. It has won unanimous praise from rural students, parents, teachers, schools and local education departments for its remarkable effect in improving rural education quality and enriching rural quality education resources. Education experts have affirmed the project's innovative model of integrating AI technology with rural education assistance, recognizing its important role in promoting educational equity and rural education revitalization.

3. Case-related images, videos, and other materials

Relevant materials including activity silhouettes of online assistance, the architecture of the smart education assistance system, AI education applications and characteristic course systems are attached separately (cloud drive link: to be supplemented).

Case 49

AI-Driven Innovation in After-School Services: An Integrated Model for Safety Supervision and Emotional Support

Guobing Qian

Changxi Primary School, Huzhou Aishan Primary School Education Group, Zhejiang, China

Background

With the full implementation of China's "Double Reduction" policy, demand for in-school after-school services has increased dramatically. Statistics indicate that the average daily student participation rate has reached as high as 85%. However, behind this high participation rate lie dual challenges in safety management and psychological care. On the one hand, a structural mismatch persists between the end time of after-school services and the working hours of some parents. Approximately 28% of students are picked up late, resulting in congestion and crowding at school gates during peak dismissal periods. Communication barriers – particularly in intergenerational pickup arrangements, where grandparents or elderly caregivers often lack access to or familiarity with digital communication tools used by schools – further complicate coordination, thereby increasing safety risks for students who remain on campus. Meanwhile, supervising teachers are often required to wait indefinitely for individual students to be collected, leading to accumulated management tensions over time. On the other hand, the psychological well-being of students who remain on campus after school is frequently overlooked. Survey data show that 43% of supervising teachers report difficulty in monitoring the anxiety levels of these students in real time, while the coverage of traditional psychological counseling services remains below 15%. The absence of effective real-time monitoring and intervention mechanisms highlights an urgent need for technological solutions to address these service gaps.

In response to these challenges, Changxi Primary School, part of the Huzhou Aishan Primary Education Group, has innovatively developed an integrated intelligent care solution that integrates safe pickup management, emotion recognition, and AI-driven psychological intervention. Built upon the DingTalk

platform and supported by facial recognition hardware, the system establishes a full-process closed-loop management framework spanning safety supervision, emotional monitoring, and psychological support.

Figure 1 “One Platform, Three Systems”

Implementation Process

1. Technical Framework

The solution consists of three coordinated core modules.

(1) SafePick System

This intelligent care management system is developed based on the DingTalk platform and supports synchronized operation across PC, mobile, and web interfaces. Its core functionalities include:

- student entry/exit tracking
- automated notifications
- online reservation
- real-time information sharing
- location tracking
- duty check-in management

(2) AI-Based Emotion Recognition System

Relying on facial recognition terminals and fixed-channel surveillance devices integrated within the SafePick system, this module deploys AI-driven emotion recognition algorithms to perform real-time emotional analysis of students.

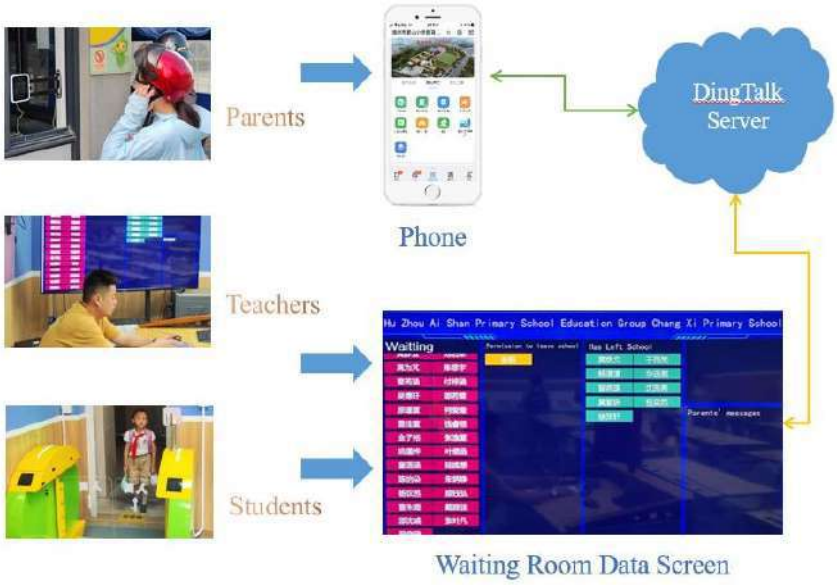


Figure 2 Overall architecture of the SafePick system

(2) AI-Based Emotion Recognition System

Relying on facial recognition terminals and fixed-channel surveillance devices integrated within the SafePick system, this module deploys AI-driven emotion recognition algorithms to perform real-time emotional analysis of students.

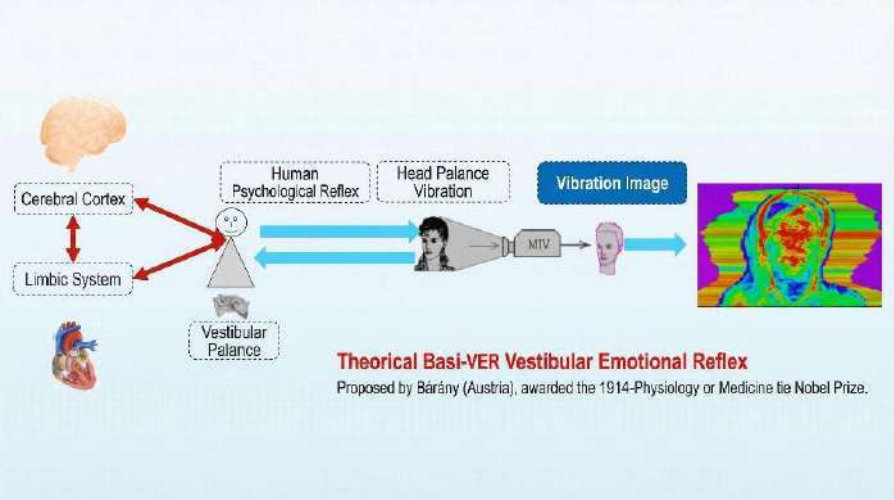


Figure 3 Technical framework of AI-driven emotion recognition

(3) Companion AI Agent

An AI-powered psychological support agent, embodied in the school-specific virtual character “Xibao,” provides emotional support through natural language interaction. The system integrates a structured psychological education knowledge base and adopts an empathy-oriented dialogue model to help students alleviate academic stress and regulate negative emotions.

2. Implementation Steps

First, the SafePick intelligent care management system is deployed to digitally reconstruct the after-school dismissal process using Internet of Things (IoT) technologies. Facial recognition terminals accurately record students' departure status and send real-time notifications to parents, ensuring synchronized information flow and orderly pickup procedures.

Second, the AI-based emotion recognition system is introduced. By leveraging computer vision and big data analytics, the system conducts non-contact monitoring of students' emotional states during extended after-school periods. It automatically identifies and flags students with frequent delayed pickup or abnormal emotional fluctuations. Upon detecting potential risks, the system triggers alerts and enables targeted intervention by homeroom teachers.

Third, the companion AI agent is developed. The school-designed "Xibao" AI agent integrates professional psychological education resources and provides continuous emotional support through natural language interaction. Utilizing an empathy-based conversational approach, it responds promptly to students' emotional expressions, helping alleviate anxiety and academic pressure during waiting periods. This serves as an effective extension and complement to traditional mental health education.

Innovative Features

This integrated solution not only addresses the practical difficulty of parents being unable to pick up children on time, but also responds to students' emotional needs during waiting periods. It represents a shift from "safety management" to "holistic care," achieving the following outcomes.

Resolving Parental Challenges. The system ensures transparent and accurate information flow, allowing parents to track their children's status in real time. Parents who miss the pickup window no longer experience panic or conflict, resulting in a more composed and secure pickup process. Meanwhile, data on delayed pickups enable teachers to analyze underlying causes and improve home-school communication, enhancing overall satisfaction.

Supporting Student Well-being. By integrating facial recognition-based emotional detection into after-school supervision, the system closely monitors students' psychological changes during extended care periods. Targeted interventions based on emotion recognition effectively reduce anxiety, fear, and other negative emotions. Big data analysis further identifies high-risk students, triggering teacher involvement and strengthening home-school collaboration.

Reducing Teacher Workload. Through intelligent facial recognition and centralized management, supervision of delayed students shifts from a fragmented to a consolidated model. This frees teachers from prolonged one-on-one waiting duties, optimizes human resource allocation, and alleviates workload pressures.

Enhancing School Management Order. Dynamic notification functions significantly reduce congestion and disorder at school gates. Parents receive timely updates on student dismissal status, enabling orderly waiting and pickup. The system effectively mitigates crowding, confusion, and conflict during peak hours while strengthening campus safety governance.

Optimizing Social Resource Allocation. The system enables coordinated information sharing with traffic police, public security, and urban management departments, allowing dynamic adjustment of

personnel deployment. Data show that congestion duration at the school gate has decreased from 45 minutes to 12 minutes, demand for traffic coordination staff has dropped by 60%, and parent complaints have decreased by 92%, significantly improving governance efficiency.

Outcomes and Impact

The implementation of this integrated intelligent care system has significantly enhanced both the safety level and human-centered quality of after-school services, representing an innovation in technology-enabled educational governance. To date, the system covers 1,317 students and has delivered 37,521 instances of intelligent care services.

In terms of management efficiency, the response time to emotional risk alerts has decreased by 40%, while centralized management has significantly reduced ineffective teacher waiting time, thereby contributing to improved teacher job satisfaction. In terms of service satisfaction, the system has alleviated parental anxiety associated with delayed pickup, rendered pickup processes more orderly and predictable, and increased overall parental satisfaction to 98.6%.

Scalability and Transferability

In sum, this solution provides a new paradigm for digital governance in schools. It not only addresses the widespread challenge of delayed student pickup but also pioneers a novel pathway for AI-enabled mental health education, demonstrating strong practical significance and scalability.

From a technical perspective, the system requires relatively low investment, as its hardware infrastructure relies primarily on display screens and facial recognition devices, while the software is developed on the DingTalk platform. Moreover, existing home-school communication infrastructures can be directly leveraged, ensuring ease of implementation and high user acceptance.

From an educational perspective, the model enhances psychological support through timely detection and intervention of emotional anomalies, effectively compensating for the limitations of traditional mental health education. The development of the companion AI agent further contributes to innovation in moral and psychological education

Case 50

Comprehensive Intelligent Governance Solution forCounty Primary and Secondary SchoolCanteens ("Digital Canteen" Platform)

Yuguang Bao

Changyang Tujia AutonomousCounty Education Bureau, Hubei,China

Solution Introduction

Functional Overview:

This solution presents a governance-oriented digital integration framework designed for county-level education authorities, centered around the "Digital Canteen Intelligent Management Platform." It systematically addresses four persistent challenges in school cafeterias across rural and county areas: unscientific nutritional composition, food safety oversight difficulties, opaque fund utilization, and integrity risk prevention barriers. The solution adopts a "1+4+N" architecture: a unified data hub consolidating county-wide cafeteria data; four empowerment systems covering nutritional balance, standardized management, food safety compliance, and financial transparency; and 22 supporting management protocols achieving deep integration of technology and governance. Its core function isn't to replace manual management but to leverage IoT, big data, and AI technologies to embed rigorous protocols into digital systems. This establishes a four-tier collaborative governance model involving Education Bureaus, school districts, schools, and parents, ultimately transitioning from human-centric management to data-driven governance through process optimization and analytics. The initiative significantly enhances regional educational public services and modernizes governance capabilities.

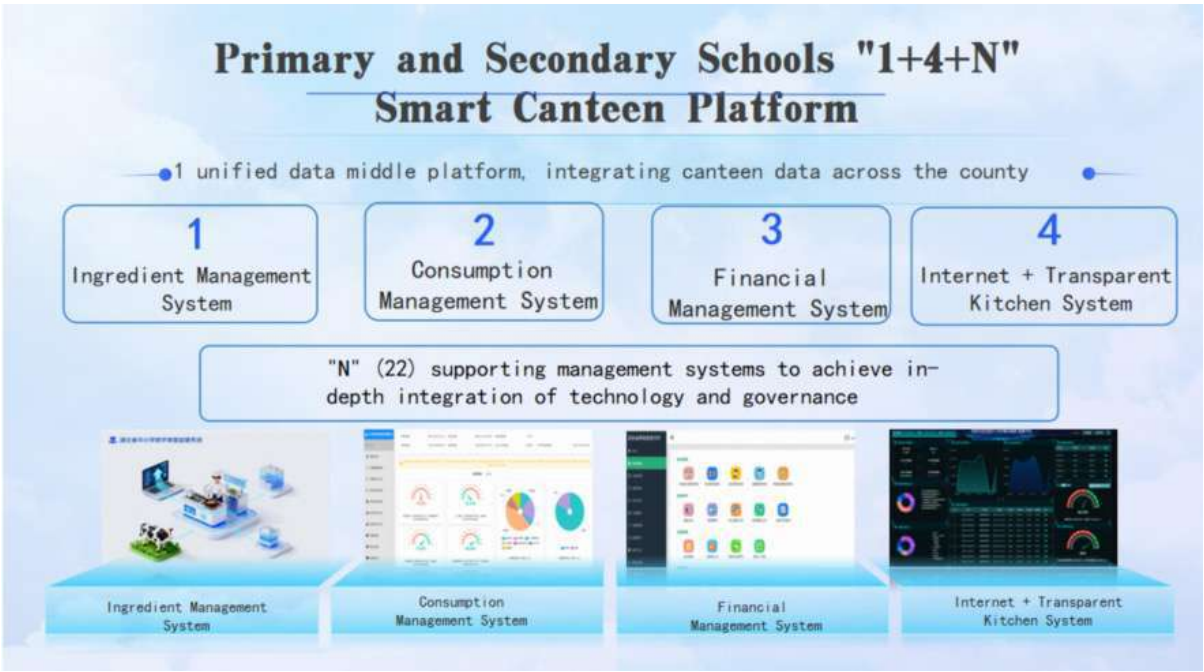


Figure 1 Primary and Secondary Schools “1+4+N” Smart Canteen Platform

Technical Highlights:

"Online + Offline" Dynamic Intelligent Quotation Engine: This innovative system integrates big data extraction with community participation. It automatically collects real-time price data from major local supermarkets while engaging a "Mom Group" composed of parent representatives and school administrators for offline market inquiries. The combined data feeds into machine learning models to generate fair procurement guidance prices for ingredients, with preset price fluctuation warning thresholds. This design eliminates price inflation at the source, achieving dual control over costs and integrity risks. All quotation and comparison processes are automatically documented, creating tamper-proof electronic records.

Solution Introduction

Application Environment and Implementation Targets:

1. Application Environment: This solution is primarily designed for school canteens in China's county and rural areas, particularly suitable for regions implementing the "Rural Compulsory Education Student Nutrition Improvement Program" and urgently requiring enhanced standardized and transparent management of canteens. The solution is hardware-and network-friendly, supporting flexible deployment in public cloud, private cloud, or hybrid modes based on local ICT infrastructure conditions, ensuring smooth implementation even in resource-constrained areas.

2. Target Audience: This solution serves a multi-stakeholder collaborative ecosystem.Core management units: Logistics, Finance, and Safety Supervision Departments of the County Education Bureau; Core executors: principals of each school, logistics directors, cafeteria administrators, and staff members; Key stakeholders involved in supervision: parent representatives (such as the Dietary Supervision Committee and "Mom Group");

3. External collaborators: including food ingredient suppliers and third-party auditing agencies.The solution tightly integrates all stakeholders, responsibilities, and processes through a digital platform.

Typical application scenarios:

1. Scenario 1: Transparent Procurement and Integrity Risk Prevention:

Implementation Process: The procurement workflow is fully digitized and visualized. After cafeteria administrators create purchase plans on the platform, the system automatically activates an intelligent pricing engine to compare planned items with "online big data average prices" and recent "Mom Group offline inquiry results." Delivery prices are determined based on the lowest average price, with items significantly exceeding guideline prices automatically flagged in red for alerts. Upon supplier delivery, school inspectors and on-duty parent volunteers jointly scan ingredient batch codes via the APP to verify information and take photos before storage, ensuring "dual-person inspection and public oversight." Settlements are automatically calculated using the system-generated formula: "delivery price * agreed discount rate." The entire process maintains data traceability, forming a complete evidence chain that is both verifiable and auditable.

Scenario Value: This initiative has institutionalized the "micro-power" of cafeteria procurement within a digital framework. By implementing dual price comparisons, parental involvement in quality inspections, and standardized settlement formulas, it establishes an anti-corruption mechanism. In practice, the system has triggered 287 price alerts with full compliance, effectively exposing practices like favoritism-based procurement and inflated pricing. Parental complaints have significantly decreased, substantially enhancing public trust in the system.

2. Scenario 2: 24/7 contactless smart security monitoring:

Implementation Process: Logistics managers from the Education Bureau Supervision Center, school principals, or cafeteria supervisors can monitor live kitchen feeds from any school cafeteria within their jurisdiction through computer screens or mobile apps without physical presence. More importantly, the AI-powered visual analysis system operates continuously in the backend, automatically detecting potential risks such as "staff not wearing chef's caps," "failure to wear designated uniforms," "appearance of pests like cockroaches on kitchen countertops," or "refrigerator temperatures exceeding safety thresholds." The system instantly captures screenshots to generate alerts, which are sent to responsible personnel via multiple channels including app notifications and text messages. Responsible parties must conduct on-site inspections and implement corrective measures within specified timelines, followed by uploading photos of rectified conditions to the platform before closing alerts. This establishes a closed-loop management system featuring "intelligent detection - real-time alerts - on-site rectification - feedback closure."

Scenario Value: This solution significantly expands the spatiotemporal scope and operationalefficiency of regulatory oversight. By freeing limited manpower from frequent on-site inspections, itestablishes an efficient "one-person county-wide management" model, achieving over 300%improvement in regulatory efficiency. According to 2025 data, the system automatically capturedmore than 600 instances of regulatory violations, with a 100% compliance rate. This has created astrong psychological deterrent for practitioners, encouraging standardized operational practicesand technically fortifying the "firewall" of food safety.

Outcomes and Case Studies

Implementation outcomes, evaluation data, or practical experience:

Since the comprehensive implementation of self-resolution solutions in Changyang TujiaAutonomous County, significant multidimensional and quantifiable outcomes have been achieved:

1. Significant improvement in management efficiency: The financial accounting work of the canteenhas been liberated from tedious manual bookkeeping, with accounting efficiency increased byover 50% . Logistics management personnel across all county schools have saved an average ofapproximately 120 hours of work per month. The procurement approval process has beenshortened from an average of 3 days to within 1 day. Twenty-two supporting managementsystems have formed a closed loop, achieving standardization and normalization of managementprocesses.

2. Significant improvement in safety and health standards: Through proactive AI monitoring and end-to-end traceability systems, the county has achieved the goal of "zero occurrence of food safety liability incidents in schools for multiple consecutive years." By leveraging platform-based nutritional data analysis and interventions, the average height and weight of students across all age groups have surpassed the national rural student average, reflecting a transition from "sufficient food intake" to "nutrient-rich dietary habits."

3. Significant improvement in integrity transparency and satisfaction: Dynamic pricing mechanisms and intelligent early warning systems have effectively mitigated integrity risks in procurement processes, with a cumulative total of 287 issues identified and rectified through early alerts. Satisfaction surveys among faculty, students, and parents regarding campus meal services consistently maintain around 95 . Parental trust in cafeteria management has markedly increased, accompanied by a 95% year-on-year decline in related complaints and petitions.

4. Coverage Scale and Application Deepening: The solution has been stably implemented in 32 primary and secondary schools across the county, serving over 27,000 teachers and students. The platform has processed more than 70,000 procurement orders, achieving full traceability for over 200 types of food ingredients, thereby establishing robust data assets and replicable promotion models.

5. Comprehensive Coverage and Promotion: The solution has been successfully selected for the 2025 World Digital Education Conference and showcased during Hubei's Education Digital Transformation Initiative. It has hosted over 30 visiting delegations from across the country. The platform's usage has now been widely adopted province-wide, achieving more stable and secure development.

Replicability, Sustainability, and Promotion Potential:

1. High modularity and configurability: The solution is designed with four core functional modules. "Nutrition Meal Planning," "Smart Procurement," "AI Supervision," and "Transparent Finance" -allowing different regions and schools to flexibly configure and implement the system in phases based on their specific needs and budgets. They can choose either the "Basic Version" (meeting core compliance and transparency requirements) or the "Advanced Version" (comprehensive digital empowerment).

2. Comprehensive "Technology + System" Output Package: Beyond providing a technical platform, we deliver 22 management system documents validated through practice, covering all stages including procurement, acceptance, warehousing, finance, and supervision. This offers a "ready-to-use" governance framework for subsequent regional implementation, complemented by localized institutional consulting services to ensure "adaptability to local conditions."

3. Clear standardized implementation pathway: A four-step standardized approach has been established, comprising "pilot implementation (selecting 1-2 model schools), concurrent institutional development, tiered training (for administrators, finance personnel, parents, etc.), and county-wide promotion." Practical evidence demonstrates that this pathway can achieve significant managerial outcomes and social benefits within 3-6 months, and is easily replicable across different county-level regions.

4. Broad technical and model adaptability: The platform supports multi-terminal access including PCs, tablets, and smartphones, with low network bandwidth requirements, enabling seamless adaptation to ICT infrastructure at various development levels in counties. It also provides comprehensive API interfaces to facilitate integration with existing local education management platforms or financial systems. Originating from China's grassroots practices, this model holds significant reference value and promotion potential globally, particularly for developing countries and regions seeking to enhance school meal quality, ensure fund security, and improve student nutrition through digital means.

Case Study Explanation:

1. Case Title: From "Confused Accounts" to "Transparent Accounts": The Digital Transformation of Longzhouping Middle School

2. Implementation Time/Location/Scale: This case was implemented at Longzhouping Middle School in Changyang Tujia Autonomous County (one of the first pilot schools), covering all faculty and students.

3. Core Outcomes:

(1) Transparent procurement with visible cost control: Parent representatives regularly participate in offline price inquiries organized by the "Mom Group," combining data with the system's online price comparison platform. This ensures that prices for frequently purchased ingredients like tomatoes and eggs remain consistently 5%-10% below market averages. In the fall of 2025, the system's price comparison alert detected abnormal potato pricing from a supplier. Following renegotiation, the unit price was reduced by 0.5 yuan per jin (approximately 0.5 kg), resulting in immediate cost savings of approximately 2,000 yuan for the semester.

(2) Enhanced regulatory visibility and standardized operations: During the fall semester of 2025, the system's AI cameras repeatedly detected a kitchen staff member not wearing gloves properly during meal preparation, with immediate alerts sent to the principal and cafeteria supervisor. Following three consecutive warnings and corrective sessions, the employee completely corrected the habit. Under sustained system enforcement, the compliance rate of the school's kitchen "three-prevention" (rodent-proof, fly-proof, and dust-proof) facilities improved from 85% to 100%.

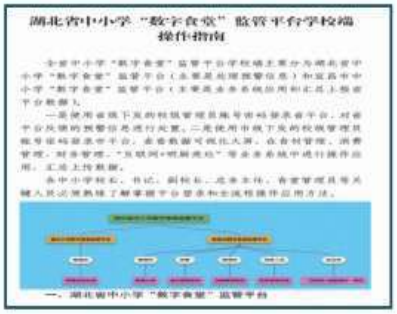
(3) Financial transparency and trust-building: The platform generates clear and accurate financial statements that seamlessly integrate with third-party audits. School cafeteria accounts have consistently received "transparent and standardized" evaluations in multiple recent audits. Supported by systematic data, the school has implemented a quarterly financial reporting system for the first time, regularly updating parent representatives on revenue and expenditure details. This initiative has earned unanimous praise from parents and completely dispelled their concerns.

Display Materials

1. Screenshots of the platform interface and runtime interface:

2、 Management processes and usage guidelines:

3、 Promotion documents and instructions for the entire province:



4、 Related reports on program performance:

Company Overview

Organization Profile:

The Education Bureau of Changyang Tujia Autonomous County is a functional department of the county people's government in charge of education. It governs 9 school districts, 2 education groups and 4 directly affiliated schools, and oversees all primary and secondary schools, kindergartens and other educational institutions across the county.

Rather than a technology developer, the Bureau acts as the demand proposer, model designer and practice leader that initiated and guided this digital transformation of public education services based on real grassroots governance challenges. Focusing on canteen management - an area closely related to people's livelihood - and guided by practical problems under the supervision and guidance of higher authorities and disciplinary inspection organs, the Bureau launched the construction of Integrity Canteens in 2021. After four years of exploration, it has deeply integrated administrative forces, school needs and market technologies. Through open bidding, technical partners were introduced while the Bureau firmly maintained overall business leadership, ultimately designing and promoting the full rollout of the Digital Canteen solution from pilot implementation to countywide coverage.

Experience or Qualifications in the Field of Digital Education:

Our bureau has always adhered to the principle of "small entry points, big scenarios". Starting with the specific scenario of school canteens, we have invested a total of over 2 million yuan in special research and pilot funding, and successfully explored a feasible path for county-level education digital transformation, with the core concept of "system as the foundation, digital and intelligent empowerment".

This solution is the core practical achievement of our bureau in the field of digital education governance. It has been selected as an "Excellent Case of Digital Reform in the Education Sector" by the Hubei Provincial Department of Education, and has been promoted across the province as a typical experience of "using information technology to prevent and control 'micro-corruption'" by the Hubei Provincial Commission for Discipline Inspection and Supervisory Commission.

In 2025 alone, we have received inspection and study delegations from 7 provinces and over 30 counties and cities nationwide, sharing the implementation experience of the "Changyang Model". We have now developed mature capabilities for solution output and experience sharing.

Case 51

Innovation and Practice of the "S2C Paradigm" in Regional Education Digital Transformation: A Representative Case of AI-Empowered High-Quality Development of Basic Education

Chongqing High tech Zone Public Service Bureau, Chongqing, China

Background

As the core area of the Western (Chongqing) Science City, Chongqing High-tech Industrial Development Zone faced significant hurdles when it began independent operations in 2019. Chief among these was a stark urban-rural divide, resulting in the highly uneven distribution of quality educational resources. The majority of schools in the area are standard public primary and secondary schools, with average class sizes ranging from 40 to 55 students per class. This created an increasingly severe challenge of balancing large-scale teaching with personalized learning. The age distribution of the teaching staff follows a "dumbbell-shaped" pattern: young teachers are quick to learn new technologies but lack teaching experience, while older teachers, though experienced, face technical challenges. Consequently, this disparity in digital proficiency have become a barrier to enhancing teaching quality. Under traditional teaching models, these issues were compounded by difficulties in resource sharing and delayed assessment feedback. This made it nearly impossible to achieve a comprehensive and precise analysis of student learning.

The digitalization of education is a vital breakthrough for opening new frontiers and cultivating new advantages in educational development. To overcome existing development challenges, the Chongqing High-tech Industrial Development Zone has proactively implemented the National Education Digitalization Strategy. By leveraging Artificial Intelligence (AI) as the key to bridging the gap between large-scale teaching and personalized learning, the area pioneered the "S2C" (Student to Curriculum) paradigm — a first-of-its-kind model in China. This digital transformation uses AI to empower every

stage of the teaching and learning process, exploring an innovative path for the rapid, "leapfrog" development of regional education.

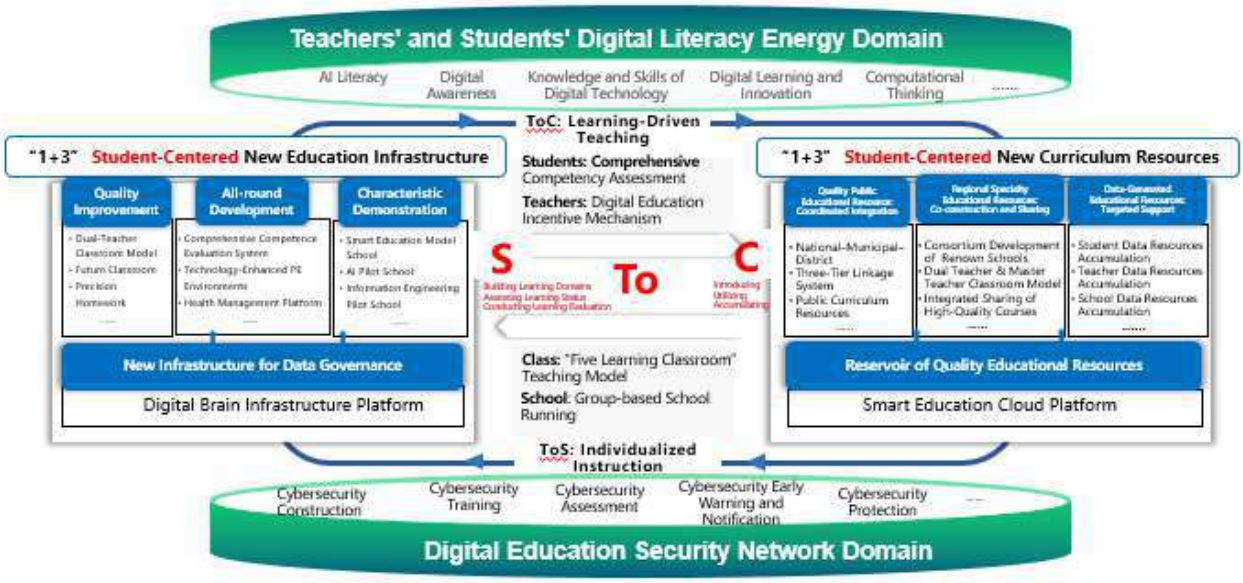


Figure 1 The "Three-End and Two-Domain" Implementation Framework for the "S2C" Digital Education Transformation

Implementation Process

(I) Focusing on the "S" Dimension: Strengthening the Digital Education Foundation

We have built a "1+3" student-centered infrastructure model. The "1" refers to the new infrastructure for education governance, which involves a district-level smart education platform integrating 139 applications such as smart teaching and research. The "3" covers: four types of digital classrooms, including AI twin classrooms, to improve teaching quality; four application scenarios, such as smart aesthetic education, to support holistic development; and pilot projects leveraging reform zones to create demonstration model. All schools in the district have been equipped with dual-teacher classrooms, AI twin classrooms, and precision homework systems, enabling "AI teaching researchers" to provide real-time classroom guidance. Systems for evaluating student development in ethics, intellect, physique, aesthetics, and labor have been established, generating "digital growth profiles" for 72,000 students.

(II) Expanding the "C" Dimension: Promoting Integrated Resource Sharing

We have developed a "1+3" curriculum-centered system for sharing digital and physical educational resources. The "1" is a resource pool containing over 800,000 high-quality teaching resources, 3,800 renowned courses, and 1,563 research projects. The "3" involves the coordinated use of public resources, co-construction of district-specific resources, and precise deployment of generative data resources. Over 1.1 million data resources have been accumulated to support personalized learning and teacher development. We have also actively promoted the National Smart Education Platform and collected 1.13 million pieces of data across 550 categories with the help of expert guidance.

(III) Activating the "To" Dimension: Establishing a Digital Evaluation System

We have created a "four-in-one" digital evaluation system covering students, teachers, classrooms, and schools. A student competency evaluation framework and a digital education incentive mechanism have been introduced, along with the "Five-Learning Classroom" teaching model. This model emphasizes problem-guided, context-created, activity-based, digitally-assisted, and evaluation-optimized learning. Smart classrooms focus on goal precision, method appropriateness, cognitive engagement, digital integration, and outcome attainment. Using data on learning, interaction, assignments, emotion, and development, we generate personalized learning profiles for students. An "AI + Education" intelligent agent system supports the entire teaching process. On average, teachers spend 12 hours per week on online lesson preparation. Over 8,200 smart classroom sessions have been conducted, and 36,000 students have received personalized learning plans.

(IV) Strengthening the "Two Domains": Ensuring Network Security and Digital Literacy

We continue to improve the two key domains — network security and digital competency — to achieve a "dual improvement" in educational network security capabilities and the digital literacy of teachers. For the Security Network Domain, we have upgraded the regional education metropolitan area network by completing fiber optic transformation of "10 Gigabit to schools, Gigabit to classrooms", achieving 100% wireless network coverage on campuses, upgrading core routers, firewalls, and other security equipment. In addition, we have conducted quarterly network security training. For the Digital Literacy Competency Domain, we have formulated an implementation plan for enhancing teachers' digital literacy, under which corresponding training has been delivered for 25,000 teachers. In addition, annual student digital literacy improvement activities have been organized, including youth science and technology innovation competitions, robotics competitions, and other events.

Key Innovation

(1) Paradigm Innovation: A Deep Shift from Experience-Driven to Data-Driven Education

The "S2C" paradigm moves beyond the traditional linear transition from "teacher-centered" to "student-centered" approaches. By adapting the "C2M" model of the digital economy to education, it establishes a three-dimensional framework of "student needs — learning process — contextual adaptation." Guided by a model of "precise diagnosis — dynamic intervention — value-added evaluation," data mining is used to accurately map students' knowledge graphs, while real-time learning data enables intelligent adjustment of instructional strategies. This facilitates a fundamental shift from experience-driven to data-driven practices.

The smart homework system supports one-click generation of student "competency radar charts," instant identification of weak knowledge areas, and targeted assignment delivery. It reduces student workload by approximately 40% and decreases teachers' grading workload by about 55%.

(2) Scenario-Driven Innovation: A Systemic Transformation from Technology Integration to Ecosystem Reshaping

Leveraging an AI-powered classroom behavior analysis system, a "Five-in-One" classroom diagnostic model has been developed, consisting of: seamlessly integrated smart classrooms, traceable multi-dimensional classroom recordings, process-oriented comprehensive evaluation systems, detailed diagnostic reports, and intelligent feedback through AI-supported teaching research.

Before class, learning conditions are precisely assessed; during class, differentiated tasks are delivered

in tiers; after class, error-analysis videos and AI-generated classroom diagnostic reports are automatically produced.

A comprehensive student evaluation system has also been established, capturing data such as classroom behavior analytics and academic performance tracking. This system generates visualized, multi-dimensional student digital profiles and automatically recommends personalized learning pathways.

(3) Mechanism Innovation: Advancing from Isolated Applications to Holistic, System-Wide Collaboration

A "three terminals, two domains" implementation pathway has been constructed, forming a dual-driven development mechanism that integrates resource allocation and digital literacy enhancement.

A five-tier teacher development system — ranging from novice teachers to master teachers in smart education — has been established, supported by five major platforms: large-scale learning, training, practice, competitions, and forums. The nation's first interdisciplinary digital research and training center has also been created.

Additionally, 12 education consortiums have been formed, covering all schools in the district, enabling joint development of teaching resources and reciprocal teacher exchanges. Coverage of high-quality educational resources has reached 95.7%.

A regional education dashboard has been developed, integrating 28 subsystems and enabling one-click management of processes such as student transfers and enrollment record adjustments.

Outcomes and Impact

Overall, education quality across Chongqing High-tech Industrial Development Zone has entered the top tier citywide and now ranks among the leading performers.

In the 2024 compulsory education quality monitoring, 50% of indicators ranked among the top three in the city; at the primary level, four out of six subjects ranked first, with overall performance leading the city.

In early childhood education, the rates of standardized management for community-based kindergartens, public provision, and inclusive access increased from 36.3%, 28.6%, and 68% in 2019 to 100%, 62%, and 98%, respectively.

By 2025, the admission rate to joint senior high school entrance programs reached 73.36%, an increase of 44 percentage points compared to 2019, while the percentage of students reaching the special admission control score line in the National College Entrance Examination (Gaokao) — a benchmark for top-tier university eligibility — rose to 88.12%, up by 67 percentage points.

Teachers have received 1,260 awards in competitions at ministerial and provincial-level or above, including 233 national first prizes and 787 provincial/ministerial first prizes, with nearly one-quarter of all teachers recognized. The number of nationally recognized exemplary courses has ranked first in the city for two consecutive years.

Students have won 9,556 awards in municipal-level or higher competitions in science, technology, sports, and the arts. A total of 36 inventions have applied for national patents, and 13 students have received the Chongqing Youth Science and Technology Innovation Mayor Award or nominations.

The zone has been designated as a National Experimental Zone for Science Education in Primary and Secondary Schools and has received 15 national and municipal honors. Its practices have been widely

reported — over 300 times — by major media outlets, including People's Daily, Xinhua News Agency, and Guangming Daily.

Scalability and Transferability

1. Universal Value Addressing Common Challenges

The "S2C" paradigm offers a direct response to three universal challenges in regional educational digital transformation: fragmented top-level design, the difficulty of personalizing learning at scale, and uneven digital literacy among teachers. To address these, the "Three-Terminal and Two-Domain" framework provides a systematic solution for the equitable distribution of high-quality resources. By leveraging data-driven services, the model bridges the gap between standardized instruction and personalized development. Furthermore, through a structured professional development system, it establishes a progressive growth mechanism for teachers' digital literacy. This innovative approach has gained significant recognition, drawing over 19,700 visitors from eight Chinese provinces and five countries, including Australia.

2. Promoting multi-dimensional outputs through diversified pathways

First, platform-based output: leveraging the technical architecture and functional modules of the regional smart education platform to provide other regions with reusable digital infrastructure solutions.

Second, resource sharing: opening access to 3,800 exemplary course resources and over 800,000 teaching and lesson-preparation materials, while establishing a new mechanism featuring "integrated development of prestigious school resources, two-way alignment of distinguished teacher resources, and integrated sharing of high-quality course resources."

Third, mechanism transfer: packaging the "five-tier progressive" teacher development system, the "four-dimensional integrated" evaluation framework, and the "five-learning classroom" teaching model into a standardized, scalable implementation package.

3. Ensuring effective implementation through adaptive adjustments.

An adaptation strategy of "retaining core modules + embedding local characteristics" is adopted. For regions with a strong digital foundation, the full "three-end, two-domain" architecture can be directly replicated; for regions with relatively limited resources, implementation can begin with selected scenarios — such as smart homework systems and future classrooms — and then be gradually expanded. In western regions, efforts can be aligned with the promotion and application of the National Smart Education Platform to strengthen the supply of high-quality resources; in more developed eastern regions, focus can be placed on deepening exploration of frontier areas such as large-scale artificial intelligence models. Practical validation has already been carried out in counties and districts such as Jingning, Zhejiang and Bishan, Chongqing, receiving endorsement in the form of an inscription by renowned educator Gu Mingyuan.

Case 52

Building a Digital-Intelligent Foundation, Enabling Scenario-Based Growth: The Construction and Practice of a Digital Education Ecosystem

Haihua Wu

Dongfengdong Road Primary School, Yuexiu District, Guangzhou, Guangdong, China

Background

The digital transformation of basic education has entered a new phase of systematic development, yet it faces dual challenges. First, general-purpose large language models exhibit inherent limitations when applied to educational contexts, including opaque reasoning (the “black box” problem), lack of causal reasoning, and fragmented knowledge structures, making them ill-suited to meet the demands of in-depth nurturing in basic education. Second, disparate data formats and incompatible interfaces across teaching, assessment, administration, and home–school communication systems within schools have created severe data silos. Moreover, the development of personalized applications involves prolonged scheduling cycles and high costs, while AI Agents and applications autonomously created by teachers cannot be shared or reused, severely constraining the deep integration of AI with teaching and learning. Against this backdrop, it is imperative to establish an integrated digital-intelligent foundation platform that encompasses data governance, collaborative application development, and resource sharing. Such a platform would enable a stable, controllable, and sustainable “AI Agents + Applications” ecosystem, driving the transition of AI in education from “tool stacking” toward “systemic integration.”

Case Implementation Status

Grounded in the core philosophy of “People-Centered Education as the Foundation, Intelligence as the Priority, and Digitization as the Cornerstone,” this case study constructs a “1+N” digital education ecosystem and explores a new pathway for digital nurturing through the dual-wheel drive of “Applications + AI Agents.” By dismantling data barriers across all domains to establish a unified “Digital

Brain," the initiative implements N intelligent nurturing scenarios integrating the Five Domains of Education (moral, intellectual, physical, aesthetic, and labor education), achieving full coverage of the five domains, comprehensive integration of key elements, and end-to-end optimization of educational processes. This approach ensures equitable access for every student to high-quality digital education resources and propels the digital transformation of basic education from "technology empowerment" toward "ecological renewal."

Founded in 1948, Dongfengdong Road Primary School in Yuexiu District, Guangzhou, launched its information technology–driven school development strategy in the 1990s and established the Dongfengdong Education Group in 2024. With over two decades of sustained engagement in digital development, the school nonetheless encountered a deep-rooted challenge characterized by "systems without ecosystem, data without connectivity, and applications without scalability." Confronting the industry-wide challenges of educational digitalization—where generic systems are difficult to adapt and isolated applications are hard to sustain—the school adopted technologically rational pathway of "first building the digital-intelligence infrastructure, then enabling scenario-based growth." Specifically, it employs a unified data platform to interconnect information across all domains, leverages an intelligent hub to support application innovation, and adopts open mechanisms to empower collaborative co-creation by teachers and students. Through this approach, the school explores a localized pathway for primary school AI education to evolve from "tool stacking" toward "systemic integration," advancing methodically through four strategic phases:

Assessing the Landscape and Setting the Direction: Anchoring the Core of Infrastructure Construction. Building upon the school's legacy of information technology development, the initiative moves beyond the constraints of traditional construction models by establishing a pathway of "building the infrastructure first, then deploying applications." It constructs a digital support system composed of "one AI-powered digital-intelligence foundation + three core scenarios + four user-centric digital-intelligence spaces" (see Figure 1), giving priority to resolving fundamental issues such as unified entry points, unified data, and unified governance. This forms a digital support system that is "governable, sustainable, and scalable," reserving ample room for the subsequent growth of applications.

Figure 1 Dongfengdong Road Primary School's Digital-Intelligent Ecosystem Development Architecture

Consolidating and Strengthening the Foundation: Constructing a Three-Tierdigital-intelligent foundation. The school establishes a "1+N"digital-intelligent foundation by designing a "Super Education Brain" through systems engineering methodology. This infrastructure is built upon a three-tier architecture comprising the Data Layer, Intelligence Layer, and Application Layer. At the Data Layer, aa unified data platform is constructed is constructed to aggregate data from all domains—including teaching, assessment, and administration—according to unified standards. The Intelligence Layer embeds AI capabilities and intelligent analytics engines, supporting dynamic model access and iterative updates. The Application Layer provides standardized open interfaces to enable regulated access for various applications, integrating 23 standardized applications to precisely serve common teaching and management needs across all departments (see Figure 2). Simultaneously, a three-dimensional collaborative governance mechanism of "Contractual-Relational-Administrative" dimensions is established, providing robust organizational and institutional safeguards for infrastructure implementation. This forms a foundational support system characterized by "stable infrastructure and orderly applications."

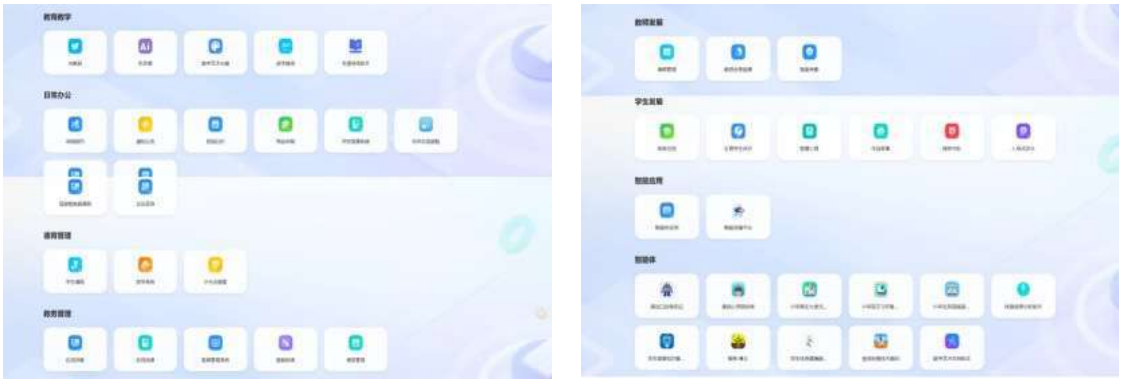


Figure 2 Twenty-Three Benchmark Applications on the Digital Base

Enabling Scenario-Based Growth: Co-Constructing a Five-Ring Intelligent Ecosystem. Teachers and students collaboratively build an intelligent application ecosystem. Leveraging the “Digital Brain,” the school develops a five-ring interconnected intelligent application ecosystem of “AI-assisted Teaching, Learning, Assessment, Student Development, and School Management,” dismantling data barriers across the entire education lifecycle. Addressing frontline management pain points, the school has created 14 customized applications, including proposals submitted to the School Congress (see Figure 3). By breaking down data silos throughout the full education lifecycle, the initiative empowers teachers and students to transition from “users” of applications to “co-creators” of the ecosystem, realizing the evolution of artificial intelligence from “single-point empowerment” to “full-chain collaboration.”

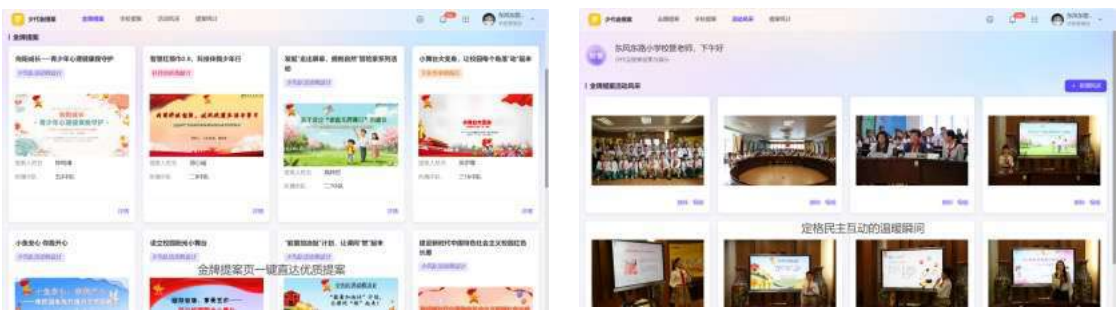


Figure 3 School Congress Proposal Application

The school developed an "AI + Five-Education" AI Agent matrix (see Figure 4), achieving interdisciplinary learning through five-education integration, thereby transforming these agents into personalized cognitive companions for teachers and students.

Figure 4 Series of AI Agents for Five-Educations Parallelism

Observing the Data Landscape: Achieving Closed-Loop Operation as the Norm. Leveraging the data dashboard, the school constructs a closed-loop governance mechanism of “Visible-Governable-Optimizable” (see Figure 5). On a single dashboard, administrators gain comprehensive visibility into platform operations, user behaviors, and core metrics across the entire school. Real-time monitoring of platform operational data enables precise optimization of application functions and entry points, driving the efficient implementation and sustained operation of the digital infrastructure.

Figure 5 Data Cockpit of Dongfengdong Road Primary School

Figure 6 Education Brain of Dongfengdong Road Primary School

Case Innovation and Breakthroughs

This case study achieves comprehensive innovative breakthroughs across four dimensions: philosophy, model, technology, and practice. It has established the "Dongfengdong Paradigm" for the digital transformation of basic education—one that combines theoretical sophistication with practical depth—providing a referable and implementable pathway for the deep integration of AI with teaching and learning, while accumulating substantial intellectual property and academic achievements.

1. Case Innovations

Philosophical Innovation: Reconstructing Teacher-Student Roles, Returning to the Essence of Digital Nurturing. Breaking through the limitations of traditional informatization characterized by "technology-assisted instruction," this initiative reconstructs the teacher's role from "knowledge authority" to "human-machine collaborative meaning architect," and transforms students from "answer consumers" into "meaning creators." It enables AI to evolve from "functional add-on" to deep integration throughout the entire nurturing process, establishing a new value coordinate for talent cultivation in basic education for the digital era.

Model Innovation: Three-Dimensional Collaborative Governance Leading Systemic Transformation. Deeply integrating "project governance theory" with "systems engineering thinking," this initiative innovatively constructs a three-dimensional collaborative governance system of "Contractual-Relational-Administrative" dimensions. At the contractual dimension, the "Three Clarities and One Strictness" framework defines boundaries of authority and responsibility, product standards, and service specifications. At the relational dimension, it consolidates school-enterprise synergy, empowering teachers to transition from "technology acceptance" to "value co-creation." At the administrative dimension, it implements the "Principal Accountability" system coupled with whole-process performance evaluation, propelling the digital-intelligent transformation from singular technology application toward systematic and sustainable ecosystem construction.

Pathway Innovation: Dual-Wheel Drive Development, Cultivating a Growth-Oriented Application Ecosystem. Upholding the principles of “Applications First, Mutual Interdependence, Winning at the Middle Layer, and No Tree is a Forest,” this initiative forms a new paradigm of digital-intelligent transformation driven by “systems engineering thinking,” pioneering a dual-wheel drive pathway of “Platform + AI Agents.” It unifies users, data, applications, and messaging through the digital-intelligent foundation, empowers teachers and students to rapidly create and compose via a low-code platform, and enables AI Agents to dynamically "grow" from authentic educational needs rather than being one-off "developed." This cultivates a school-based application ecosystem that covers all scenarios of the five-domain education and sustains continuous iteration.

2. Case Breakthroughs

Technical Breakthrough: Conquering Multi-Source Heterogeneous Data Fusion Technology to Crack the Data Silo Challenge. Through the digital-intelligent foundation, the school achieves unified identity authentication, message push notifications, and data standards. By aggregating data from all domains—including teaching, assessment, and administration—according to unified standards, the initiative realizes the seamless integration and fusion of multi-source heterogeneous data, thereby providing high-quality, high-credibility data support for upper-layer intelligent applications. The school establishes a dynamic AI model access mechanism to ensure the long-term accumulation and preservation of digital assets: The digital-intelligent

foundation does not bind itself to a single technology stack, supporting dynamic access and iterative upgrading of AI models. This reserves ample space for future technology evolution, enabling school data, applications, AI Agents, and other digital assets to achieve long-term accumulation and reuse. It thoroughly avoids the industry pain point of "technology obsolescence leading to asset nullification," forming an accumulable, growth-oriented digital capability foundation.

Breakthrough in Application and Practice. First, Breakthrough in Nurturing Model: From tool stacking to Integrated Nurturing. Eight disciplinary AI Agents and 14 customized applications have been fully deployed and are operational, forming a virtuous cycle of "stable infrastructure, growing applications, and accumulating data." AI has been deeply integrated into the entire process of Five-Educations Parallelism, providing each student with accompanying personalized support such as study guides and exercise prescriptions. Accompanying assessment generates comprehensive digital portraits of students. In 2025, the school won the championship in the VEX IQ Elementary Division at the World Robot Competition Beijing Championship, with nurturing effectiveness validated by national-level competitions.

Second, Breakthrough in Teacher Development: From Technology Use to Value Co-Creation. Leveraging the intelligent application creation platform, teachers have independently developed 14 customized management applications—the same set previously mentioned. Through collaborative application development, they have achieved rapid professional growth, transitioning from "passive technology acceptance" to "active value creation." For three consecutive years, the school has ranked first in Yuexiu District in both the total number of awards and award levels across various digital literacy competitions.

Third, industry demonstration breakthrough: forming the replicable Dongfengdong Paradigm. The school was successfully selected as a Ministry of Education second-batch Artificial Intelligence Education Base. Its "digital education" achievements were included in the 2024 China Smart Education

Regional Development Report, and related outcomes were showcased at the 7th China Education Innovation Achievement Public Welfare Expo (see Figure 7). The school annually hosts large-scale teaching research activities in Beijing, Shanghai, Guangzhou, and other cities, sharing experiences through cross-regional live streaming to Hong Kong, Macao, and over ten paired assistance cities including Xinjiang and Guizhou, generating substantial industry demonstration and radiating effects.

Figure 7 "Digital Education" New Achievements Unveiled at the 7th Education Expo

3.Awards and Achievements

In terms of academic contributions, the school has proposed an original theoretical framework of “Digital Nurturing” and its corresponding ecosystem construction pathway. The project Transforming Nurturing Models and Practices Based on AI + Learning Spaces won the Second Prize of the National Basic Education Teaching Achievement Awards in 2022 and was selected for the National Teaching Achievement Promotion Program. The article Three Realms of Digital Nurturing was published in China Basic Education in 2024. The monograph AI + School: Learning Spaces and Educational Innovation Toward 2035 received the Third Prize of the Sixth National Outstanding Achievement Awards in Educational Science Research (with only five primary schools nationwide receiving this honor). In addition, the case study AI + Learning Spaces–Based Accompanying Assessment of Moral Education was recognized as a Provincial Typical Case of Education Evaluation Reform in 2022.

Promotion Value and Risks

1. Application Achievements

Since its launch in August 2025, the digital-intelligent foundation system has registered 6,090 users, with 2,514 activated users and 1,657 active users, accumulating 173,000 visits. Standardized application activity stands at 65.91%, with 34 personalized applications deployed. The platform has

been deeply integrated into the school's full processes of teaching, assessment, and administration. Horizontally, it comprehensively covers all scenarios of Five-Educations Parallelism integration; vertically, it achieves full-level penetration from school-level governance to classroom teaching and individual students. This has formed a benign development momentum of "system established, applications growing, and data accumulating," effectively achieving the construction goals of improving teaching quality while reducing burden, enabling precise and efficient management, and delivering personalized nurturing adapted to individual needs.

Figure 8 System Usage Statistics

2. Social and Economic Value

Social Value: Through data-driven precise nurturing mechanisms and equitable allocation of high-quality educational resources, the initiative effectively enhances regional education quality and balanced development. Students‘ comprehensive competencies—including innovation capacity and interdisciplinary learning abilities—have been significantly improved. Achievements such as winning the World Robot Competition championship fully validate the practical effectiveness of the “digital nurturing” model. Economic Value: Through the construction of a unified digital-intelligent foundation, the school substantially reduces costs associated with fragmented procurement and redundant construction in campus informatization, optimizes school management efficiency, and constructs a sustainable development model of "platform + ecosystem." This provides a high-quality practical sample of cost reduction and efficiency enhancement for the digital transformation of basic education.

3. Demonstration and Leadership

As a Ministry of Education AI Education Base School for primary and secondary schools, the "Dongfengdong Paradigm" developed through this case study combines strong operability with high replicability. Its "Contractual-Relational-Administrative" three-dimensional collaborative governance system and "Platform + AI Agents" dual-wheel drive model provide an integrated "governance + application" holistic solution for digital transformation in primary and secondary schools nationwide. This drives the basic education digitalization industry to upgrade from "tool stacking" to "ecosystem reconstruction." Related achievements have been promoted across regions and levels through multiple channels including the Education Expo, regional education alliances, and high-quality open classes, with demonstration effects continuing to expand.

4. Risk Identification and Mitigation

Potential risks identified during case implementation primarily include data security concerns, insufficient content review of AI Agents outputs, and ambiguous AI ethical boundaries. To address these risks, the school will establish and improve data security management systems, construct a

dual-layer content review mechanism of "intelligent review + manual verification," and formulate ethical guidelines for AI applications in education. Combined with dynamic assessment and full-process supervision, these measures will fortify risk prevention and control defenses, ensuring that digital technology applications consistently adhere to the primacy of nurturing, and that technology serves the core needs of teaching and learning.

Case 53

Digital Education Innovation Practice In Yuzhong District

Education Commission of Yuzhong District, Chongqing, China

Background

As the core district of Chongqing, Yuzhong District boasts dense educational resources, with 114 primary and secondary schools, kindergartens and 76,000 students. In advancing higher quality development of education, it faces five prominent challenges:

1.Heavy teaching burden on teachers, as repetitive work such as homework correction and health data collection occupies a large amount of teaching time.
2.Fragmented student health management, with scattered data on myopia, obesity, mental health and other indicators lacking systematic integration.
3.Experience-dependent physical education teaching evaluation without precise data support.
4.Complex links, long cycles and difficult cross-departmental collaboration in the supervision of off-campus training institutions.
5.Lack of standards, non-standard configuration and low utilization efficiency in AI education laboratory construction, restricting the effective implementation of artificial intelligence education.

With two national pilot programs—Pilot District for Boosting Teacher Team Construction via Artificial Intelligence and Pilot District for AI-Enabled Education Initiative—as leverage, and guided by the vision of Humanistic Yuzhong&Quality Education, the Yuzhong District has systematically promoted the digital transformation of education, built a district-wide digital education ecosystem, and realized the shift from experience-based management to data-driven governance.

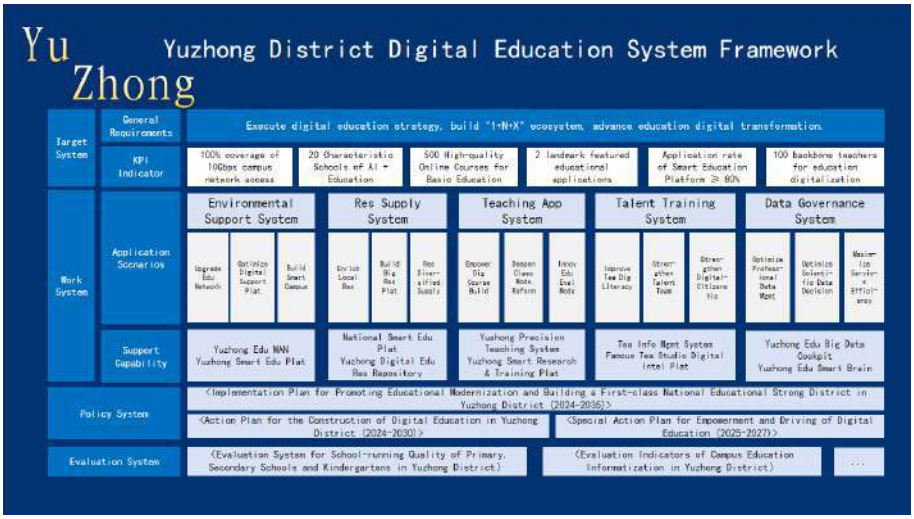


Figure 1 Yuzhong District Digital Education System Framework

Case Implementation Status

1. Building a District-wide Digital Education Infrastructure

Yuzhong has developed a digital education ecosystem of "1 Platform + N General Applications + X Personalized Applications". In 2022, it launched Version 1.0 of the Smart Education Platform, integrating 45 application systems covering campus management, classroom teaching, teacher training and other scenarios. It is now developing Version 2.0 to upgrade the platform from data-oriented to intelligent.

Figure 2 Yuzhong Smart Education Big Data Platform Cockpit

2. AI Empowering Smart Teaching Improvement

Tiered Homework: Promoted in 21 schools and 534 classes, the data-driven tiered homework model adopts a "4+1" design (four common assignments + one personalized assignment per week), covering 1,120 teachers and 21,432 students to realize personalized homework assignment.

AI Essay Scoring: Established a closed-loop system of "Standard Formulation → AI Preliminary Evaluation → Teacher Refinement → Secondary Optimization". AI automatically identifies typos and faulty sentences, generates scoring reports; teachers review and students revise; the system produces class and individual learning analytics to improve efficiency and targeting.

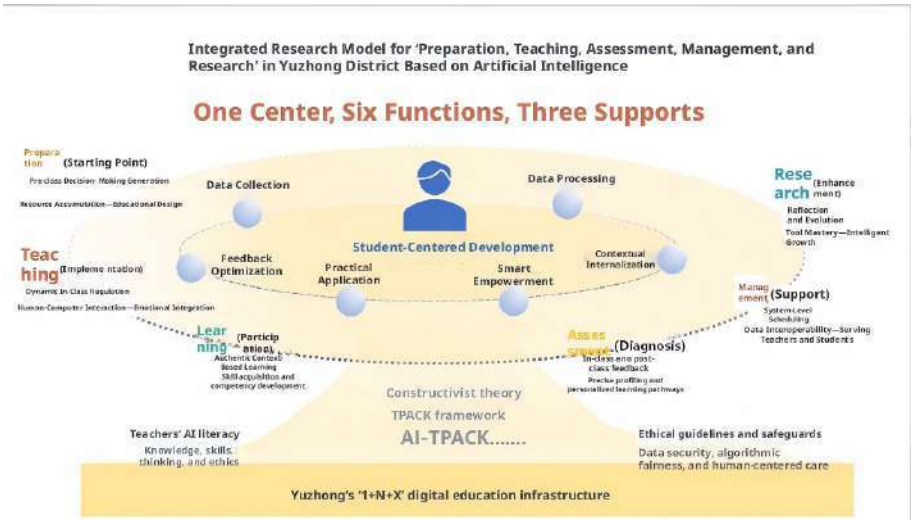


Figure 3 Yuzhong District AI-Based Integrated Research Model of Preparation-Teaching-Learning-Evaluation-Management-Research

3. Constructing a Smart Student Comprehensive Health Platform

A district-wide smart student comprehensive health platform for primary and secondary schools has been built, integrating morning/afternoon checks, infectious disease monitoring, physical examinations and mental health services. Physical examination data is automatically collected to generate six-year consecutive growth curves, and parents can access personalized health reports via the parent portal. Daily health "zero-reporting and daily reporting" is completed by 10 a.m. district-wide, realizing paperless and intelligent management.

Figure 4 Yuzhong District Student Comprehensive Health Smart Platform Cockpit

4. Promoting Whole-process Transformation of Smart Physical Education

Smart physical testing stations, sports bracelets and other devices have been deployed in selected schools to form a full closed loop of "Pre-class → During-class → After-class". Teachers adjust exercise intensity in real time based on heart rate data; a PE evaluation mini-program supports physical fitness management, home exercise check-ins and value-added evaluation, with parents receiving synchronized student fitness reports.

5.Advancing Digital Transformation of Preschool Education

Kindergartens are equipped with IoT devices such as morning check robots, smart bracelets and corner beacons to realize non-sensing data collection of children's attendance, mood, exercise and water intake data. The platform automatically generates monthly reports covering children's physical health, social competence and potential interests. Selected kindergartens have accessed AIGC large models to assist teachers in writing observation notes, lesson plans and notices, reducing administrative burdens.

6.Realizing Intelligent Whole-life-cycle Governance of Training Institutions

An "All-in-one Supervision for Training Institutions" application has been developed, connecting with the Ministry of Education supervision platform, integrating 47 types of data, and establishing a "One Institution, One Code" whole-life-cycle closed loop. Red/yellow light risk alert rules have been formulated to enable automatic problem identification and intelligent task assignment. Verification and disposal time has been shortened from 15 working days to 5, and links reduced from 38 to 21.

7.Standardized Construction of Artificial Intelligence Laboratories

A laboratory construction guide has been issued, with three tiers (basic, standard, demonstration) tailored to different school stages, supporting curriculum, class hours, faculty and maintenance to promote universal AI education across the district.

Case Innovation and Breakthroughs

1. Main Innovation Content

Ecosystem Innovation: Built a district-school collaborative, district-wide connected "1+N+X" digital education ecosystem with platform interoperability, data sharing and application integration.

Teaching Innovation: Established a dual-drive smart teaching system of "tiered homework + AI scoring", shifting from experience-based to data-driven teaching.

Management Innovation: Digitized the whole process of student health, smart PE, preschool management and institution supervision, moving from fragmented management to integrated intelligent governance.

Evaluation Innovation: Generated student health, growth and physical fitness profiles based on multi-dimensional data, establishing a process-based and growth-oriented evaluation system.

Standard Innovation: Issued the Guidelines for the Construction of Artificial Intelligence Laboratories in Primary and Secondary Schools in Yuzhong District, clarifying construction standards and unifying hardware/software configuration, curriculum and faculty requirements.

2.Technology Breakthrough Content

Multi-source Data Fusion: Connected data from market regulation, public security, urban management and other departments via Digital Chongqing IRS, realizing cross-system and cross-level data connectivity.

AI Scoring Model: Applied natural language processing (NLP) to realize intelligent essay scoring and automatic learning analysis, improving efficiency and feedback accuracy.

IoT Perception + AI Integration: Combined IoT devices and AI algorithms in preschool and PE scenarios for non-sensing data collection and intelligent analysis of student behavior and health data.

3.Application Practice Breakthrough Content

Teaching: Accurately reduced burdens and improved efficiency, with personalized learning diagnosis and homework assignment, and significantly enhanced teacher correction and research efficiency.

Health: Solved challenges in student health management (myopia, obesity, mental health), realizing full-cycle tracking and home-school collaborative intervention.

Governance: Achieved closed-loop intelligent supervision of off-campus training institutions with greatly improved efficiency, recognized as an excellent case by the Ministry of Education.

Inclusivity: Formed a regional integrated promotion model, providing a replicable and scalable path for digital transformation of basic education in core urban areas.

4.Intellectual Property Status

This case is based on the smart education platform and scenario applications independently planned and constructed by Yuzhong District. It has formed regional standards, management norms and application paradigms for educational digitalization. All platforms, application modules and construction guidelines are led and implemented by the Education Committee of Yuzhong District, with independent management and application rights.

Promotion Value and Risks

1.Application Effect and Promotion Value

Yuzhong Smart Education Platform covers all primary and secondary schools and kindergartens in the district. Smart teaching systems are used regularly in 21 schools, the student comprehensive health platform covers all primary and secondary schools, and the preschool digital-intelligent platform covers all kindergartens in the district. The platform operates under a sustainable model of "district-level coordination, school application, enterprise operation and maintenance".

2. Social and Economic Value

Digital transformation of education has significantly improved teaching and management efficiency, reduced teacher burdens, promoted student healthy development and strengthened home-school collaboration. The intensive platform construction model has effectively reduced repeated IT investment in schools, showing sound economic benefits.

3.Demonstration and Leading Role

This case has formed systematic practical experience in the overall architecture of educational digital transformation, district-school collaboration, AI-Enabled teaching and health data governance, providing a replicable and promotable model for regional digital transformation of basic education nationwide.

4.Potential Risks and Responses

Data Security Risk: The platform aggregates large amounts of sensitive student data. Strict hierarchical and classified data management, enhanced access control and encrypted transmission shall be implemented.

Ethical Risk: AI scoring and intelligent evaluation shall ensure algorithm transparency and interpretability, avoiding excessive technologization that weakens humanistic care.

Other Relevant Information

1. Case Award Status

Global Excellent Case of Smart Education 2023

Global Excellent Case of Smart Education 2024

Global Smart Education Innovation Award 2025
Global Excellent Case of Smart Education 2025

2.Presentations.and Media Promotion

High-level Conferences & Forums (30+ times): Presented at the Global Smart Education Conference (2024, 2025), National Seminar on Off-campus Training Supervision (2025), Annual Conference of the Chinese Society of Education (2025), Chongqing Municipal Education Work Conference (2025), and Chongqing Digital Education Construction Conference (2025). Highly recognized by Ministry of Education expert panels and peers.

Mainstream Media Coverage: Featured in special reports by CNR, Guangming Online, China Education News Network, China Education Daily, and Chongqing Daily.

User Feedback: Parent satisfaction surveys show widespread acclaim for the "Health Platform" and "Smart Sports" applications.

3.Case-related images, videos, and other materials

Pictures, system interface screenshots, platform cockpit diagrams and other materials related to the case are detailed in the attachments.

Case 54

China-ASEAN Primary and Secondary School Information Technology Smart Education Platform

Guangxi Science & Technology Publishing House Co.,Ltd, Guangxi, China

This case introduces the China–ASEAN Primary and Secondary School Information Technology Smart Education Platform, developed to address challenges such as uneven resource distribution, abstract teaching content, and limited personalized learning in Guangxi. By integrating artificial intelligence, knowledge graphs, and multimodal technologies, the platform supports both teachers and students through intelligent lesson preparation, instruction, and adaptive learning. The platform has been fully promotion across Guangxi, significantly improving teaching quality, teacher capacity, and reducing urban–rural educational gaps. With its scalable architecture and multilingual adaptability, it provides a replicable model for regional and international "AI + Education" collaboration, particularly within the China–ASEAN context.

Background

Artificial intelligence technology is profoundly driving educational reform. Implementing the national education digitalization strategy and promoting the high-quality and balanced development of basic education constitute the core tasks of high-quality development in basic education at the present stage. Guangxi Zhuang Autonomous Region attaches great importance to the integration of artificial intelligence and education. However, constrained by factors such as geography, economy and educational infrastructure, the teaching of information technology in primary and secondary schools in Guangxi is confronted with numerous difficulties, which not only hinder the local process of educational digitalization but also restrict the improvement of students' scientific and technological literacy. Firstly, there is inadequate adaptation of educational resources with an unbalanced urban-rural distribution. Teachers suffer from a shortage of teaching preparation resources that are insufficiently tailored to local learning conditions, and there is a lack of exclusive resources connecting with ASEAN educational scenarios. Secondly, the practical implementation of classroom teaching is challenging. It is difficult to visualize and explain abstract disciplinary knowledge, and the imperfect multimedia conditions in some

schools further exacerbate this problem. Thirdly, the development of personalized teaching is impeded. Students vary greatly in their foundational information literacy, and the prominent urban-rural digital divide undermines educational equity and quality.

Meanwhile, the Action Plan for "Artificial Intelligence + Education" further specifies that China shall leverage geographical advantages to promote the export of artificial intelligence-based educational resources to ASEAN, build a China-ASEAN cooperation platform for educational digitalization, and deepen regional educational exchanges. As a frontier and core region for China's opening-up and cooperation with ASEAN, Guangxi is seizing policy opportunities to build a highland for international cooperation in artificial intelligence, advance the integration of artificial intelligence with local education, and facilitate the digital transformation of education.

In view of the above, it is highly necessary to carry out scenario-based teaching relying on artificial intelligence and establish an education cooperation platform oriented toward ASEAN. Guided by relevant action plans, this project utilizes AI technology to achieve accurate resource matching, visualization of abstract knowledge and personalized learning recommendation. It can not only address the pain points in local teaching in Guangxi and bridge educational gaps, but also give full play to Guangxi's geographical advantages to export high-quality AI educational solutions and resources to ASEAN. This will deepen bilateral cooperation in educational digitalization and support the implementation of the national education digitalization strategy.

Implementation Process

This case centers on the core principles of scene-driven development, precise empowerment, and two-way radiation, rooted in Guangxi and oriented toward ASEAN. It constructs a practical system for the deep integration of artificial intelligence (AI) and information technology teaching in primary and secondary schools, and promotes platform construction and application implementation in a phased and step-by-step manner. The specific implementation process is as follows:

1. Core Technical Scheme

The platform adopts a systematic architecture of cognition-driven – generative collaboration – multimodal generation – data closed-loop, and builds an integrated framework of general large model + vertical knowledge base + professional tool library + digital learning paradise, so as to develop an intelligent teaching assistant agent for information technology in primary and secondary schools that adapts to Guangxi's teaching practice and meets ASEAN's demands. Its core technical applications are as follows: Based on educational cognitive computing and knowledge distillation technology of large language models, the platform realizes three-level structured extraction of teaching content and constructs a four-level knowledge graph, which accurately matches teachers' needs and ensures the traceability of knowledge. Taking teaching cognitive results as input, it invokes a multimodal engine to generate courseware and other materials, and enhances classroom practicality through style transfer and containerized sandbox technology. By integrating the multimodal generation engine, it generates visualized teaching materials with one click, and ensures the compliance and effectiveness of materials through semantic alignment and quality judgment. Adopting a knowledge-embedded database and a behavior log analysis engine, the platform forms a data closed-loop, and combines an adaptive recommendation model to construct a three-dimensional intelligent service ecosystem (Figure 1).

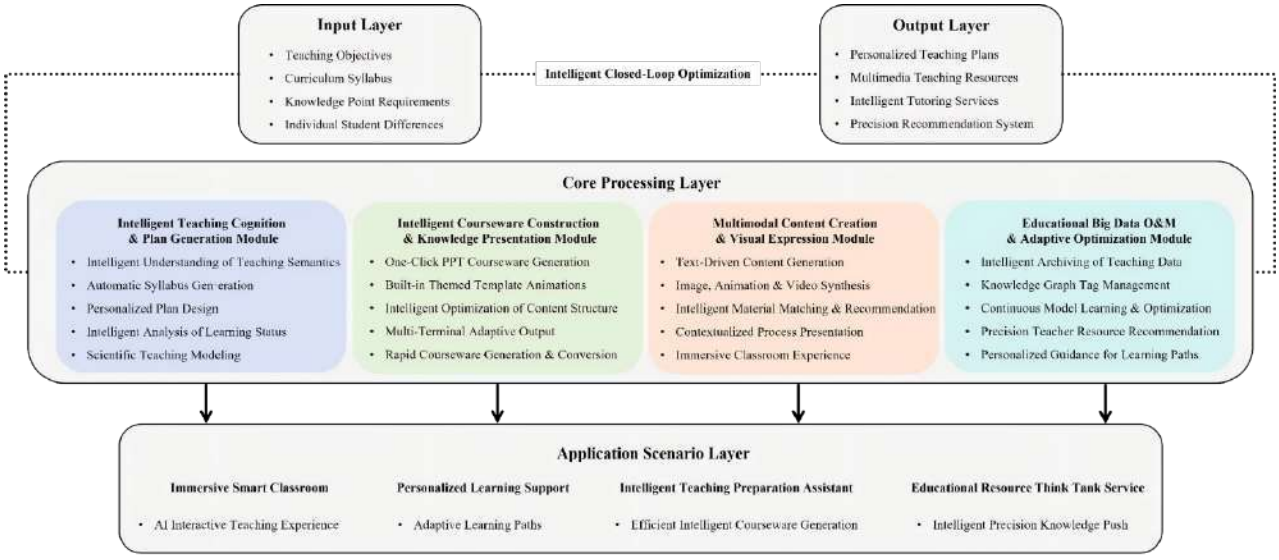


Figure 1 System Framework Diagram

2. Specific Application Measures

The specific application measures cover multiple dimensions. On the teacher side, one-stop intelligent support is provided for the whole process of lesson preparation, teaching and after-class expansion, facilitating efficient teaching. On the student side, a digital growth paradise is built with interesting design to stimulate internal learning motivation, and adaptive recommendation is adopted to accommodate the needs of students with different academic levels. The resource system integrates the task content of 210 lessons for information technology in primary and secondary schools, collects supporting curriculum resources and interdisciplinary teaching resources, and integrates diverse teaching tools, which greatly reduces the teaching difficulty for teachers. Multilingual interfaces are reserved for docking with ASEAN, and a standardized intelligent teaching resource repository is established based on Guangxi's actual teaching situation and oriented to ASEAN's teaching demands. In terms of security and compliance, hierarchical data desensitization and other strategies are adopted to ensure data compliance, and a two-dimensional evaluation system is established to continuously optimize platform performance.

3. Implementation Steps and Timeline

The project is carried out in four phases:

R&D Phase (January–December 2024): A project team is established to complete platform architecture design, core module development and construction of the localized knowledge graph, followed by internal testing and optimization.

Pilot Phase (January–July 2025): The platform is piloted in selected primary and secondary schools in Guangxi; teacher training is conducted, feedback is collected, and functions are optimized with preliminary design of multilingual interfaces.

Application Phase (August–December 2025): The platform is promoted across Guangxi, with enriched resources and planning for multilingual adaptation for ASEAN.

Improvement Phase (From January 2026 onwards): The integration of technologies is further deepened, the layout in ASEAN is expanded, and a benchmark for AI + Education between China and ASEAN is built.

Innovation Highlights

Compared with analogous practices in the field of “AI + Education”, this project is rooted in Guangxi and oriented toward ASEAN, with scenario-driven development as its core. It demonstrates unique advantages in technical architecture, resource adaptation and application models, and its innovative merits are prominently reflected in the following four aspects:

(1) The technical logic conforms to the essence of education. In contrast to the shortcoming of traditional teaching systems that “can generate content but lack educational understanding”, this platform takes AI semantic understanding as its underlying driving logic and constructs an intelligent pipeline of “objective analysis–semantic extraction–knowledge matching–generation optimization”. Combined with the RAG knowledge enhancement and agent collaboration mechanism, it realizes closed-loop self-correction between knowledge retrieval and generated content, ensuring that teaching plans and courseware materials comply with both technical specifications and educational cognitive laws, so that technology can truly serve teaching scenarios.

(2) Resource adaptation integrates both localization and internationalization. The platform deeply integrates teaching materials for the information technology discipline in Guangxi, which is highly consistent with local teaching practices. It establishes a dedicated teaching logic exclusively for the information technology discipline and can directly output complete courseware and teaching plans. Focusing on the whole process of teachers’ lesson preparation, it realizes one-stop empowerment of “integrated lesson preparation and instruction”, which distinguishes it from general AI tools and student-oriented vertical teaching aids. Meanwhile, multilingual adaptation interfaces are reserved to improve the adaptability to ASEAN educational scenarios, promote the interoperability of educational resources between China and ASEAN, and fill the gap in regional and international AI+information technology teaching resources.

(3) A two-way empowerment scenario system for teachers and students is constructed. It breaks through the limitation of unilateral empowerment in similar platforms and creates a two-way model of “teacher empowerment + student activation”. On the teacher side, it provides intelligent support covering the whole process of lesson preparation and instruction, greatly reducing teaching difficulty and improving lesson preparation efficiency. On the student side, it stimulates intrinsic learning motivation through interesting design and personalized recommendation, realizing the transformation from “passive learning” to “active learning”. Coupled with multimodal generation technology, it solves the teaching difficulties of abstract disciplinary knowledge and innovates the classroom teaching model.

(4) A replicable closed-loop promotion model is formed. Taking Guangxi as a pilot area, the platform builds a closed-loop development path of “technology research and development–scenario application–optimization and iteration–radiation and promotion”. It not only solves local teaching pain points, but also exports mature “intelligent teaching solutions” by virtue of geographical advantages, providing a referable practical path for cross-regional “AI+education” cooperation and demonstrating the international influence of China’s educational digitalization.

Case Outcomes

Since its launch in 2025, the platform has been implemented across Guangxi Zhuang Autonomous Region. Supported by objective data, practical outcomes and recognized honors, it has achieved

remarkable effects in student development, teacher professional growth and teaching quality improvement, and has become a typical demonstration case of “AI + Education”.

1. Outcomes in Teacher Professional Growth

To date, the platform has been gradually rolled out to primary and secondary schools throughout Guangxi. Information technology teachers have integrated it into the entire process of daily teaching, making the platform a core auxiliary tool for instructional practice. Teachers’ instructional design capabilities and teaching efficiency have been significantly improved. A number of teachers have developed high-quality lesson cases based on platform resources and won awards in teaching competitions, which has effectively enhanced their digital teaching competence and addressed the pain points of insufficient lesson-preparation resources and limited teaching experience.

2. Outcomes in Teaching Quality Improvement

By providing standardized, high-quality and easily accessible intelligent teaching services, the platform has effectively narrowed the gaps in information technology teaching between urban and rural areas as well as among different schools in Guangxi. Since its launch, the digital resources on the platform have accumulated more than 140,000 visits and nearly 20,000 downloads. A resource system covering all academic stages and adapting to local teaching realities has been formed, promoting the overall improvement of regional information technology teaching quality.

3. Honors and Achievements

Relying on its innovative practices in the integration of AI and basic education as well as the digital transformation of publishing resources, the project has been successfully selected as one of the 2025 Annual Innovative Cases in Publishing and Distribution by China Press and Publication Radio and Television News · Publishing Weekly, establishing itself as a typical model of AI teaching assistant empowering disciplinary instruction.

Scalability

This case, rooted in Guangxi and oriented toward ASEAN, features strong universality and demonstration value in technical architecture, application models and resource systems. With clear promotion paths and localized adaptation schemes, it can be replicated and extended across regions and scenarios, helping more regions resolve pain points in information technology teaching and driving the scenario-based reform of “AI + Education”.

1. Universality and Demonstration Value

The core strengths of this case are strong scenario adaptability, low technical threshold and remarkable application effects. The constructed model of “AI teaching assistant + full-process teaching empowerment” can be directly applied to information technology teaching in primary and secondary schools nationwide, especially in border and underdeveloped areas, effectively solving common problems such as the urban-rural educational digital divide and the shortage of teaching preparation resources for teachers.

2. Promotion Paths

Deepen promotion across Guangxi by expanding coverage, improving the resource system and optimizing platform functions, so as to build a demonstration benchmark and form replicable experience. Leverage geographical advantages to promote radiation to ASEAN, optimize multilingual adaptation, conduct pilot programs in cooperation with local educational institutions, export teaching

models and resources, and hold exchange activities. Summarize practical experience for promotion in underdeveloped and border areas nationwide, strengthen cooperation with local education authorities, and carry out teacher training to facilitate platform implementation. Conduct industry exchanges through education exhibitions, academic forums and other channels to share experience and achievements and promote the upgrading of the education sector.

3. Localized Adaptation Schemes

Resource adaptation: Customized upload and editing interfaces are reserved to support local regions in supplementing localized resources and adjusting knowledge graphs and teaching plans. Language adaptation: Multilingual functions will be improved to support switching among languages of ASEAN countries and domestic ethnic minority languages, with optimized presentation of translated multilingual resources. Demand adaptation: A user feedback mechanism will be established to continuously optimize functions and develop personalized scenarios based on user feedback.

4. Expected Effects

Within 2–5 years, the platform is expected to cover more than 90% of information technology teaching scenarios in primary and secondary schools across Guangxi, narrowing the regional educational digital divide and improving teaching quality. It will establish educational cooperation with ASEAN countries to realize resource interoperability and model sharing, forming a benchmark for China-ASEAN “AI + Education” cooperation. A mature practical model will be developed to provide replicable solutions for the digital transformation of K-12 information technology education nationwide, promote the scenario-based and large-scale application of artificial intelligence in education, and support the building of a strong educational country.

Case 55

Process, Model, Service: The Triple Transformation of AI-Driven Campus-Wide Management

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Background

With the expansion of campus scale and the advancement of informatization, traditional campus management models are facing increasingly prominent challenges: first, fragmented data sources and inconsistent standards make it difficult to form a unified basis for decision-making; second, operations and maintenance rely on manual efforts, resulting in delayed responses and challenges in achieving refined management; third, resource allocation lacks dynamic optimization mechanisms, making it difficult to balance energy consumption and efficiency; fourth, information collaboration between teachers, students, and administrators is hindered, and the campus service experience needs improvement. To address these issues, Hangzhou Zhongce Vocational School Qiantang Campus has launched a campus-wide dynamic management system construction project driven by artificial intelligence (see Figure 1), promoting a paradigm shift from "human management" to "intelligent management" and advancing the comprehensive digital transformation of educational elements, educational operations, and educational scenarios.

Case Implementation Status

1. Process Reengineering: From "Offline Legwork" to "Mobile Completion"

Taking process reengineering as the starting point, promoting the leap of campus office work from "offline legwork" to "mobile completion." The school takes process reengineering as a breakthrough, comprehensively migrating traditional offline paper-based approvals to mobile terminals and building a digital office system of "mobile completion." First, the electronization of approval processes: 19 types of paper application forms for procurement, duty scheduling, leave requests, meal services, etc., have been fully replicated on the DingTalk platform. Through "form replication + logical reconstruction,"

electronic transformation has been achieved. The approval process strictly follows the principles of "clear authority and responsibility, hierarchical control," and the system automatically triggers differentiated approval paths based on the type of matter. Second, the lightweight design of office tools: Independently developed a "Evening Self-Study Duty Mini-Program," allowing teachers to view personal and duty arrangements online. If shift changes are needed, teachers can select colleagues with the same responsibilities in the mini-program in advance, and the shift change information is automatically synchronized. Supervising teachers can create a DingTalk group for the day's duty with one click, and the system pushes duty reminders in advance and on the day; clicking leads directly to the details. Third, the digitalization of visitor management: Developed a visitor appointment mini-program. After visitors submit personal information, appointment time, and the number of accompanying persons, the host receives a push notification in real-time and conducts the review. Upon approval, visitors can enter the campus with a QR code, achieving unified management of campus visitors. Fourth, the professionalization of teacher development: Addressing the pain points of numerous review nodes and complex scenarios in teachers Professional Title Evaluation, the school independently developed an on-campus performance evaluation system. Through digital means, it achieves standardized submission of application materials and automated workflow of the review process, effectively solving problems such as low efficiency and high error rates associated with manual review.

2. Model Innovation: From "Passive Response" to "Active Warning"

Driven by model innovation, transforming safety management from "passive response" to "active warning." The school promotes the transformation of the campus management model from "post-event handling" to "pre-event prevention," building an active intelligent warning system. First, proactive safety prevention: Deployed 2,333 high-definition cameras and an AI intelligent analysis server, integrating algorithm models such as behavior recognition and abnormal event detection, achieving 7×24 hour intelligent monitoring. The system automatically identifies abnormal behaviors and triggers warnings, enabling precise event traceability with locally stored video footage. Second, automated attendance management: Established a digital closed loop of "terminal check-in + data statistics + data analysis." Records generated when students check in via electronic class boards are transmitted in real-time to the attendance system. The system automatically generates analytical reports including check-in times, absent personnel and reasons, and historical morning/evening check-in rates. Third, intelligent dormitory management: Installed facial recognition devices in each dormitory building to automatically count students' departure and return data. Linked with the student leave system, it displays the expected and actual number of students in each building in real-time, helping duty teachers accurately grasp student dynamics and significantly reducing manual inspection workload.

3. Service Upgrade: From "Uniform Supply" to "Precise Delivery"

Led by service upgrade, elevating teacher-student services from "uniform supply" to "precise delivery." Guided by the needs of teachers and students, the school promotes the upgrade of campus services from a "one-size-fits-all" uniform supply to a "precision-targeted" personalized delivery model. First, precise home-school services: In student entry/exit scenarios, the facial recognition system not only identifies students' communication records information but also sends real-time entry/exit

updates to parents' mobile phones, helping parents stay informed about their children's arrival at and departure from school promptly. The system has received unanimous praise from parents since its launch. Second, personalized teacher services: The Evening Self-Study Duty Mini-Program not only provides duty schedule inquiry functions but also pushes duty reminders based on teachers' job responsibilities. The backend management system automatically counts teachers' monthly duty frequencies, eliminating manual formatting hassles. Third, convenient visitor services: The visitor appointment system realizes the entire online process of "application—review—entry with QR code." Visitors no longer need paper registration or on-site waiting, and hosts can complete reviews anytime, anywhere, significantly improving visitor experience and campus access efficiency.

Case Innovation and Breakthroughs

1. Main Innovation Content

The case achieves innovations across three dimensions: process reengineering, model innovation, and service upgrade. In terms of process reengineering, it breaks through the limitations of traditional paper-based approvals for the first time, building a "mobile completion" digital office system. This enables online processing and real-time feedback for procurement, duty scheduling, leave requests, meal services, and other areas. In terms of model innovation, it transforms campus safety management from passive response to active warning. By deeply integrating AI algorithms with IoT perception, it achieves intelligent monitoring of campus safety, attendance, and dormitory management, shifting from "post-event handling" to "pre-event prevention." In terms of service upgrade, it shifts the service provision model from uniform supply to precise delivery. Through data empowerment, it provides personalized services for parents, teachers, and visitors, achieving deep collaboration between people and technology and significantly enhancing the campus service experience.

2. Technology Breakthrough Content

The project has achieved several technological breakthroughs: First, large-scale heterogeneous device access and unified management. By integrating IoT technology, over 2,000 terminal devices including lighting, air conditioners, and door locks are connected to the IoT control platform, achieving interoperability and remote control of devices. Second, the deep application of AI vision algorithms. Deployed AI intelligent analysis algorithms supporting multi-scenario applications such as facial recognition, behavior analysis, and anomaly detection, enabling 7×24 hour intelligent monitoring across the campus. The system's warning accuracy and real-time performance have reached the industry-leading level. Third, cross-platform data synchronization and business collaboration. By deeply integrating with the DingTalk open platform, it achieves real-time synchronization of attendance data and approval data, building a digital closed loop of "terminal check-in + data statistics + data analysis." These technological breakthroughs have significant value for promoting refined campus governance and establishing an active campus security system, positioning the project's technical level at the forefront among similar vocational schools domestically.

3. Application Practice Breakthrough Content

Significant breakthroughs have been made in application practices: First, achieving "full-scenario awareness" in campus management. Through the extensive deployment of sensing terminals such as facial recognition gates, electronic class boards, and high-definition cameras, real-time collection and

intelligent processing of campus personnel, equipment, and environmental data are realized. Second, realizing "visualized" campus O&M management. A campus-wide digital network supervision system and energy consumption control system were established, achieving refined management of network behavior and teaching area electricity usage, driving green campus construction. Third, promoting the formation of a "teacher-student co-creation" application ecosystem. By empowering teachers and students with AI technology and campus data, they have independently developed multiple lightweight applications such as duty management, visitor appointment, and attendance analysis systems, creating a sustainable innovation ecosystem. These practice breakthroughs have important demonstrative significance for promoting the digital transformation of domestic vocational education.

4. Intellectual Property Status

The project's core technologies, including the independently developed "Evening Self-Study Duty Mini-Program," "Visitor Appointment System," and other software achievements, are currently being organized for software copyright registration. The ownership of these achievements belongs to Hangzhou Zhongce Vocational School Qiantang Campus.

Promotion Value and Risks

1. Application Prospects

The project has already achieved significant application results at Hangzhou Zhongce Vocational School Qiantang Campus. Currently, the campus-wide dynamic management system has served over 3,000 students, generating 1.182 million check-in records and 118 million log entries. Management systems such as mobile approval, duty management, visitor appointment, energy consumption control, and campus surveillance have been fully rolled out. The operation and management model follows a unified platform + multi-terminal collaborative approach, supporting large-scale promotion and replication. The case is highly replicable and referential, particularly suitable for large and medium-sized primary and secondary schools and vocational colleges.

2. Social and Economic Value

In terms of social value, the project significantly enhances campus safety prevention and control capabilities, ensuring the safety of teachers and students. The precise home-school connectivity service strengthens family-school communication and enhances educational satisfaction. It also cultivates teachers' and students' digital literacy and innovation abilities, creating a favorable digital culture atmosphere. In terms of economic value, refined energy management is expected to reduce overall campus energy consumption by more than 5%. The application of automated management tools reduces labor costs, with human resource costs in duty management alone decreasing by an estimated 15%.

3. Demonstration and Leading Role

The case plays a demonstrative and leading role in the basic education field. It provides a replicable AI management paradigm for the vocational education sector. Its successful experience in achieving non-inductive services and precise delivery offers a reference for regional education digital upgrades. The "teacher-student co-creation" application ecosystem formed by the project exemplifies "everyone learns AI, everyone uses AI, everyone creates AI" and promotes the deep integration of AI with educational practices.

4. Potential Risks

Technical risks include that rapid updates in AI technology may lead to system iteration lagging; the stability and security of hardware devices cannot be completely guaranteed; and the complexity of data synchronization across multiple systems poses consistency risks. Ethical risks include that the extensive deployment of biometric collection devices raises personal privacy protection issues; students and parents may have concerns about data security; data biases may affect decision fairness; and excessive reliance on technological management may diminish human care and the flexibility of educational management. These require comprehensive consideration in subsequent applications.

Other Relevant Information

1. Case Award Status

The independently developed "On-Campus Performance Evaluation System" won the Third Prize in the East China Division of the 2nd Educational Information Technology Application Innovation Competition. No other awards have been received to date.

2. Third-Party Evaluation

The "Evening Self-Study Duty Mini-Program" independently developed by the project and the visitor appointment system have been highly praised by teachers, students, and parents. Teacher representatives stated, "The duty mini-program solves the hassle of manual shift adjustments and statistical reporting, greatly improving work efficiency." Parent representatives commented, "The real-time notification feature when children enter and leave the school makes us feel more at ease." Feedback from 9,903 visitors served over the past two years indicates that the visitor appointment system has significantly simplified the entry process. Some media have reported on the campus's refined management practices.

3. Case-related Images

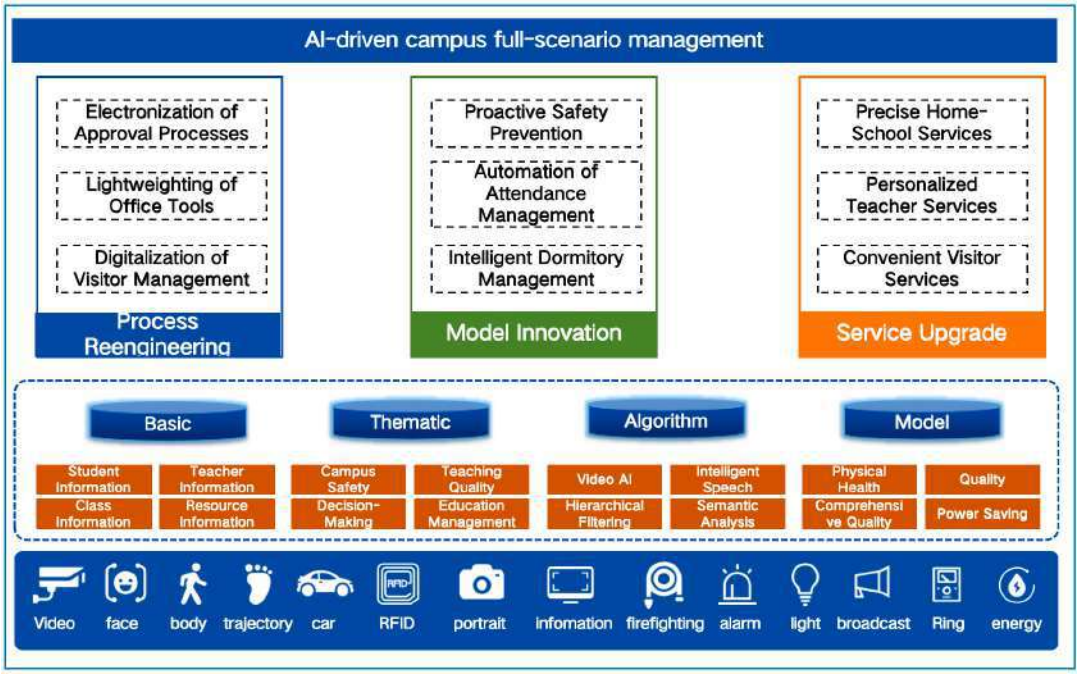

Figure 1 Campus Dynamic Management System Planning

Case 56

AI-Empowered Future Learning: Construction and Practice of a Digital Innovation Knowledge Center

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Case Background

Higher education serves as the vanguard in building a leading nation in education. However, core drivers of high-quality development—such as curriculum architecture, resource allocation, and digital transformation—often suffer from managerial inertia, unscientific decision-making bases, and insufficient resource support. These challenges result in content redundancy and a lack of interdisciplinary integration, rendering traditional pedagogical and administrative models ill-suited for the new era's demand for precise, personalized talent cultivation.

In response, Harbin Institute of Technology (HIT) leverages Artificial Intelligence (AI) as its core driver to construct an autonomous, all-scenario knowledge system characterized by a "university-scale data foundation, full-chain AI empowerment, and personalized training." By integrating teaching resources and visualizing data, HIT is restructuring its disciplinary framework and optimizing curricula. This initiative fosters a virtuous cycle of "Education-Technology-Talent", effectively addressing systemic challenges in talent cultivation and academic management.

Implementation Process

(I) Implementation Steps

Adopting a "Top-Level Design → Tool Development → Service Upgrade → Pilot Deployment" strategy, the project executes a top-down digital reconstruction and AI integration of university-wide teaching resources.

1.Top-Level Planning & Knowledge Graph Construction: Aligned with the goal of cultivating four types of elites—academic masters, engineering giants, industry leaders, and national pillars—the university systematically deconstructs teaching resources from a holistic perspective. Resources are granularized into knowledge points, fully digitized, and visualized to build an autonomous, university-level talent cultivation knowledge graph.

Figure 1 HIT's Digital Innovation Knowledge Center

2.Development of Intelligent Teaching Tools: For faculty, tools for automatic generation of knowledge graphs, lesson plans, and assessment items, alongside learning analytics, have been developed. For students, features include personalized learning path recommendations and intelligent resource alignment. This achieves full-chain AI empowerment in teaching and learning, streamlining administrative tasks and enhancing student autonomy.

Figure 2 AI Tool Library

3.Deployment of Pedagogical Intelligent Agents: Leveraging a million-scale resource knowledge base and mature domestic Large Language Models (LLMs), HIT launched "Ha-xiao-gong," an intelligent Q&A system. It covers high-frequency scenarios such as academic advising, policy interpretation, psychological support, and career pathing, providing dual-path (on/off-campus) intelligent services.

Figure 3 "Ha-xiao-gong" Intelligent Assistant

4.Construction of Panoramic Teaching Spaces: Integrating AI and AR technologies, panoramic teaching spaces bridge digital insights with physical classrooms. Utilizing "glasses-free 3D" and device-agnostic interfaces, these spaces create immersive, virtual-real fused prototypes of future classrooms.

Figure 4 Panoramic Teaching Space

5.Phased Rollout & Pilot Leadership: Deployment proceeds in batches, led by the School of Future Technology and key disciplines. The initiative expands layer-by-layer to achieve full coverage across colleges and majors, with AI models and platform functions continuously optimized based on user feedback.

Figure 5 Knowledge Graph of the School of Future Technology

(II) Technical Architecture

The system integrates NLP, deep learning, and Graph Neural Networks (GNN). Built upon an NLP deep parsing engine and the DeepSeek-R1 LLM, it forms a "University-Level Knowledge Graph + Full-Chain AI Empowerment" technical ecosystem.

Graph Construction: Automates the integration of multi-source textbooks; interdisciplinary knowledge network modeling accuracy exceeds 95%, with LLM-based academic resource extraction error rates <2%.

Pedagogical Empowerment: Identifies interdisciplinary overlaps and analyzes curriculum redundancy, supporting one-click generation of knowledge graphs for diverse resource types.

Intelligent Services: Deploys a dual-path Q&A engine enabling natural language understanding and human-like interaction.

Immersive Integration: Realized via the Unity engine for seamless virtual-real fusion.

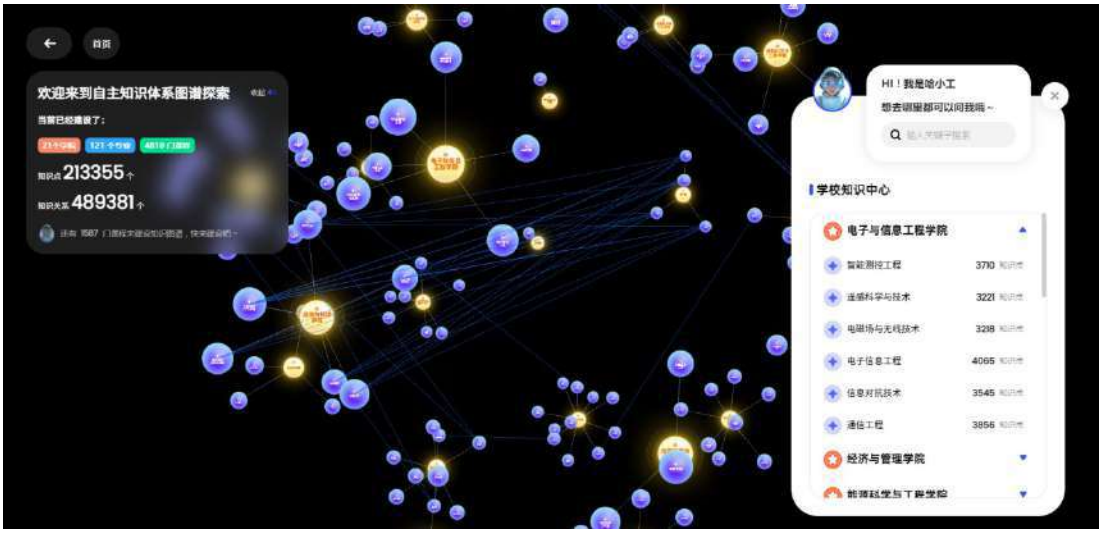

Figure 6 University-Level Knowledge Graph

(III) Timeline

Construction commenced in September 2023. By June 2025, core components were completed, achieving large-scale resource integration and full-chain AI deployment across 20 colleges and 110 majors. All elements of massive teaching resources are now digitized and visualized. The platform continues to undergo iterative optimization of AI models and functional upgrades.

Figure 7 Data Observation Dashboard

Innovation Highlights

(I) Model Innovation: The "Top-Level Design + Intelligent Tools" framework orchestrates data connectivity across disciplines, curricula, and resources. AI-driven analytics provide a scientific basis for optimizing talent strategies and resource layout, preventing redundant construction. An embedded AI knowledge extraction center significantly simplifies graph and database creation, accelerating digital resource development.

(II) Cultivation Innovation: AI empowers pedagogy and personalized learning by embedding the growth logic of four elite talent types into the university knowledge graph, creating an all-scenario intelligent education ecosystem. AI assists faculty in optimizing content by mapping knowledge relationships and identifying redundancies. Furthermore, leveraging learning data, AI customizes "One-Student-One-Strategy" pathways, enhancing cultivation outcomes.

(III) Classroom Innovation: Resources, data, and technologies from the center deeply inform panoramic teaching spaces, creating a "student-centric," immersive, and multi-dimensionally interactive future classroom. This offers a new paradigm for the digital transformation of higher education.

(IV) Technological Innovation: Breakthroughs in automated educational knowledge graph construction enable precise multi-source resource integration and interdisciplinary network modeling. Supported by AI Q&A engines, this facilitates personalized training. A virtuous ecosystem is formed where teaching practice drives AI innovation, which in turn enhances classroom instruction.

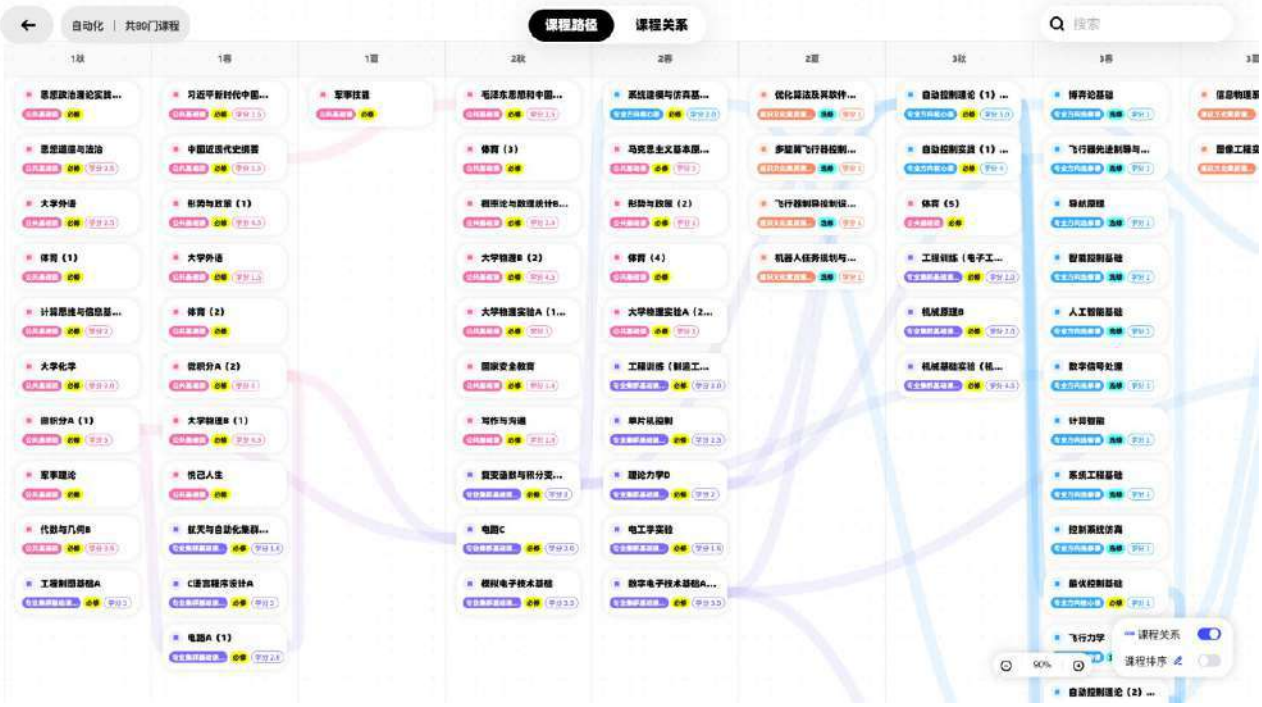

Figure 8 Talent Cultivation Pathways

Promotion Value and Risk Management

(I) Universality and Demonstrative Value

Addressing common pain points in higher education (curriculum design, resource fragmentation, digital lag), the "Data Foundation + AI Empowerment + Personalized Training" model aligns precisely with current reforms in broad-based education and credit systems. Its practices in AI-higher education integration, knowledge graph construction, and intelligent service ecosystems offer a replicable blueprint for domestic universities.

(II) Scalable Promotion Pathways

Knowledge Transfer: Disseminate the core "Design + Tools" model and practical experiences through inter-university seminars and sharing forums.

Technology Export: Provide verified technical frameworks for automated graph construction and AI analytics to reduce development costs for other institutions.

(III) Localized Adaptation Strategies

Universities can tailor knowledge graph dimensions and resource integration priorities to their unique disciplinary strengths. Regional and vocational colleges may prioritize AI empowerment in advantageous disciplines before scaling university-wide, utilizing low-threshold AI tools for efficient adoption.

(IV) Expected Impact

This model optimizes curriculum architecture, enables personalized cultivation via digitalization, and deepens AI application in higher education. It elevates overall teaching quality and the autonomous training of innovative top-tier talents, while driving the smart education industry, thus providing robust support for building a leading education nation.

Risk Mitigation:

Potential risks include IP disputes and data security issues in cross-institutional sharing; algorithmic bias affecting major/course recommendations; and privacy concerns regarding student data mining. To mitigate these, robust regulatory mechanisms must be established to balance innovation with security.

Achievements

The Digital Innovation Knowledge Center has achieved large-scale deployment with significant results.

(I) Core Metrics

As of March 2026, the center has integrated 4,810 courses, over 210,000 knowledge points, and 350,000+ teaching resources, mapping nearly 500,000 knowledge relationships to form a million-node intelligent network. Total student engagement exceeds 2.1 million person-times.

(II) Ecosystem Optimization & Efficiency Gains

AI-driven curriculum optimization and resource consolidation have enabled efficient resource allocation, laying a data foundation for broad-category enrollment and comprehensive credit system reforms. Lesson preparation efficiency for faculty has increased by 50%, while students benefit from precision-resource push mechanisms, significantly boosting self-directed learning and interdisciplinary capabilities.

(III) Recognition & Influence

The case was selected as a "Typical Application Case for Digital Empowerment in High-Quality Education Management" by the Ministry of Education (2025) and a "Typical 'AI + Higher Education' Scenario" by Heilongjiang Province. It received the First Prize for Digital Education Innovation from the China Association for Educational Technology and supported HIT's selection as a pilot university for AI-empowered higher education reform by the Ministry of Education.

Key Words

AI empowerment; higher education; digital innovation knowledge center; knowledge graph; personalized training; educational digitalization; teaching intelligent agent

Case 57

From "Classroom Reform" to "Environment Reconstruction": Hefei Smart Classroom Drives the Practice of Smart Education

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Background

Under the strategic blueprint of "Shaping New Development Advantages through Educational Digitalization" outlined in the "Outline of the Education Power Construction Plan (2024-2035)", the implementation of the National Education Digitalization Strategy has become the core approach to addressing regional educational equity challenges and adapting to educational transformations in the intelligent era. As a key educational hub in the Yangtze River Delta, Hefei City has keenly grasped the pulse of promoting high-quality education development through digitalization. By establishing smart classroom construction as a strategic pivot, the city has initiated systematic innovations spanning from pilot exploration to comprehensive transformation. Through coordinated efforts in hardware, teaching, management, and resource integration, Hefei aims to build a sustainable ecosystem featuring multi-stakeholder collaboration, data interoperability, and dynamic resource balance. After over a decade of dedicated efforts, this innovative practice has evolved from "single-point pilots" at three prestigious schools into a city-wide initiative covering 12 counties (cities) and districts, along with municipal schools. This transformative initiative, which began in classrooms but extends beyond them, provides a replicable model for regional smart education development.

Case Implementation Status

1.Demand Analysis

The digital transformation of education in Hefei began with a deep demand analysis of regional educational equity and teaching efficiency. Research identified pain points such as insufficient classroom interaction, delayed learning feedback, and uneven distribution of high-quality resources between urban and rural areas. Consequently, Hefei established a smart education ecosystem

centered on smart classrooms, designed to support large-scale applications, data interoperability, and pedagogical evolution in the intelligent era.

2.Technology R&D and Customization

Hefei implemented an integrated "Cloud-Network-Terminal" R&D strategy, focusing on underlying data governance and scenario-based tool development. At the cloud and data level, leveraging a big data capability engine, it constructed the "One Repository, One Platform, Four Services" system and an educational data warehouse featuring 3 basic databases and 22 thematic databases. This system achieved deep governance and cross-departmental verification of 372 million data assets and 11.3 TB of heterogeneous data, breaking down data silos. Regarding terminals and tool R&D, 10,205 smart classrooms were tailored and deployed for differentiated teaching scenarios, achieving 100% coverage of junior and senior high schools. Meanwhile, addressing personalized needs, "AI Teacher Assistants" were customized and piloted across 230 schools to reduce teacher burden. For student well-being, the "Stress-Relief Planet" platform was developed, integrating AI psychological companions and risk-warning algorithms to provide personalized psychological assessment reports. Furthermore, standardized interface R&D enabled seamless data interconnection between all city-wide terminals and the Hefei Education Cloud.

3. Application Optimization and Iteration

To ensure large-scale effectiveness, Hefei established an optimization mechanism of "Technical Monitoring + Institutional Constraints." The Smart Classroom Supervision Platform was launched to monitor equipment operation and resource usage via real-time dashboards, shortening repair responses to within one hour with a 99.3% closed-loop rate. Based on weekly and monthly data reports, districts are able to optimize teaching strategies targetedly. Data from April 2025 shows a 341% year-on-year increase in sessions per class; this data-driven feedback loop ensures the continuous evolution of the ecosystem from "equipment installation" to "normalized high-quality application."

Case Innovation and Breakthroughs

1. Main Innovation Content

Hefei has achieved a paradigm shift from "unidirectional construction" to "ecosystem reconstruction". In governance, it pioneered a "City-District-School" three-tier linkage system, breaking hierarchical information barriers through specialized workgroups and collaborative research to achieve synergistic governance of regional educational digitalization. In pedagogy, the self-developed "3+X" smart teaching model, which won the provincial First Prize for Teaching Achievement, has facilitated a deep transformation from "knowledge infusion" to "core competency cultivation" by reshaping pre-class, in-class, and post-class processes. Furthermore, Hefei utilized LLM technology to create AI agents such as "dialogues with virtual historical figures," leading new interactive teaching forms in the intelligent era.

2. Technology Breakthrough Content

The core technological breakthroughs lie in overcoming regional educational data silos through an underlying big data engine that enables precision scheduling and targeted services for heterogeneous data. In operational technology, the innovatively developed Smart Classroom Supervision Platform reconstructs traditional "passive reporting" into a digital proactive governance system with second-level visualization of device status. Furthermore, standardized interface R&D ensures seamless data

interconnection across all city-wide terminals, providing a robust technical foundation for large-scale smart education applications.

3. Application Practice Breakthrough Content

A synergistic "Cloud-Network-Device" strategy establishing a regional smart teaching infrastructure, enabling standardized deployment across 10,000+ smart classrooms with 440,000+ interconnected terminals;An innovative intelligent supervision platform that dramatically enhances operational efficiency (1-hour repair response, 99.3% resolution rate) while driving balanced application ecosystem development;Pioneering large-scale piloting of generative AI teaching assistants (230 schools/3,400+ teachers) to reconstruct pedagogical models and enable precision teacher development;Systematic dismantling of urban-rural educational barriers—featuring China's first tri-level "Dual-Teacher Classroom" for targeted resource delivery (designated Ministry of Education exemplary case), an MoE-certified Smart Sports Community enabling training-assessment closed loops, and a knowledge-graph-driven ubiquitous learning platform supporting autonomous learning (91 schools);Concurrent development of scenario-based innovations including AI psychological intervention and Five-Domain education integration. Collectively, these form a replicable paradigm for regional educational digitization—advancing from smart infrastructure to ecosystem reconstruction.

Case Innovation and Breakthroughs

1. Application Achievements and Prospects

Hefei has achieved full coverage of smart classrooms in secondary education, establishing standardized construction and management systems with continuously increasing application activity, marking a transition from "hardware coverage" to "routine high-quality application". Through tiered training programs like the "Innovative Integration Workshop" and "Digital Education Management Training Program", the city systematically enhances teachers 'digital literacy and cultivates a group of digital teaching pioneers, earning high recognition in the Ministry of Education's pilot evaluation for AI-assisted teacher team development.Through synchronous teaching research mechanisms, premium resources from urban elite schools are precisely delivered to rural schools.Meanwhile, nearly 100 schools have implemented home-based self-directed learning during winter and summer vacations, engaging tens of thousands of students. The "Stress Relief Planet" smart mental health platform has cumulatively served hundreds of thousands of self-assessment and stress-relief services, while integrated practices like smart sports and cross-temporal moral education effectively promote students 'physical and mental health and comprehensive development. Looking ahead, Hefei will deepen the integration of generative AI with teaching, expand AI teacher assistant pilots, and cultivate core forces for human-machine collaborative innovation. The city will further build a full-scenario smart education ecosystem, promoting data interoperability in teaching, management, and evaluation to empower modern educational governance. Simultaneously, it will continue refining the "Hefei Model" through hosting national conferences, participating in national-level research projects, and establishing partnerships with sister cities, radiating Hefei's experience nationwide and contributing regional strength to the national education digitalization strategy.

2. Social and Economic Value

This case facilitates the precise accumulation and cross-district sharing of high-quality resources, effectively narrowing the urban-rural educational gap and significantly enhancing equity. Regarding

governance efficiency, the online enrollment system has served over 220,000 people, fulfilling the social value of "letting data do the walking while citizens do less running". Additionally, digital supervision reduced equipment repair response times to within one hour, drastically lowering the human and time costs of IT maintenance and increasing the marginal utility of financial investments.

3. Demonstration and Leading Role

As a pilot zone for the Ministry of Education's AI-boosted teacher development, Hefei represents an industry-leading level in AIGC applications, big data governance, and digital literacy training (e.g., "Fusion Innovation Workshops"). Its "City-District-School" linkage mechanism provides a replicable model for large and medium-sized cities. Having showcased its achievements at high-level conferences like the World Digital Education Conference, Hefei leads the evolution of basic education from "technology empowerment" to "systematic reconstruction".

4. Potential Risks

(1)Technical and Ethical Risks: Issues regarding data privacy and algorithmic bias in Generative AI applications; (2) Digital Divide: Potential lags in the development of digital habits among teachers in later-developing regions; (3) Data Ethics: Challenges in protecting student privacy and defining data ownership during large-scale data collection.

Hefei is actively addressing these through digital ethical standards and dynamic evaluation feedback mechanisms.

Other Relevant Information

Case Award Status:

2025: The achievement "From 'Classroom Transformation' to 'Environmental Reshaping': Hefei's Practice of Driven Smart Education Ecosystem through Smart Classrooms" was honored as a 2025 Outstanding Case in Smart Education (National Level).

Awarding Institutions: Global Smart Education Alliance (GSEA), Organizing Committee of the Global Smart Education Conference, and the Ministry of Education's Strategic Research Bases for Educational Informatization (Beijing, Central China, Northwest).

Figure 1 "City-District-School" three-tier linkage system

Case 58

FAITH: Enhancing Educational Effectiveness and Efficiency through AI-empowered Free and Online Tools

Chenggui Duan

Hong Kong Metropolitan University, Hong Kong, China

Background

The global adoption of Artificial Intelligence (AI) presents a unique opportunity to revolutionize educational processes by providing personalized learning experiences and augmenting pedagogical content. However, the integration of AI in higher education faces significant challenges. A primary pain point is the digital literacy gap among teaching staff and students, which impedes the effective utilization of emerging technologies. Recent data indicates that despite high individual usage among students, ranging from 86% to 92% (Digital Education Council, 2024; Freeman, 2025), formal institutional readiness remains critically low. Most significantly, 70% of teachers have not received any formal training on how to use AI in the classroom (Langreo, 2024), leaving a vast majority unprepared to guide students through this technological transformation. Furthermore, while AI-driven educational tools are increasingly available, there is a profound lack of awareness and understanding regarding their practical application. Educators and learners often experience "Tool Anxiety"—the overwhelming pressure to constantly adopt new applications without a clear pedagogical strategy, leading to fragmented workflows and subscription fatigue.

Additionally, the absence of a centralized platform for sharing resources, best practices, and experiences creates silos of knowledge, hindering collaboration. There is also a critical deficiency in targeted training and ongoing support to help users navigate the complexities of AI-assisted learning.

To address these challenges, Hong Kong Metropolitan University (HKMU) initiated the project "Enhancing educational effectiveness and efficiency through AI-empowered free and online tools," funded by the Quality Enhancement Support Scheme (QESS) of the Hong Kong Education Bureau. The objective is to create a vibrant, adaptive community of practice that leverages free, AI-empowered open educational tools. By establishing a comprehensive, one-stop platform and providing structured training, the project aims to bridge the digital divide, shift the focus from "Tool Anxiety" to "Skill Empowerment," and ultimately enhance the overall learning experience and teaching efficiency in higher education.

Case Implementation Status

The implementation of this project has been a comprehensive, multi-phased endeavor encompassing demand analysis, technological development, personalized customization, and continuous application optimization.

1. Demand Analysis and Strategic Planning

The project commenced in September 2024 with a thorough needs assessment to identify the specific requirements and challenges faced by students and teaching staff at HKMU. This assessment informed the design of a user-friendly, centralized platform tailored to the unique academic environment. The core philosophy adopted was "workflows over widgets"—prioritizing the underlying educational tasks and skills over the mere acquisition of technological novelties. The project team conducted regular weekly meetings throughout the entire project period, covering user interface design, functionality requirements, technical specifications, and the careful selection of AI-empowered educational tools.

2. Technology Research and Platform Development

Based on the needs assessment, the project team developed and deployed the FAITH (Free AI Tools Hub) platform (https://www.hkmu.edu.hk/oetools/), which was officially launched on 20 June 2025 at the International Conference on Enhancing Lifelong Education and Building Learning Societies through Digitalization (CELEBLS) to an audience of over 200 international attendees in Guangzhou. The platform serves as a dynamic repository, currently hosting 108 carefully curated, AI-powered open educational tools. These tools are systematically categorized into areas such as Academic Research, Document Processing, Efficiency Enhancement, Instructional Design, Intelligent Writing, Knowledge Management, Language Learning, and Multimedia Processing. To enhance user experience, the platform integrates intelligent search capabilities, smart category filtering, and an AI-powered OETools Chatbot that provides personalized tool recommendations based on user needs. A weekly "AI in Education" news section has been active since June 2025, and a Resources Hub provides curated learning materials created by the project team.

During the needs analysis and initial development stage, the project team identified four key challenges in foundational university mathematics courses: the difficulty of making knowledge structures explicit, the difficulty of tracing proof strategies, the difficulty of identifying individual differences, and the difficulty for instructors to provide scalable feedback.

To address these issues, AI4Math team systematically organized years of accumulated resources from the School of Mathematical Sciences, including textbook commentaries, lecture notes, and structured learning materials. AI4Math team also incorporated peer tutoring experience and transformed these resources into data usable by intelligent agents. Since 2024, the project has explored online problem banks and tutoring systems within the university. In 2025, building on the award-winning multi-agent workflow project in the competition of AI application held in Fudan, the platform was integrated into the university's eHall system. This provided a direct prototype and operational experience for real-world deployment. In the same year, the project was officially funded by the Center for AI in Education Innovation in Fudan.

Figure 1 Keynote Speech at the International Conference on Enhancing Lifelong Education and Building Learning Societies through Digitalization, 20 June 2025

3. Personalized Customization: The AI Agents

Recognizing that generic tools often fail to address highly specific educational scenarios, the project team achieved a major technological milestone by developing a suite of 15 customized AI-empowered agents/tools. These agents/tools are designed to assist educators and learners in creating teaching and learning materials with unprecedented speed and quality. In the realm of audio and multimedia, the Intelligent Podcast Creator and Multilingual Podcast Generator transform text into engaging podcasts with virtual hosts across 40 languages, while the Dynamic Conversation Builder generates immersive 2-3 minute audio discussions. For assessment and interactive learning, the Smart Quiz Generator and Magic H5P Creator automatically extract keywords to build interactive exercises exportable as SCORM packages or standalone HTML, and the AI Assessment Assistant parses student PDF essays against custom rubrics to generate comprehensive class analytics and individual feedback. Language and translation needs are met by the Cross-Region Chinese Convertor, the Master of Mandarin Phonology, and the Term Based Translator. Finally, visual and study aids include the Interactive Mind Map Designer, Matching Card Creator, and dedicated English and Mandarin Flashcard Generators.

4. Application Optimization and Capacity Building

To ensure successful adoption and maximize impact, the project implemented a robust capacity-building framework. A total of 15 targeted training workshops and conference sessions (online and on site) were conducted from October 2024 to March 2026, reaching over 1000 participants. These

sessions covered highly practical topics, including “Unlocking AI’s superpower: Prompts are magic spells!”, “Building Your Custom AI Agents with Coze”, and utilizing AI for multilingual translation. To document and share successful implementations, the team conducted 13 in-depth interview meetings with 9 teaching staff across 5 different academic schools at HKMU, resulting in seven published case studies highlighting best practices in curriculum integration. The project also developed an asynchronous online course titled “AI Essentials for Learning & Teaching,” hosted on a self-hosted Learning Management System, which awards a digital badge upon the successful completion of eight module quizzes. The culmination of this optimization phase was the publication of the comprehensive academic book, “Let AI Empower Your Learning and Teaching: A Practical Guide to 101 Tools”. This 400-page guide synthesizes the project’s findings, offering a structured approach to building personal AI toolkits.

Case Innovation and Breakthroughs

1. Main Innovation Content: Pedagogical Paradigm Shift

The primary innovation of this project lies in its profound pedagogical approach to AI integration in higher education. The project innovates by solving the absence of a centralized platform that traditionally creates silos of knowledge. It establishes a one-stop dynamic platform that consolidates major open educational tools for university students and staff. This approach aligns with international frameworks for “Opening Up Education,” which advocate for institutional support to enhance access and transparency (Inamorato dos Santos et al., 2016). Furthermore, by prioritizing free and open-source software (FOSS), the project addresses a critical gap in higher education development, providing pedagogical flexibility without the constraints of high-cost licensing (Duan & Lee, 2022).

Rather than focusing solely on the technological capabilities of AI, the project champions a paradigm shift from “Tool Anxiety” to “Skill Empowerment.” It introduces a task-oriented framework encapsulated by the motto: “Start with the Task, Not the Tool.” By prioritizing “workflows over widgets,” the project empowers educators to become active architects of their productivity systems, ensuring that AI serves as an amplifier for human curiosity, creativity, and critical thought. By combining this repository with an asynchronous online course and active case study documentation, the project fosters a culture of innovation essential for adopting novel teaching strategies.

2. Technology Breakthrough Content: Customized Educational AI Agents

While the FAITH repository successfully aggregates existing tools, the most significant technological breakthrough is the in-house development of the 15 customized AI Agents. Unlike generic AI chatbots, these customized tools directly address specific pedagogical needs—such as generating quizzes or mapping knowledge—significantly lowering the technical barrier for educators attempting to integrate AI into their curriculum. These agents represent a high level of technical integration, seamlessly combining Large Language Models (LLMs), Optical Character Recognition (OCR), Text-to-Speech (TTS), and interactive content generation frameworks into single, user-friendly interfaces tailored specifically for complex academic workflows. For instance, the AI Assessment Assistant automates the highly nuanced task of evaluating PDF essays against specific rubrics, generating both individual feedback and comprehensive class analytics. The Term Based Translator synergizes customizable LLMs with dynamic terminology management, featuring context-aware glossary injections. Furthermore, the platform itself utilizes personalized AI learning recommendations and adaptive content delivery to enhance the user experience.

3. Application Practice Breakthrough Content: Democratizing AI Access

A major breakthrough in application practice is the project's unwavering commitment to democratizing AI access through free and open educational tools. The project bridges the digital divide by teaching the "What, Why, and How" of applying different AI-enabled open educational tools. By meticulously selecting and promoting tools that do not require expensive premium subscriptions, the project actively combats the "subscription fatigue" commonly experienced by students and institutions. The successful implementation of these tools across five distinct academic schools at HKMU demonstrates their immense versatility. By publishing seven real-world case studies detailing how teaching staff utilize these tools across different academic disciplines, the project provides proven, replicable blueprints for pedagogical transformation. This ensures that the knowledge generated is highly transferable and actionable for other institutions seeking to undertake similar digital transformation initiatives.

4. Intellectual Property Status

The intellectual property generated includes the design and architecture of the centralized AI platform, the comprehensive learning materials from the training workshops, the curriculum of the "AI Essentials" online course, and the proprietary configurations of the customized AI agents developed by the HKMU project team.

Promotion Value and Risks

1. Application Prospects and Achievements

The project has achieved significant scale and depth. It directly benefits over 19,000 students and 1,400 staff members at HKMU. Furthermore, because the platform focuses on free and open tools, it is accessible to the broader academic community, with an estimated reach of over 10,000 students from other self-financing higher education institutions in Hong Kong, bringing the total number of potential beneficiaries to over 31,000. The operation model is highly sustainable; the platform's maintenance and continuous updates have been integrated into the recurrent expenditure of the HKMU School of Open Learning, ensuring long-term viability without the need for continuous external funding.

2. Social and Economic Value

Economically, the project saves educational institutions and students substantial costs by curating and providing access to free, high-quality AI tools, eliminating the need for expensive software licenses. Socially, it promotes educational equity by ensuring that all learners have access to cutting-edge technologies that enhance learning outcomes. For educators, the customized AI agents drastically reduce the time spent on administrative and material-creation tasks, allowing them to focus on high-value pedagogical interactions and student mentorship.

3. Demonstration and Leading Role

The project serves as a demonstrative model for higher education institutions seeking to integrate AI systematically. The project's outcomes have been widely disseminated at major international conferences, including the International Conference on Enhancing Lifelong Education and Building Learning Societies through Digitalization (CELEBLS), the International Conference on Open and Innovative Education (ICOIE 2025), and the 8th International Conference on Technology in Education (ICTE 2025). It is also highly regarded by visiting delegations, such as scholars from HKUST(Guangzhou) and Guangdong University of Technology.

4. Potential Risks

Ethical and Privacy Risks: The use of AI tools raises concerns about data privacy. The project mitigates this through clear disclaimers on the OETools Chatbot, advising users against inputting personal data.
Academic Integrity Risks: There is a risk of over-reliance on AI for academic assignments. The project addresses this by emphasizing human-AI collaboration, critical thinking, and responsible AI use in its training workshops.
Technical Risks: Potential risks involve technical obsolescence, given the rapid pace of AI development, which necessitates continuous updates to the repository and training materials to ensure relevance. The project's "workflows over widgets" philosophy mitigates this by teaching adaptable skills rather than reliance on specific software.

Other Relevant Information

1. Case Award Status

The project is funded by the Quality Enhancement Support Scheme (QESS) of the Education Bureau of the Hong Kong SAR Government (Project No.: 01/QESS/2024). The project has also been selected for presentation at highly regarded international forums, including the ICTE in Shenzhen, and the 2025 International Conference on Open and Innovative Education (ICOIE).

2. Third-Party Evaluation

The project has garnered positive reception from both industry and academia. It has undergone rigorous monitoring and evaluation by the QESS secretariat. It was invited to share and promote at both Chu Hai College of Higher Education and a TRAE Workshop hosted by ByteDance, highlighting its industry relevance. Additionally, the project's achievements were presented to visiting academic delegations from Hong Kong University of Science and Technology (Guangzhou) and Guangdong University of Technology, demonstrating strong peer interest and validation. The project's research output has been peer-reviewed and accepted at international academic conferences.

3. Case-related Images, Videos, and Other Materials

The following materials are available for reference:

- **Project Main Platform:** https://www.hkmu.edu.hk/oetools/
- **Customized AI Agents Page:** https://www.hkmu.edu.hk/oetools/agent-main-page/
- **Case Studies:** https://www.hkmu.edu.hk/oetools/case-studies/
- **Online Course:** https://oetools.net/
- **Project Publication:** "Let AI Empower Your Learning and Teaching: A Practical Guide to 101 Tools" (ISBN: 978-988-71114-1-2, August 2025): https://www.researchgate.net/publication/395910449_Let_AI_Empower_Your_Learning_and_Teaching_A_Practical_Guide_to_101_Tools
- **Workshop posters and activity photos** have been attached in the Appendix.

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Appendix

「AI引領智慧學習」
系列工作坊
"AI EMPOWERED SMART LEARNING" WORKSHOP SERIES
刪繁就簡：從聲影圖洪流中提取文字
From Anything to Text: Turning Voice, Video, and Images into Usable Words
2026-01-16 I 7:00 - 8:00 pm I 廣東話 Cantonese I ZOOM
工具包括 Tools include:
Tongyi Tingwu, Buzz Captions, OLMOCR, Microsoft Snipping Tool, etc.
師從AI：激發創意與培養批判性思維
Learn from AI: Unlocking Creativity and Critical Thinking
2026-02-06 I 7:00 - 8:00 pm I 英語 English I ZOOM
內容 Highlights:
探索 AI 如何重塑教育，推動創新與批判思維
Discover how AI transforms education through innovation and critical thinking
從靈感到論文：AI如何助力你的學術通關之路
From Idea to Paper: How AI Empowers Academic Success for Every Student
2026-03-06 I 7:00 - 8:00 pm I 普通話 Putonghua I ZOOM
內容 Highlights:
探索 AI 在教育研究中的雙重角色與未來趨勢
Explore AI's dual role in education research and its future integration trends
氛圍編碼入門
Introduction to Vibe Coding
2026-04-09 I 7:00 - 8:00 pm I 廣東話 Cantonese I ZOOM
工具包括 Tools include:
Trae, Cursor, etc.
講者 Speaker
翟雪松 教授
Professor ZHAI Xuesong
浙江大學教育學院研究員, 博士生導師
科學與技術教育學位點負責人
Senior Researcher and Doctoral Supervisor
Chair of Science and Technology Education
Zhejiang University
史丹佛2%頂尖科學家
Stanford's Top 2% Scientists
開放予公眾參加
Open to the public
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Register now
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Case 59

Case Study on AI-Empowered Rural Education Practices

HongBin He, JianCai Mao

Kaihua County Educational Technology Center

Problem Background

Kaihua County is located at the junction of three provinces (Zhejiang, Anhui, and Jiangxi). The county's terrain is dominated by mountains and hills, resulting in a school distribution pattern described as "many sites, long distances, and wide coverage." Among the county's 36 primary and secondary schools, there are 7 small rural schools with fewer than 100 students, and 5 schools with 100–200 students, accounting for 35.29% of all schools. These schools have long faced systemic challenges: structural teacher shortages, inability to offer a full range of courses, lack of high-quality resources, and weak support for teacher professional development. In terms of teacher structure, young teachers under 35 account for over 50%, while experienced teachers aged 40-49 make up only 16.5%; more than 50% hold junior professional titles; teachers of Chinese, mathematics, English, and science constitute 67.24%, leading to severe shortages in other subjects. Traditional approaches such as teacher recruitment and hardware investment alone cannot resolve these issues, hindering the balanced urban-rural development of county education.

Implementation Process

Kaihua County has established a "1+2+N" overarching framework:1specialized education network (10 Gbps to schools, 1 Gbps to classrooms, full wireless coverage, IPv4/IPv6 dual-stack);2 resource platforms (the "Smart Education Of China" and the "Zhijianghui Internet School"); and N AI-enabled scenarios (covering AI teaching, teaching research, sports, listening and speaking, reading, etc.). The county has made AI education a "top-priority" project, empowering localized curriculum development, boundless learning, and specialized teacher training.

(I) Strengthening Top-Level Design

Four major support systems have been built: organizational guarantee, digital resources, policy guidance, and funding guarantee. A dedicated task force was established to form a closed-loop mechanism of "list-based implementation and phased evaluation." Localized AI resource packages were procured and developed, and a "seed teacher" training program was implemented. In 2025, a

special fund of over 4 million yuan was allocated, leading to the procurement of 574 intelligent mobile terminals and the establishment of 5 AI competition venues, 4 smart sports venues, 10 AI evidence-based teaching research spaces, 12 oral language spaces, among others.

(II) Strengthening the Digital Backbone

With the "Zhijianghui Internet School + Education Cube" as the central backbone and the "Qianjiangyuan Digital School" as the hub, various platforms and applications are integrated. AI empowerment is manifested in the following four scenarios.

1. AI-Empowered "Boundless" Learning

Majin Town Junior High School has established regular two-teacher classes with Hangzhou Entel Foreign Language School. Relying on 5G and Zhejiang University's "Metaverse Platform," the school comprehensively uses large language models such as DeepSeek and Doubao to assist lesson preparation and answer questions, together with iFlytek's oral language devices and Xuehai Technology's resources. Each semester, 12 live interactive classes are conducted between rural students and urban foreign teachers. Experiments show that students' English scores increased by an average of 6.64 points, with significant progress in pronunciation, vocabulary, and expressive skills. The precision teaching platform has been deployed in all seven schools with fewer than 100 students and two teaching sites. Through "teacher-device-student three-way interaction," the platform enables intelligent lesson preparation (time reduced from 2 hours to 40 minutes), AI learning companions (e.g., a mathematics underachiever practicing 15 minutes daily raised his score from 53 to 78), intelligent homework grading (time reduced by 60%), and knowledge graph diagnosis (as shown in Figures 1 and 2).

Figure 1 Interacting via the metaverse

Figure 2 teacher-device-student three-way interaction

2. AI-Empowered "Localized" Curriculum Development

Local cultural resources such as tea, bamboo, and root carving have been integrated to develop six AI-assisted courses (see Figures 3 and 4). Qixi Town Central Primary School uses AI image recognition: students take photos of tea garden pests and diseases, and the system instantly provides prevention and control knowledge. Tongcun Town Central Primary School has turned bamboo weaving craftsmanship into an AI interactive micro-course. To address the shortage of physical education teachers in rural schools, four low-cost smart sports venues have been built: using ordinary cameras combined with AI algorithms, automatic counting and movement evaluation (e.g., rope skipping, standing long jump) are achieved; the system also customizes exercise plans based on students' physical fitness data. Students train in groups according to AI schedules, and the morning exercise

participation rate increased from 62% to 91%.

Figure 3 Localized Tea Culture Curriculum

Figure 4 Localized Root Carving Culture Curriculum

3. AI-Empowered Specialized Teacher Training

Ten AI evidence-based teaching research spaces have been built, covering all small schools. The system collects classroom data on teacher-student behavior and verbal interaction to generate analytical reports covering dimensions such as question types and response distribution. For example, a new teacher discovered from a report that low-order questions accounted for a high proportion and that she tended to ask front-row students. After two rounds of lesson polishing, these problems were significantly improved. A dual “AI + human” evaluation mechanism has been established: each public

lesson is first scored by AI with improvement suggestions, then reviewed by a teaching researcher. From the second half of 2025, a total of 114 lessons were analyzed and 158 improvement plans were formed. A quarterly county-level teaching big-data report is generated; for instance, when it was found that “student autonomous inquiry time averaged less than 5 minutes,” specialized training was organized (see Figure 5).

Figure 5 Evidence-Based Teaching Research

4. AI-Empowered Evaluation System Upgrade

A three-dimensional digital-intelligent evaluation system covering students, teachers, and schools has been built. At the student level, a full-process digital profile and personalized growth portfolio are established; the system automatically matches and recommends suitable competitions or science-innovation activities based on the profile. At the teacher level, a professional development digital portfolio is created, incorporating indicators such as digital literacy and teaching effectiveness; quantitative assessment and title evaluation are conducted based on the profile. At the school level, “one school, one report; one year, one profile” is realized, allowing the education bureau to generate development radar charts and allocate resources precisely (see Figure 6).

Figure 6 School AI Application Data

Adhering to a People-Centered Approach

The initiative promotes a shift for teachers from “being able to use” technology to “using it wisely,” and for students from “learning to pass exams” to “learning how to learn.” In the second half of 2025, 24 AI application training sessions, 2 competitions, and 3 teaching evaluations were organized. In January 2026, a public demonstration class using intelligent teaching terminals was held for small county schools, covering four subjects with all seven small schools participating. In April 2026, the collection and selection of 100 exemplary AI-empowered lessons were completed among all teachers in the county.

Innovation Highlights

1.Systematic Architecture: The “1+2+N” framework enables systematic deployment from infrastructure to application services.

2.Three Empowerment Pathways: AI empowers localized curriculum, boundless learning, and specialized teacher training.

3.Human-Machine Collaboration Mechanism: The “teacher-device-student three-way interaction” smart classroom enables AI teaching assistants and AI learning companions to work together.

4.Evidence-Based Teaching Research Model: The “AI + human” dual evaluation mechanism uses data-driven approaches to solve rural teaching research problems.

5.Evaluation System Upgrade: The three-dimensional digital-intelligent evaluation system leverages evaluation reform to drive educational transformation.

Case Outcomes

In May 2025, the county’s AI-empowered rural education initiative was approved as a provincial pilot project. A case study submitted by the county’s Educational Technology Center was shortlisted as a key cultivation case for typical digital education application scenarios in the Zhejiang Provincial Education System. It is planned to be included in the*Zhejiang Provincial Digital Education Development Blue Paperand* received recognition from provincial party committee and government leaders.

A first prize was won in the provincial “Zhijiang Good Classroom” competition. In various AI competitions, students from Kaihua secured over 70 awards at national, provincial, and municipal levels, of which more than 80% of the award-winning students came from small rural schools. Related cases from Daxibian Township Central School, Tongcun Town Central Primary School, and Chengdong Primary School were respectively selected as provincial typical application cases. The Zhejiang Provincial Promotion Conference on AI-Empowered Development of Small Schools was held in Kaihua, and multiple provincial media outlets reported on the county’s practices.

Scalability

This case addresses common pain points prevalent in mountainous, remote, and rural small schools, offering wide adaptability. A replicable “1+2+N” framework, three empowerment pathways, human-machine collaboration model, AI evidence-based teaching research mechanism, and digital-intelligent evaluation system have been formed. Dissemination pathways cover four levels: policy, technology,

teaching research, and evaluation. Other regions can flexibly adjust the framework configuration based on local conditions, prioritize 1-2 typical scenarios for pilot implementation, and then gradually expand. Expected outcomes include effectively alleviating structural teacher shortages in small rural schools, improving course quality and teaching efficiency, and narrowing the urban-rural education gap.

Case 60

School-Based Path to Digital Empowerment for Classroom Quality Improvement

Li Qiong

No.6 Middle School of Yichang, Hubei, China

Background

Focus on elaborating on the pain points or key issues in the education field that are addressed, and briefly introduce the necessity and implementation objectives.

Under the global digital transformation of education and China's "Double Reduction" policy, middle schools face three core challenges: insufficient precise teaching, shallow student engagement, and disconnection between technology and teaching. Traditional teaching relies on experience, making it hard to grasp real-time student differences and carry out differentiated instruction. Digital tools are often used for superficial interaction without stimulating deep thinking. Teachers lack systematic strategies to integrate technology into teaching objectives, processes and assessment.

To solve these problems, Yichang No.6 Middle School launched a systematic teaching improvement project in 2025, supported by the municipal research project Research on Strategies for Improving Classroom Teaching Quality Through Digital Empowerment. Guided by integration, optimization and deepening, the school aims to build a sustainable, classroom-centered digital empowerment path, realize data-driven precise teaching, enhance learning experience, promote teacher development, and boost high-quality basic education.

Case Implementation Status

Including but not limited to the exploratory practices carried out in aspects such as demand analysis, technology research and development or personalized customization, and application optimization. Text and pictures can be used together for better illustration.

1. Demand Analysis

The school carried out teaching diagnosis on the basis of evidence-based teaching practice and confirmed three core demands: improving teaching precision with data, enhancing deep student engagement, and integrating technology and teaching organically. It established an evidence-based evaluation system focusing on student engagement, learning situation mastery and competencies attainment (the “Three Degrees”).

Figure 1 Evidence-based Classroom Feedback Reports

Figure 2 School Academic Monitoring Platform

2. Top-Level Design and Mechanism

A project team composed of school leaders, teaching researchers, subject leaders and IT teachers was

set up, adopting a dual-line strategy: school-level institutional construction and teacher classroom practice innovation. The school integrated smart platforms, national smart education resources and subject digital tools to build a shared school-based resource library.

Figure 3 School's platform on lesson preparation

3. Hierarchical Classroom Practice

- **Science subjects**: Data-driven precise teaching using platform data for error analysis, targeted micro-lessons and layered instruction.

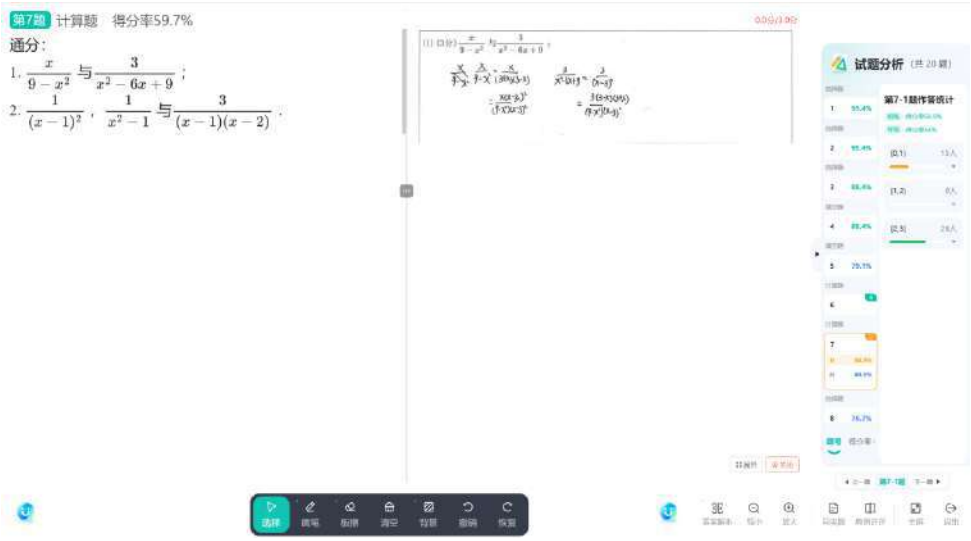

Figure 4 Real-time feedback on students' exercises in class

Figure 5 Real-time feedback on students' exercises after class which helps teachers with precise teaching

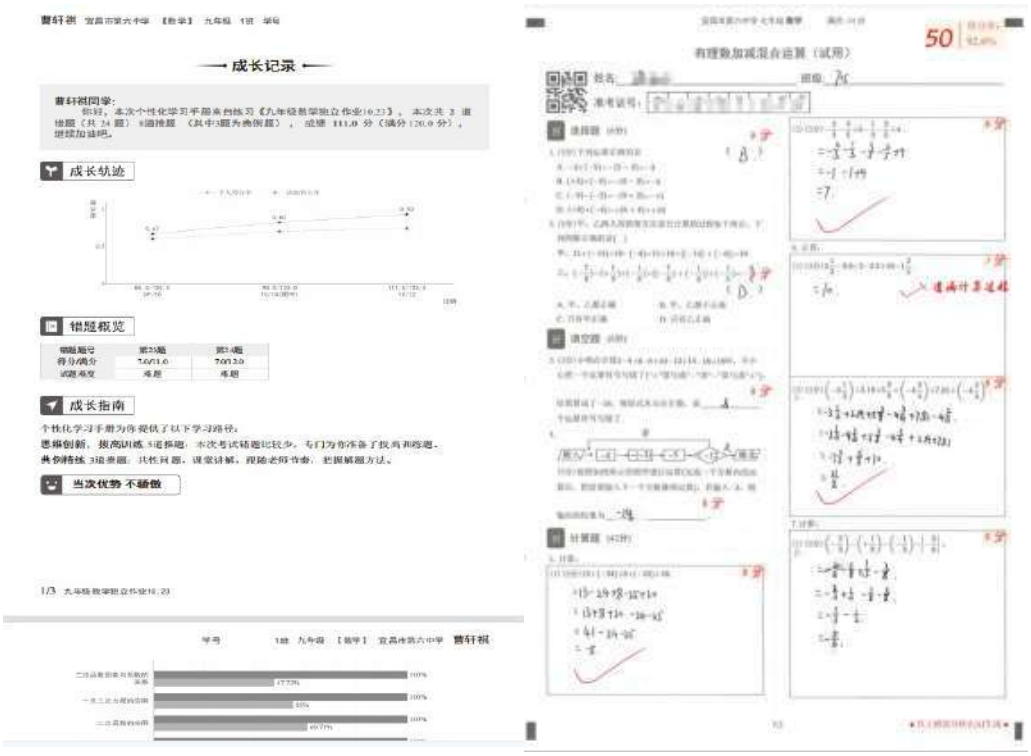

Figure 6 Student's personalized learning which makes growth visible

- **Humanities subjects**: Tool-integrated deep learning with digital maps, dynamic timelines, mind maps and real-time interactive tools.

Figure 7 Student's digital painting exhibition

Figure 8 Student's mind map

- **Interdisciplinary learning:** Project-based inquiry including *Digital ID Cards for Campus Plants*, *Historical Relics Speak* and *Study Tour Route Design*.

Figure 9 Courses developed by teachers on interdisciplinary learning

Figure 9 Student's Works: Digital ID Card for Campus Plants

Figure 10 Course developed by teachers: 3D Campus Modeling, which involves technology, math and geography learning

4. Teacher Development and Application Optimization

The school carried out regular digital teaching research and established a Digital Teaching Innovation Workshop. Practical tools such as GeoGebra, Seewo Whiteboard, AI video generation, VR scenes and virtual experiments were shared. Teachers implement closed-loop lesson study: design – practice – observation – discussion – improvement, and turn practical problems into small research projects.

Shared Tools	Application Scenarios	Shared By
Wuxiang	Generate visualization videos	Liu Yangjun
How to generate videos from text using Doubao + Jianying	Classroom teaching	Xu Jing
AI Science Experiments of the Central Library of the National Smart Education Platform	Experimental class teaching	Ma Xiaoli
Basic operations of Geogebra	Mathematics and physics drawing	Wu Yuhui
Seewo Whiteboard	Classroom teaching	Li Yang
Mind map editing, AI table making	Classroom application, data collection	Chen Wenjing
Importing VR scenes into Seewo Whiteboard	Classroom teaching	Wang Qin
AI-generated mind maps	Intelligent lesson preparation	Xie Jianhao
How to generate VR scene videos using Doubao and Jimeng	Classroom application	Shi Chen
VR applications of the National Smart Education Platform, AI-generated PPT, development of web-based mini-programs	Classroom teaching, experimental interaction, conference participation, etc.	Ma Xiaoli

Figure 11 Some presentations by teachers

5. Ethics and Management

Student data privacy is strictly protected. Technology is used appropriately and educationally. Digital teaching performance is included in teacher assessment to ensure stable and standardized implementation.

Case Innovation and Breakthroughs

1. Main Innovation Content: Focus on introducing the innovations in educational and teaching models, technology application, and other related aspects.

Concept innovation: Transforming from “technology application” to “ecological empowerment”, building a complete digital teaching ecosystem.

Path innovation: Integrating research, teaching and teaching research to ensure practice-oriented sustainable improvement.

Strategy innovation: Creating a differentiated practice model: popularization in Grade 7, deepening in Grade 8, efficiency in review lessons for Grade 9.

2. Technology Breakthrough Content (If Any): Specify what kind of technological breakthroughs have been achieved, the significance and value of these technological breakthroughs for educational informatization and digital transformation, and the technical level of the case in the industry.

The case focuses on scenario-driven integrated application using mature AI and digital tools, realizing intelligent learning diagnosis, precise assignment, virtual experiments, immersive scenarios and real-time feedback. It breaks through limitations of traditional experiments, microscopic knowledge

teaching and basic knowledge review. This model is at an advanced practical level in digital empowerment with low cost and high replicability.

3.Application Practice Breakthrough Content: Clarify the breakthroughs made in application practices, and their significance and value for the development of domestic basic education.
It realizes data-driven precise teaching and personalized learning in large-class settings, solving the long-standing problem of "one-size-fits-all" teaching. Replaceable teaching strategies and tool kits for multiple subjects have been formed, promoting teachers to change from passive users to active innovators. It enhances student initiative, collaboration and creativity, providing a replicable path for digital transformation of basic education under the "Double Reduction" policy.

4.Intellectual Property Status: Provide information about the distribution, ownership, and other relevant details of intellectual property rights.
Based on public digital platforms and open tools. All school-based lesson plans, teaching strategies, tool guides and resource libraries are independently developed and owned by Yichang No.6 Middle School for internal teaching and public welfare promotion. No commercial patents or proprietary intellectual property involved.

Promotion Value and Risks

1.Explain the application prospects of the case or the application achievements already obtained (including but not limited to the current application scale, current depth and breadth of application, operation and management model, large-scale promotion, etc.).

The practice has been fully implemented school-wide with mature models for science, humanities and interdisciplinary subjects. A large number of lesson cases, toolkits and operation mechanisms have been formed, which can be directly promoted in similar middle schools with low cost and strong operability.

2.Illustrate the social and economic value it brings.
It improves teaching quality and efficiency, reduces invalid workload, optimizes student learning experience, and promotes educational equity. It provides a replicable sample for public middle schools to carry out digital transformation without high investment.

3.Elaborate on its demonstration and leading role in the entire basic education field.
It provides a practical path of "research-led, classroom-focused, hierarchical promotion and teaching research-supported" for basic education, leading middle schools to return to the essence of education and realize people-oriented digital empowerment.

4.Identify potential risks such as technical risks and ethical risks that may arise during the application of the case.

Technical risks: Uneven digital literacy among teachers.
Ethical risks: Student data privacy protection.
Sustainability risks: Time guarantee and incentive mechanism need long-term optimization.

The school has established management norms and training systems to effectively control risks.

Other Relevant Information

1. Case Award Status: Include the award time, award name, and awarding institution.
2. Third-Party Evaluation: Present evaluations received by the case regarding its application effects, innovative practices, etc., such as user evaluations, expert review opinions, third-party testing and certification, positive public opinions, etc. (If available, the evaluation subject, information source, and other relevant supporting documents should be specified).
3. Case-related images, videos, and other materials. (Can be attached via cloud drive or provided as separate attachments).

In 2023, our principal was invited by China Education Association For International Exchange to moderate a panel discussion on digital education development among K-12 schools in China and the U.S. in the 24th China annual conference and expo for international education.

第24届中国国际教育年会暨展览 CACIE 2023

基础教育

Basic Education

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中美基础教育数字化发展研讨会
K-12 Schools Dialogue: Digital Education Development in China and the U.S.

时间 2023年10月26日 13:30-17:00
Date & Time 13:30-17:00, October 26, 2023
会议室 311B
Room 311B

数字技术促进教育改革创新是新时代发展的诉求，数字技术与课程内容整合而成的数字化学习模式推动着课堂形式和教学理念等方面的变革。突如其来的疫情，为推动教育数字化变革按下了“快进键”。线上教学、数字课程在疫情期间得到了广泛应用，为实现“停课不停学”做出了积极贡献。后疫情时代，数字技术将持续推动教育数字化变革。

此次研讨会将重点围绕数字技术推动校园管理、课程变革、在线教学、教师数字化能力提升等推动中美基础教育在教育数字化领域交流与对话。

Innovations in digital technology today are driving forces for educational reforms across the world. Integrating technology and curriculum content, a digital learning mode calls for new approaches and conceptual revolutions from classroom teaching to pedagogies. In addition, fast-forwarded by the sudden outbreak of COVID19, online teaching and digital courses have been rapidly developed and implemented, contributing to the "suspension of classroom teaching without interruption of learning", a widely praised practice in China and elsewhere. It is confident to say in the post-epidemic era, digital technology will continue transforming education.

This seminar brings together representatives and experts from K-12 schools in China and the United States for dialogues on digital technology and its impact on various aspects in education, including school management, curriculum development, online teaching, as well as professional development of teachers' digital competences.

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平行论坛一基础教育
CACIE Forums-Basic Education

会议议程
Agenda

13:30 开场致辞 Opening Remarks
主持人：中国教育国际交流协会副秘书长 傅博
Moderator: FU Bo, Deputy Secretary General, China Education Association for International Exchange (CEAIE)
1. 中国教育国际交流协会会长 刘利民
LIU Liming, President, CEAIE
2. 中国教育部国际合作与交流司副司长 陈大立
CHEN Dali, Deputy Director General, Department of Education Cooperation and Exchanges, Ministry of Education, China
3. 美国驻华大使馆新闻文化处公使衔参赞 Mary Sue Fields
Mary Sue Fields, Minister Counsellor for Public Affairs, U.S. Embassy in China
4. 华美协进社高级教育副社长 廖申辰
LIAO Shenzhan, Senior Vice President of Education, China Institute
5. 布鲁克林技术高中校长 David Newman
David Newman, Principal, Brooklyn Technical High School

14:00 主旨发言 Keynote Speeches
主持人：中国教育国际交流协会国际合作司主任 刘轶博
Moderator: LIU Yibo, Director of Department of International Cooperation, CEAIE
1. 北京市教育委员会副主任 王攀
WANG Pan, Deputy Director General, Beijing Municipal Education Commission
2. 纽约市教育局学区长 Rafael Alvarez
Rafael Alvarez, Superintendent, New York City Department of Education
3. 宁波市教育局局长 毛才盛
MAO Caisheng, Director General, Ningbo Education Bureau
4. 纽约市教育局学区长 Hoa Tu
Hoa Tu, Superintendent, New York City Department of Education

14:40 茶歇 Tea Break

15:00 专题研讨（一） Panel Discussion I
数字技术推动课程建设案例分享
Case studies of Digital Technology and Curriculum Development
主持人：湖北省宜昌市第六中学校长 李琼
Moderator: LI Qiong, Principal, No.6 Middle School of Yichang

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Case 61

SJTU AI Hub: A Practical Case of AI-Enabled Integrated Teaching Applications

Shanghai Jiao Tong University, Shanghai, China

Background

Shanghai Jiao Tong University has pioneered the “AI + HI” philosophy for the future of higher education, continuously advancing comprehensive reform in the integration of AI into education and teaching, and focusing on addressing the following challenges:

(1) Separation of teaching spaces and insufficient integration support.

Data from smart classrooms—such as learning behavior, teaching platform resources, and assignment data—remain isolated, forming data silos. The separation of software and hardware functionalities prevents the creation of a closed-loop teaching model.

(2) Fragmented teaching applications with limited service collaboration

Workflows across different systems lack connectivity, and data integration is difficult, making it challenging to conduct multidimensional teaching analysis.

(3) Misaligned teaching scenarios with weak innovation support

Intelligent tools often have low adaptability to real classrooms, with fragmented functions that increase teachers’ workloads and hinder innovation and efficiency in teaching.

To address these issues, the university leverages data as a connector and AI as an engine, integrating smart classrooms with the online teaching management platform to build the SJTU AI Hub—a fully interconnected teaching infrastructure. This initiative breaks spatial barriers, enables data connectivity, integrates various applications, empowers education with AI, and fosters scenario-driven innovation. It provides a demonstrative and scalable model—the “SJTU Paradigm”—for the digital transformation of higher education.

Case Implementation Status

In 2024, Shanghai Jiao Tong University released its "AI + Education and Teaching" action plan, building a complete system from infrastructure to teaching applications, breaking spatial and data barriers,

strengthening online-offline collaboration, and innovating teaching scenarios.

1. Spatial integration: building an integrated online-offline teaching space

1.1 Spatial integration and data connectivity

Classrooms underwent a series of intelligent upgrades, with a focus on building interactive connections with the teaching platform so that the platform becomes an "extension" of the classroom and the classroom becomes the "terminal" of the platform.

1.1.1 Reform of classroom interaction models: reconstructing a three-dimensional "teacher-student-screen" interaction ecosystem

SJTU pioneered a model that integrates five functions into an in-class learning-status interaction screen: learning-status viewing, instant response, preset response, classroom bullet comments, and attendance check-in. Students participate by scanning QR codes, and results are automatically analyzed and displayed. This data-driven, precise, and efficient approach reconstructs the classroom interaction ecosystem.

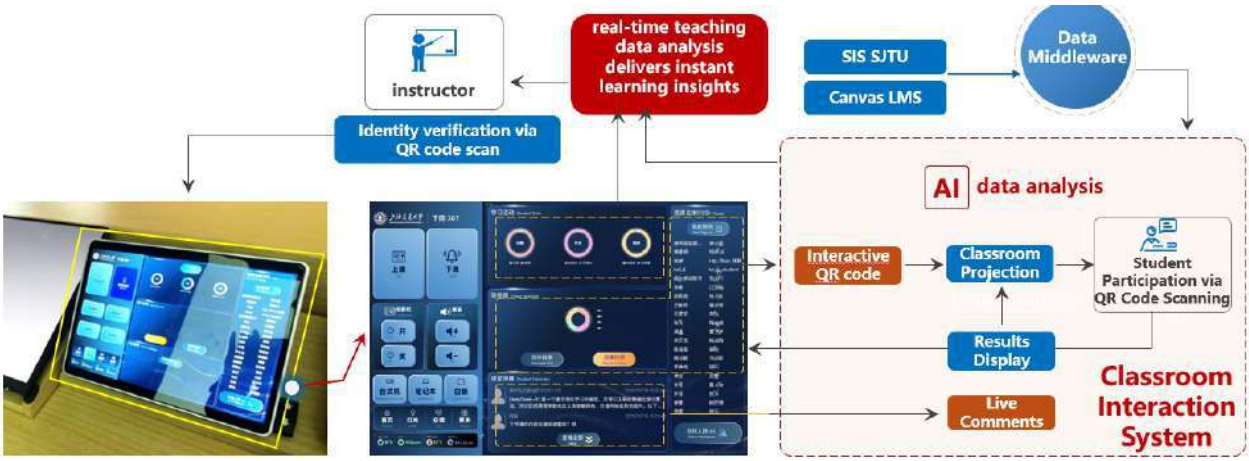

Figure 1 AI Interactive Display Terminal

1.1.2 Multi-dimensional data collection devices: building a "digital twin" classroom

Using intelligent lecture capture, digital blackboards, and other devices, the university collects data from the teaching process. With AIGC-based intelligent parsing, it upgrades resources across structural, semantic, and cognitive dimensions, thereby supporting student learning and feedback as well as teaching-process evaluation.

Figure 2 Intelligent Lecture Video

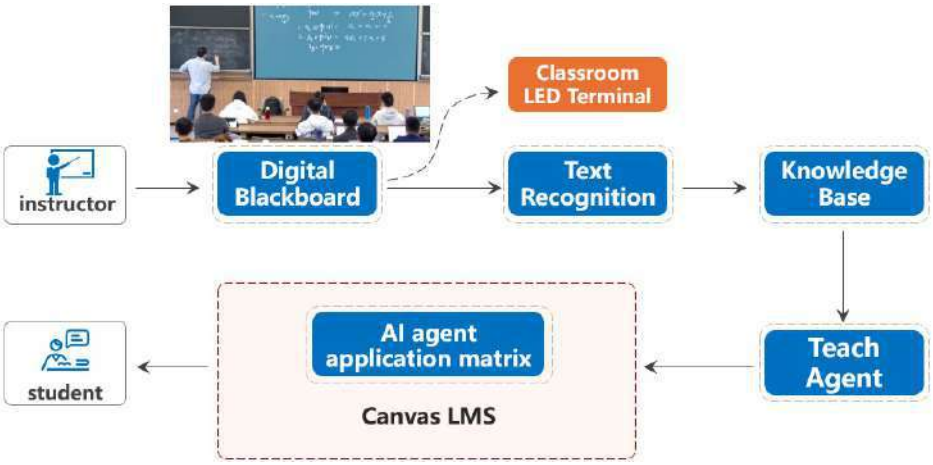

Figure 3 Digital Board Notes

1.2 Application coordination and data empowerment

Through standard protocols, applications such as intelligent lecture capture, classroom interaction, and knowledge graphs are connected to the teaching platform, forming an integrated application ecosystem that enables complementary functions and coordinated business workflows while providing comprehensive support for teaching activities.

Relying on the teaching data middle platform, the university has built a data connection hub spanning the teaching platform, academic affairs system, intelligent lecture capture system, classroom interaction system, and other teaching applications. Through a data gateway, shared data is used to construct a three-in-one data application architecture featuring "data aggregation, intelligent analysis, and shared presentation," providing strong data support for teaching.

2. Intelligent teaching and learning support: a multidimensional matrix

2.1 Intelligent teaching and learning support - application matrix of teaching agents

Relying on an intelligent application development platform, the university has built more than 400 AI+ courses and developed more than 1,000 intelligent agents covering course learning, teaching evaluation, learning management, and more. These agents support intelligent generation of teaching resources, precise analysis of the teaching process, and quantitative evaluation of learning outcomes.

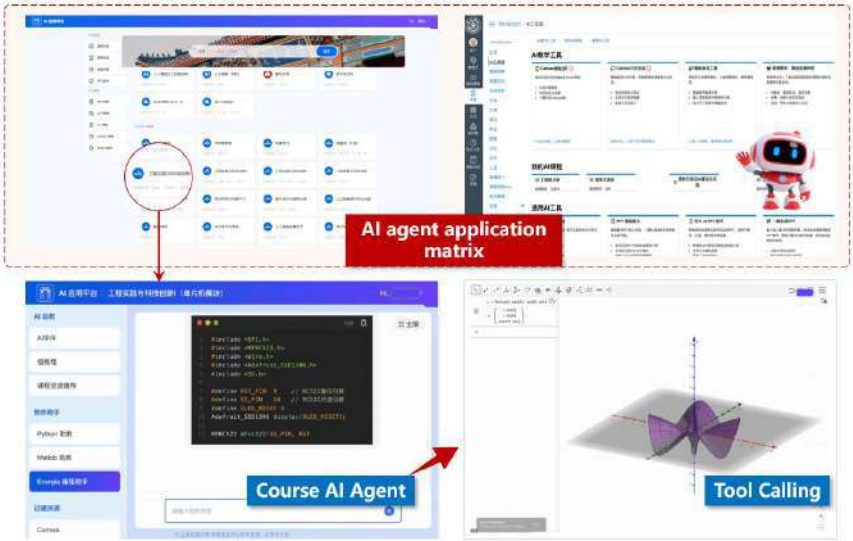

Figure 4 AI Application Center and featured intelligent-agent cases

2.2 Support from a locally deployed, fully domestic AI computing platform

The university launched the first fully domestic, fully featured local deployment of the complete "R1+V3" DeepSeek 671B series in a Chinese university, providing hundred-billion-parameter large-model services while ensuring that data remains on campus for security. This has significantly improved research and learning efficiency.

3. SJTU AI Hub: end-to-end integration across all scenarios

The university has built an integrated AI teaching hub that brings together the data middle platform, AI application center, physical spaces, digital spaces, and intelligent agents. It breaks spatial barriers so that data can "flow" through teaching spaces, providing an innovation platform for the university's "AI + major/micro-major" development and "AI + classroom teaching" reform while enhancing students' self-directed learning and innovative practice capabilities. On the teacher side, it creates a closed-loop teaching process of "smart lesson preparation - precise instruction - learning feedback." On the student side, it creates a personalized learning model of "personalized learning - intelligent study companion - academic feedback." Together these form a complete system featuring spatial integration, data connectivity, application coordination, and intelligent empowerment.

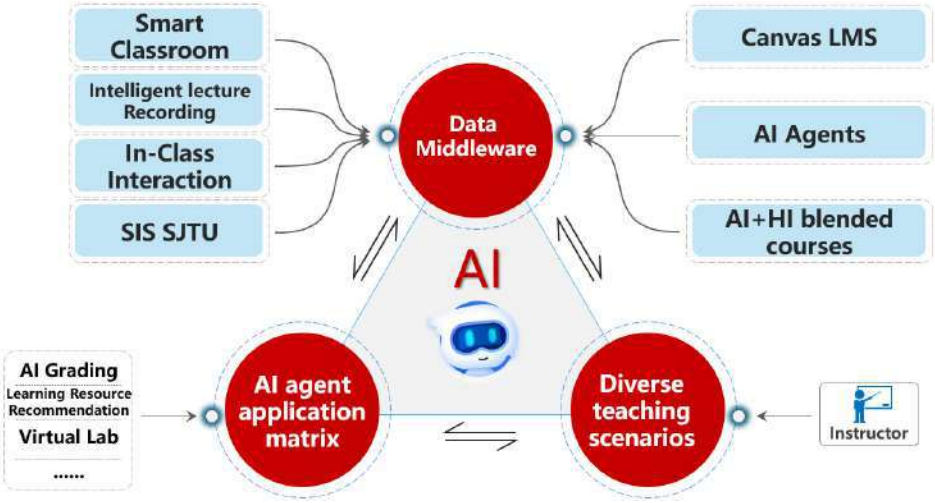

Figure 5 SJTU AI Hub Framework

Case Innovation and Breakthroughs

1. Main innovations

The university innovatively established a three-in-one architecture of "data middle platform + AI application center + scenario workshop." SJTU AI Hub builds a smart teaching architecture with the data middle platform at its core, an intelligent-agent matrix as support, and the scenario workshop as its carrier. The data middle platform integrates data streams from smart classrooms, the teaching platform, and teaching applications to enable data aggregation, processing, and analysis. The intelligent-agent matrix includes more than 1,200 teaching agents, forming a service network covering all teaching scenarios. The scenario workshop provides low-code development tools to support teachers in rapidly building personalized teaching applications. This architecture breaks through key bottlenecks of traditional education informatization, including weak data connectivity, insufficient application integration, and inadequate support for scenario innovation, and provides a systematic solution for the digital transformation of universities.

The university also innovatively constructed a full-chain support system covering "domestic computing power - education large models - intelligent hardware - intelligent applications," realizing a complete AI teaching closed loop from infrastructure to application scenarios. The classroom interaction learning-status screen integrates six functions in one. In class, AI intelligently analyzes questions, answers, discussions, and other content in real time, visually presenting students' core questions and needs while feeding precise information back to teachers. The locally deployed DeepSeek 671B large model ensures data security, and more than 400 AI+ courses have already validated the effectiveness of the applications. This closed-loop system supports the entire process from data collection and intelligent analysis to teaching optimization, enabling end-to-end implementation of AI teaching applications and substantially improving the efficiency and quality of classroom interaction.

The university further innovatively developed a scalable "AI+HI" collaborative teaching paradigm, building a top-talent cultivation system led by human intelligence. It emphasizes that HI should always remain in the leading role in teaching, fully leveraging the unique strengths of humans in instructional design, value guidance, and creative thinking, while making use of AI's technical strengths in data processing, personalized recommendation, and intelligent assistance. The coordination of the two allows complementary advantages and produces a teaching effect greater than the sum of its parts.

2. Breakthroughs in application practice

2.1 SJTU AI Hub supports large-scale teaching application across the university

Each semester, SJTU AI Hub supports teaching and learning for more than 35,000 faculty members and students and for more than 5,000 courses, covering 90% of undergraduate and graduate courses. As of the end of May 2025, cumulative visits exceeded 529 million, participation in learning activities exceeded 9.24 million, the total number of course class sections reached 50,900, and overall teacher-student satisfaction exceeded 96%.

The cumulative number of teaching intelligent agents developed has exceeded 1,200. Total computing-resource consumption has reached 1.92 billion tokens, with average daily consumption of more than 12 million tokens. The total number of characters in the knowledge base exceeds 250 million, and the platform serves 56,000 teacher and student users. By leveraging new-quality productive forces, the system effectively puts into practice the educational philosophy of "learning at SJTU" and "helping every student become better," strongly supporting both teaching and learning processes and improving efficiency.

2.2 AI video resources efficiently support student learning

Classroom video resources are highly popular with students. Every year, the university provides live-streaming and lecture-capture services for more than 9,000 teaching classes, records 300,000 class hours of video, and sees an average of more than 4,500 live views per day and 3,700 on-demand replay class-hours viewed per day. Through intelligent processing of classroom video resources, student convenience, learning efficiency, and mastery of knowledge are all improved, thereby enhancing learning quality.

The intellectual property rights for the software, hardware, code, and related materials involved in this case all belong to Shanghai Jiao Tong University.

Promotion Value and Risks

1. SJTU AI Hub supports innovative teaching.

By integrating smart teaching, the online platform, and AI applications, the university has established a systematic model that supports the integration of teaching processes and AI applications before, during, and after class. It has achieved strong results, with overall teacher-student satisfaction exceeding 96%. SJTU AI Hub has accumulated more than 529 million visits, more than 9.24 million learning-activity participations, 50,900 total course class sections, and more than 390,000 teacher-student service instances.

2. The initiative has clear social value at home and abroad.

The university shares high-quality teaching video resources with more than 20 universities, and more than 40 courses each year are delivered synchronously to overseas students worldwide with real-time interaction.

3. The initiative supports teaching reform and research and has strong demonstration value.

Focusing on AI-empowered integrated teaching applications, the university has applied for multiple invention patents and software copyrights, organized 18 exchanges on AI-empowered (AI+) course development, and produced multiple nationally recognized exemplary cases. It has also been invited to give more than 10 speeches and reports at major industry conferences in China, demonstrating a leading role among Chinese universities. News channels, education media, newspapers, and websites have extensively reported on the initiative, attracting visits and research exchanges from more than 100 universities.

4. Technical and ethical risks.

AI technology is still in an early stage of development, and many limitations and challenges remain regarding technical reliability and accuracy. Teachers and students need to maintain critical thinking toward AI and avoid overreliance. The Educational Technology Center and the Network and Information Center of Shanghai Jiao Tong University will continue to reflect on and improve the use of AI in teaching.

Other Relevant Information

1. Awards

Year	Award	Level	Awarding Organization
2023	Case: Renovation of Multimedia Classrooms in the Upper, Middle, and Lower Courtyard Public Teaching Buildings of Shanghai Jiao Tong University	Outstanding Application Case of Digital Education Standards	CELTSC
2025	AI+HI： Driving disciplinary iteration and upgrading, and promoting innovation in teaching reform	Special Prize	Shanghai Jiao Tong University
2025	Second Education Digital Human Competition, "Intelligent Learning Assistance" track final	Second Prize	China Educational Technology Association
2025	SJTU's "HI+AI Course" selected for the "Artificial Intelligence Testbed" of the National Smart Education Public Service Platform	Selected	National Smart Education Public Service Platform
2022	Outstanding School in the 2021 annual campaign for broad adoption of online learning space applications	Outstanding	Department of Science, Technology and Informatization, Ministry of Education

2022	Case: Digital intelligent teaching environment supporting the cultivation of innovative talent	Outstanding Case in the China Intelligent Education Innovation Practice Report	Shanghai Open and Distance Education Engineering Technology Research Center
2025	Innovative practice of synchronous domestic and international teaching and virtual-physical integration to cultivate global competence through global classrooms	First Prize	Shanghai Jiao tong University
2021	Case: Smart classroom construction	Innovation Practice Award	Smart Higher Education CIO Informatization Professional Committee
2024	Case: Construction and application of practical smart classrooms based on AI technology	Typical Application Scenario Case of "Artificial Intelligence + Higher Education"	Shanghai Jiao tong University
2024	Case: Digital teaching spaces empowering transformation of teaching models and innovative talent cultivation	Innovation Breakthrough Award for Smart Teaching Space Construction	Smart Higher Education CIO Informatization Professional Committee
2023	Shanghai urban digital transformation challenge-project demonstration unit; digitally empowered model school for the new "five-education integration" cultivation model		Office of the Leading Group for Shanghai Urban Digital Transformation; Office of the Leading Group for Digital Transformation of the Shanghai Education System
2023	Excellent Cases of Informatization Construction and Application in Shanghai Universities	Gold Award	Information Management Professional Committee of the Shanghai Higher Education Association; Campus Network Professional Committee of the Shanghai Higher Education Association

2. Third-party evaluation

(1) In May 2025, Shanghai Jiao Tong University exhibited at the 63rd China Higher Education Expo. Leaders including Lin Huiqing, President of the China Association of Higher Education, and Guan Peijun, Vice President of the association, visited the booth and provided guidance. CCTV, Changchun TV, and many other media outlets reported on the university's outstanding achievements in the "AI+HI" reform.

Figure 6 Mainstream Media Coverage on SJTU's AI+HI Transformation and Innovation

(2) An "AI+HI" course appeared at the China Higher Education Expo. Jilin TV reported on Shanghai Jiao Tong University's course Chinese Character Culture, noting its use of digital humans, teaching intelligent agents, knowledge graphs, and smart classrooms to implement an AI+HI course, and offered positive evaluations.

Figure 7 Mainstream media coverage of SJTU's AI+HI reform and innovation

(3) Shanghai Jiao Tong University also appeared at the 22nd Shanghai Education Expo, where it set up an interactive experience zone to vividly showcase innovative achievements in "AI+HI" education and teaching reform, presenting the university's rich practices in integrating AI with education. Media outlets and visitors responded positively.

Figure 8 Shanghai Jiao Tong University booth at the 22nd Shanghai Education Expo

(4) ScienceNet: “SJTU President Ding Kuiling: AI and HI must be closely integrated to build the future of higher education”
https://news.sciencenet.cn/htmlnews/2024/7/525896.shtm
(5) CYOL: “Will universities disappear? Will majors vanish? Will teachers lose their jobs? SJTU President Ding Kuiling responds to AI‘s challenge to education”
https://m.cyol.com/gb/articles/2024-07/05/content_PbGvyGIx9J.html
(6) China News Service: “Academician Ding Kuiling: The more ubiquitous AI becomes, the more we must pay attention to the value of what makes humans human”
https://m.chinanews.com/wap/detail/chs/zw/10246809.shtml
(7) The Paper: "How should future higher education be built in the age of AI? Ding Kuiling: AI and HI must be closely integrated"

(8) Jiefang Daily: "Where are universities headed under the impact of AI? At the World Artificial Intelligence Conference, university presidents had this to say..."
https://m.jfdaily.com/sgh/detail?id=1371141
(9) Online Learning magazine, June 2024 issue (No. 104): the interview article "Shen Hongxing, Director of the Educational Technology Center of Shanghai Jiao Tong University: Digital transformation drives changes in teaching models" introduced SJTU's digitally intelligent teaching environment in detail and generated positive social impact.
(10) In 2023, China Youth Daily published the article "The era of digital intelligence has arrived: how should universities respond?" which gave positive recognition to Shanghai Jiao Tong University's smart classrooms and digital learning platform.
(11) "What has changed in teaching, research, and campus life after Shanghai universities launched the full-version DeepSeek?"
Source: Shanghai Education Television
https://topic.setv.sh.cn/setv_news/20250219/wx_index.html?n=2
(12) "Shanghai Jiao Tong University launches a locally deployed version of DeepSeek - how is it different from direct access?"
Source: The Paper https://m.thepaper.cn/newsDetail_forward_30174463
(13) "Explore SJTU's new campus hot spot - the East Middle Courtyard at night, and the beauty of your dedicated study!"
Source: The Paper https://m.thepaper.cn/baijiahao_10468104
(14) "Educators never forget their original aspiration: how can classrooms become smarter? SJTU teachers' golden ideas won national awards"
Source: Xinmin Evening News
https://baijiahao.baidu.com/s?id=1653426410046158392&wfr=spider&for=pc
(15) "Macaron colors, smart devices, and picture-like scenery... SJTU's beautiful new teaching spaces are easy to love!"
Source: Shangguan News https://sghexport.shobserver.com/html/baijiahao/2021/09/26/547218.html
(16) "Technology empowers teaching and learning: the renovated East Middle Courtyard at SJTU's Minhang campus makes visitors linger"
Source: Shanghai Education News http://m.shedunews.com/msite_1/con/2020-10/15/c3929.html
(17) "At the start of the semester, Shanghai Jiao Tong University's integrated online services warm hearts: 400 live-streaming classrooms support online and offline teaching"
Source: CNR
http://www.cnr.cn/shanghai/tt/20200904/t20200904_525241027.shtml
(18) "Facial-recognition check-in, autonomous delivery vehicles, and 400 live-streaming classrooms... Shanghai Jiao Tong University's smart semester opening"
Source: Tencent News https://new.qq.com/rain/a/20200905A055W900
(19) Sichuan Science and Education Channel reported on the construction of SJTU's digitally intelligent integrated teaching spaces and offered a positive evaluation.

Case 62

French-speaking International University for African Development: Digital transformation from online collaboration to AI-driven administration

Thierry VERDE

Université Senghor (French-speaking International University for African Development), Egypt

Digital transformation as institutional reconfiguration

Digital transformation (DT) in higher education is best understood as a deep organisational change, not just technology adoption. Universities are rethinking business models, governance, quality assurance and stakeholder relationships under pressure from demographic shifts, global competition, labour-market change and students' expectations for flexible, technology-rich learning (Babalola & Genga, 2024; Msila, 2022).

African higher education institutions (AHEIs) use DT both to digitise existing processes (e.g. online registration, LMS-supported courses) and to create new digital models (e.g. fully online or blended programmes, virtual student services) (Babalola & Genga, 2024; Zeleza & Okanda, 2022; Msila, 2022). Zeleza and Okanda (2022) describe DT as integral to universities' four core missions – teaching and learning, research, public engagement, and innovation/entrepreneurship – and argue that without digitalisation African universities and economies risk "perpetual underdevelopment".

COVID-19 acted as a major accelerator. Mhlanga et al. (2022) show how the abrupt switch to online learning in South Africa exposed large capability gaps but also generated key DT lessons: the need to build digital capabilities, plan for continuity, invest in platforms, and narrow access and skills divides (Mhlanga et al., 2022). Case evidence from the University of Education, Winneba (Ghana) similarly illustrates how emergency adoption of Moodle and other platforms enabled continuity for over 92,000 students, while revealing structural weaknesses in connectivity, infrastructure and digital literacy that must be addressed for sustainable DT (Ghansah, 2025).

Beyond teaching, African academic libraries have undergone a parallel digital evolution, shifting from traditional systems to Web 2.0 applications, digital repositories, open distance libraries and mobile services. A systematic review of African academic libraries across pre-COVID, COVID and the GenAI era

shows increasing innovation but persistent challenges in internet access, digitisation policies and skills (Adarkwah et al., 2024). This underscores that DT is ecosystemic, spanning libraries, administration, student services and research support, not only classrooms.

African-specific DT challenges and frameworks

DT in African universities is complex and multi-layered, requiring deliberate investment, meticulous planning and cross-sector collaboration (Babalola & Genga, 2024; Zeleza & Okanda, 2022; Lytvynov, 2025). Babalola and Genga group the main challenges into six dimensions:

- Digital infrastructure – connectivity, devices, platforms, data centres;
- Leadership – strategic vision, digital leadership skills, change management;
- Financial costs – capital and recurrent funding for platforms, licences and support;
- Diversity, Equity and Inclusion (DEI) – ensuring transformation benefits all groups;
- Policy and frameworks – institutional and national regulations, data governance;
- External factors – national digital strategies, regulation, labour market and donors (Babalola & Genga, 2024).

They argue that digital technologies can provide accessible, high-quality education and enhance Africa's global competitiveness, but only if DT is planned holistically and benefits are equitably shared (Babalola & Genga, 2024). A companion article emphasises that DT in AHEIs should be explicitly linked to sustainability (environmental, economic, social) and to a "sustainable green culture" on campus, embedding DEI concerns in curricula, leadership and campus practices (Genga & Babalola, 2025).

Leadership emerges as a decisive enabler. Loglo's multiple-case study of three Ghanaian public universities shows that DT initiatives are driven by both internal demands (improving services) and external pressures (expanding access via open, distance and digital education), but have largely unfolded through top-down, vice-chancellor-led responses, in a weakly coordinated policy climate (Loglo, 2024). Msila's South African case study similarly shows that effective digital leaders combine vision, digital literacy, emotional intelligence and collaborative decision-making; without such leadership, institutions struggle to navigate turbulence and align DT with social-justice goals and continental agendas such as AU Agenda 2063 (Msila, 2022).

Inequality is a persistent fault line. A comparative analysis of historically disadvantaged versus advantaged South African universities during COVID-19 shows that historically disadvantaged universities lag in DT due to legacies of apartheid, poor infrastructure, weak network coverage and limited IT access (Mateko et al., 2025). Mhlanga et al. (2022) also highlight that digital divides in infrastructure and skills sharply shape students' experiences of online learning. These studies stress that DT strategies must explicitly target digital inequality through infrastructure investment, policy reform and inter-institutional collaboration (Mhlanga et al., 2022; Babalola & Genga, 2024; Mateko et al., 2025; Msila, 2022).

Across the continent, practical reviews of digital teaching tools – such as LMSs, videoconferencing, games and mobile applications like WhatsApp – show that, when aligned with student-centred pedagogy, they can significantly improve engagement, problem-solving and academic performance. Yet infrastructure, devices, digital skills and institutional readiness remain major constraints, with stark differences between urban and rural institutions (Nyongesa & Westhuizein, 2025). Strategic recommendations therefore focus on improving ICT infrastructure, flexible digital-learning policies and

fair access to digital resources (Babalola & Genga, 2024; Nyongesa & Westhuizein, 2025; Ghansah, 2025; Lytvynov, 2025).

Digital transformation agendas and strategic visions

Zeleza and Okanda (2022) propose a twelve-point Digital Transformation Agenda for Africa, which includes: embedding DT in institutional culture and strategic planning; integrating digitalisation into all four core missions; sustained investment in digital infrastructure; building resilient digital business-continuity plans; consortia for online design and content; and entrenching technology-mediated modalities (face-to-face, blended, online) to diversify learners and revenues.
Babalola and Genga (2024) recommend using an integrated framework that connects core processes (administration, education, research), emerging technologies and stakeholders, with DEI embedded at every level. DT, in this view, is about re-shaping institutional culture and structures to create more inclusive, accessible and sustainable university systems (Babalola & Genga, 2024; Genga & Babalola, 2025; Lytvynov, 2025).

Table 1 Key themes in digital transformation of African universities from the literature

Theme	Core idea	Citations
COVID-19 as accelerator	Emergency online shift revealed gaps and catalysed DT agendas	Mhlanga et al., 2022; Zeleza & Okanda, 2022; Ghansah, 2025
Leadership & vision	Digital leadership, strategic vision and collaboration are critical	Loglo, 2024; Babalola & Genga, 2024; Msila, 2022
Inequality & DEI	DT risks deepening divides; DEI must be central	Babalola & Genga, 2024; Genga & Babalola, 2025; Nyongesa & Westhuizein, 2025; Mateko et al., 2025; Lytvynov, 2025
Infrastructure & funding	Connectivity, platforms and sustainable budgets are foundational	Mhlanga et al., 2022; Babalola & Genga, 2024; Zeleza & Okanda, 2022; Ghansah, 2025
Ecosystem perspective	Libraries, admin, services and pedagogy all transform together	Zeleza & Okanda, 2022; Adarkwah et al., 2024; Msila, 2022

AI as a lever within broader digital transformation

Within this already ongoing digital transformation, AI appears as one powerful – but not primary – lever. The primary drivers remain institutional strategy, leadership, infrastructure and policy; AI tools are meaningful only when embedded in these DT frameworks.

At the strategic level, AI can be integrated into universities' digital roadmaps as part of broader "intelligent university" or "smart campus" models, where AI supports administrative efficiency, quality assurance, knowledge management and personalised student services (Adel et al., 2025; Abulibdeh et al., 2025). A scoping review of AI's role in strategic planning at Qatar University shows that AI can enhance institutional efficiency, provide data-driven insights for decision-making, and support excellence themes, but also raises concerns about privacy, ethics and the reshaping of traditional models (Abulibdeh et al., 2025). Adel et al. similarly position AI as a means to automate quality assurance, streamline management tasks and personalise learning, advocating gradual, ethical adoption aligned with sustainable DT.

In African contexts, AI's role is constrained and shaped by the broader DT landscape. Reviews of GenAI in South African higher education show that tools like ChatGPT can reduce educator workload (e.g. automated grading, content creation) and enhance student engagement, but their effective use depends on prior investments in connectivity, literacy and institutional policy (Govender et al., 2025; Modiba et al., 2025). Other African-focused work on AI in education emphasises that AI may help address disparities in access and language, but only if integrated into context-sensitive digital ecosystems that tackle infrastructure, digital literacy and governance challenges (Loglo, 2024; Adel et al., 2025; Chisom et al., 2023).

Crucially, several African scholars warn that AI should not drive transformation agendas on its own. Maimela and Mbonde (2025) show that, in South Africa, uneven AI adoption between historically white and black universities reflects existing structural inequalities in infrastructure and funding; without intentional policies, AI can amplify rather than reduce these gaps, and risks reinforcing Western-centric knowledge systems ("digital colonialism"). Modiba et al. (2025) reach similar conclusions regarding GenAI: without clear regulations, skills development and improved infrastructure, generative tools can deepen divides instead of supporting equitable research and learning.

Finally, global reviews of AI in higher education suggest that, even where technical infrastructure exists, AI's impact on learning outcomes and instructional quality is mixed unless embedded in comprehensive integration plans: institutional preparedness, faculty development and student motivation strongly condition benefits (Aslam et al., 2025; Qehaja, 2025; Lytvynov, 2025). This reinforces the argument that AI should be framed as an enabler of a broader digital-institution strategy, not a standalone solution.

In sum, for African universities, the priority is to consolidate inclusive, well-governed digital transformation – through infrastructure, leadership, DEI-centred policy and ecosystem-wide change – into which AI can then be integrated as a targeted tool to enhance management, teaching, research and student support in ways that align with local priorities and mitigate risks.

Université Senghor: an institutional case study of end-to-end digital transformation

Established in 1990 and named after Léopold Sédar Senghor, Université Senghor is an international French-speaking university dedicated to African development, operating as a direct operator of La Francophonie. Hosted in Alexandria, Egypt, and networked across 17 countries with 52 partner institutions, it enrols over 700 master's students annually – 200 based in Egypt, drawn from more than 3,000 applicants – alongside some 1,000 certificate and diploma learners and between 10,000 and 30,000 participants in massive open online courses. All students are junior or senior professionals, which intensifies both pedagogical and operational demands and distinguishes the institution from conventional undergraduate-focused universities.

The institution's digital transformation was structured around two successive phases. The first, initiated from 2017 onwards, involved migrating all administrative and some of academic activity to Google Workspace (academic activity was and still is mainly based on a moodle platform). The rationale was explicitly pragmatic: to build an extended online collaboration environment, in a familiar interface, at near-zero cost, across a geographically dispersed institution. Operationally, this translated into the systematic adoption of shared drives (which were introduced later in 2019 for the basic educational plan of Google WorkSpace) and structured folder hierarchies, personalised document templates, strict access-rights controls, real-time spreadsheets for monitoring activities, and a zero email-attachment policy (figure 1). Collaborative editing of institutional reports, automated production of student certificates or diplomas (using Autocrat on Google Sheet together with Google Slide), and real-time expenditure and carbon-footprint monitoring for international missions (through a Google Sheet development) became standard practice (figure 2). The migration was not conceived as an end in itself but as a foundational layer upon which more advanced tools could subsequently be introduced with credibility and uptake.

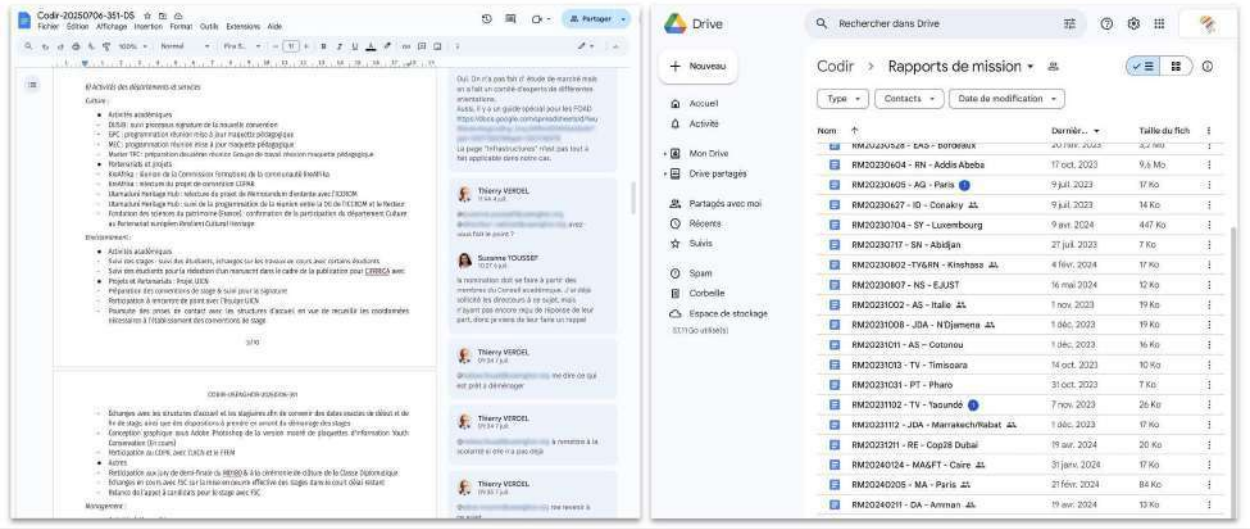

Figure 1 Weekly reports written in a collaborative way and missions reports shared with the community.

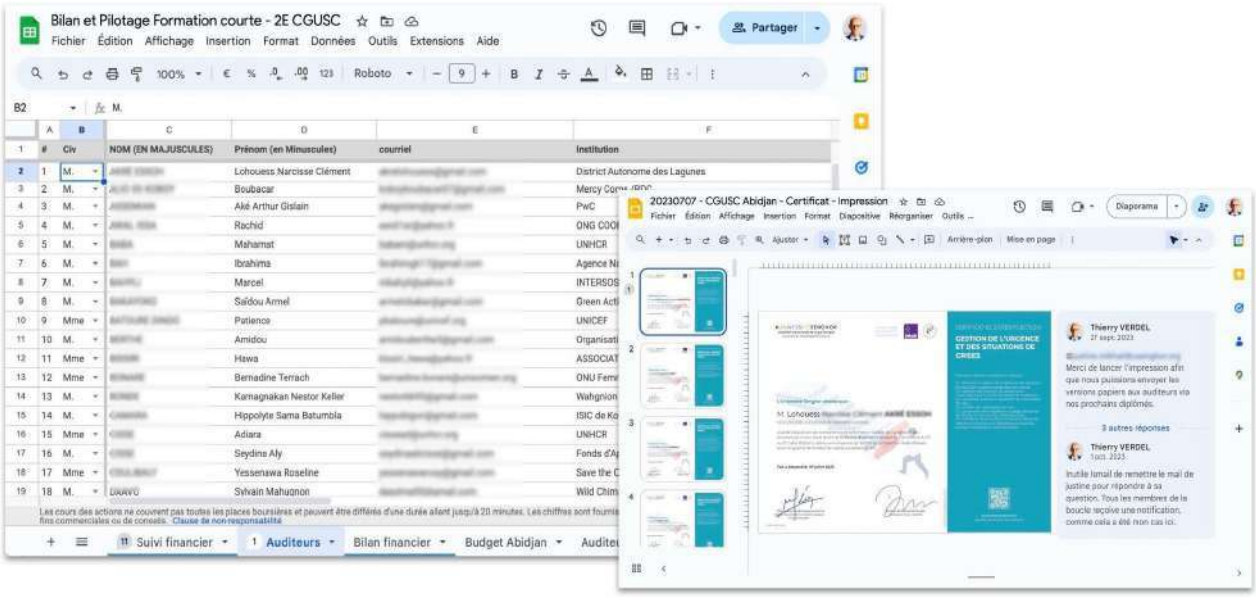

Figure 2 Managing student cohorts and editing certificates (or diploma) automatically combining a Google Sheet data file and a Google Slide template through Autocrat extension for Google Sheet.

From 2024, the institution moved to a second phase by integrating AI tools across both administrative and academic workflows. In administration, AI was deployed for the production of illustrations, regulatory and procedural documents, recruitment profiles, official communications and video editing (figure 3). In the academic domain, AI applications extended to the design of assessments, the evaluation of master's theses through a structured rubric, and a partially automated student admissions process. The most significant operational outcome of this second phase was the administration of 350 video-based admissions interviews within a 24-hour window using an AI-powered platform, combining advanced multiple-choice questions, open-ended queries with automatic transcription and scoring, and targeted human review where necessary (figure 4). These results indicate a qualitative shift in institutional capacity: equivalent volumes of work are now produced with materially fewer resources and in considerably less time.

Figure 3 Using AI for illustrations (cover pages) and base content for new regulation guides

Documented outcomes include measurable reductions in administrative processing time, faster document production cycles, improved student selection and evaluation throughput, and reduced error rates in institutional documents. Staff satisfaction with the new tools has been assessed as positive. Critically, these gains were achieved without recourse to expensive enterprise-resource-planning systems: the elimination of document version conflicts, email attachments and redundant workflows demonstrates that low-cost cloud platforms, intelligently configured and systematically adopted, can deliver substantial efficiency improvements in resource-constrained environments. The institution positions itself neither as a technology showcase nor as a pilot project, but as a functioning institutional model: a proof of concept for what structured, sequenced digital transformation can produce in an African francophone university of small size.

Beyond institutional efficiency, the transformation produced an effect that may prove more durable: its impact on the students themselves. Université Senghor recruits junior and senior professionals from across francophone Africa. Many arrive with limited exposure to structured digital collaboration – not because these tools are new, but because their home institutions and organisations have not adopted them at scale. For a significant share of the student cohort, the systematic use of shared drives, collaborative document editing, real-time data dashboards and zero-attachment workflows represents a genuine discovery. The university functions, in this respect, as an accelerator of digital literacy that is not incidental to its mission but central to it. Graduates return to their countries – to ministries, development agencies, public institutions, SMEs or NGOs – carrying both the competence and the conviction to introduce these practices in environments where resistance to change is often rooted in unfamiliarity rather than ideology. This cascading effect is difficult to quantify but structurally significant: each cohort of Master's students constitutes a potential cohort of change agents. At the scale of francophone Africa, this multiplier effect represents a form of digital transformation influence that extends well beyond the institution's own campus.

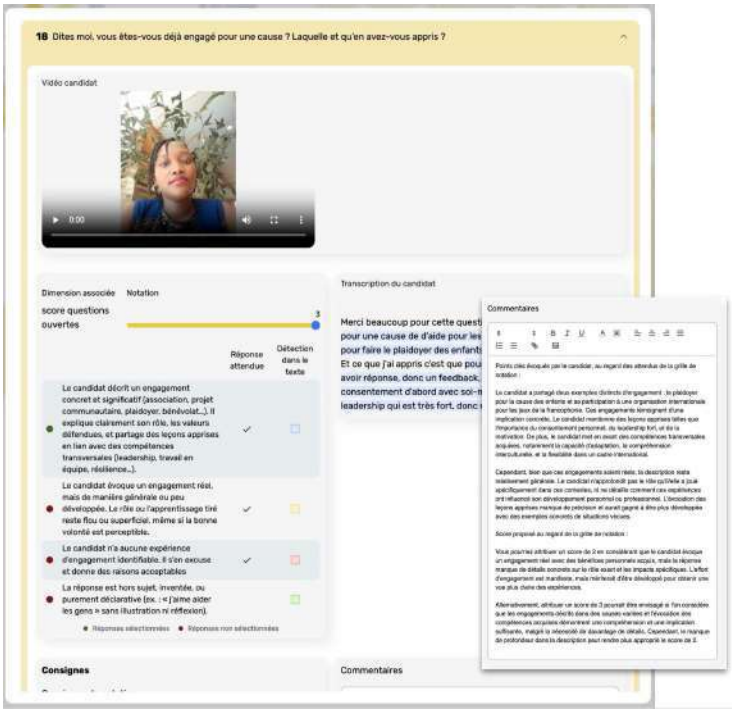

Figure 4 350 automated interviews realized in 24 hours with sweeft.ai platform.

Digital leadership in francophone Africa: implications and open questions

The Université Senghor case merits attention beyond its operational results. It demonstrates that a small, resource-constrained, geographically distributed institution can lead credible digital transformation through institutional will, stepwise implementation and strategic tool selection rather than through large-scale capital investment. This matters in the francophone African context, where the majority of institutions share precisely these constraints: limited budgets, dispersed campuses, weak legacy IT infrastructure and chronic connectivity challenges. The institution presented its trajectory and outcomes at the Global Smart Education Conference 2025 at Beijing Normal University, signalling a deliberate positioning as a reference model rather than a passive beneficiary of externally driven transformation agendas.

Three features of the Senghor model are particularly significant from a leadership standpoint. First, the transformation was explicitly sequenced: the foundational phase of online collaboration preceded the AI integration phase, ensuring that staff were operating within a shared digital environment before more complex tools were introduced. This sequencing aligns with the integrated frameworks proposed by Babalola and Genga (2024) and the twelve-point agenda of Zeleza and Okanda (2022), both of which emphasise that AI and advanced tools should be built on established digital foundations rather than introduced in isolation. Second, the transformation was comprehensive in scope, spanning administration, pedagogy and institutional communication simultaneously, rather than confined to a single domain or pilot cohort. Third, it was driven from institutional leadership, with the rector's direct engagement in and public communication of the transformation reflecting the decisive leadership role identified by Loglo (2024) and Msila (2022) as a prerequisite for sustainable digital change. Taken together, these features constitute a replicable logic, not simply a collection of ad hoc tool adoptions.

The case is not without limitations that require honest acknowledgement. Université Senghor is atypical in several respects: its relatively small student population, its predominantly professional graduate-level profile, its international and multi-donor funding base, and the administrative concentration associated with a flagship campus all mitigate some of the access, equity and infrastructure challenges that confront larger national universities in the region. The question of scalability – whether comparable transformation trajectories are accessible to institutions with tens of thousands of students, limited rural connectivity and more heterogeneous staff digital literacy – remains open and warrants dedicated empirical investigation. Moreover, the absence of independent external evaluation of the outcomes reported limits the conclusions that can be drawn about sustainability and replicability beyond the institutional context. These caveats notwithstanding, the Senghor case fills a genuine gap in the literature: documented, outcomes-oriented accounts of digital transformation in francophone African higher education, conducted at low cost and with a clear institutional logic, remain rare. As the literature consistently calls for greater evidence from diverse African institutional contexts (Babalola & Genga, 2024; Zeleza & Okanda, 2022; Loglo, 2024), this case constitutes an instructive contribution.

The Literature review of this paper was carried out with the help of "Consensus" AI.

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Case 63

Courseware AI: AI-driven platform for the digital and intelligent transformation of courseware resources

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Background

Under the traditional teaching paradigm, students' learning states are hindered by structural bottlenecks such as superficial rote memorization, unidirectional passive reception, and low self-efficacy. There is an urgent need to break through these barriers via digital and intelligent technologies. The challenges in building courseware include rigid knowledge carriers lacking generative extension, abstract micro-theories lacking concrete visualization, disconnected teaching loop lacking round-the-clock accompaniment and distorted practical scenarios lacking high-frequency and effective trial-and-error.

There are some challenges that GenAI can address nowadays, which is as follows:

First, static multimedia, such as traditional PPTs and textbooks, impose a cognitive ceiling that restricts the divergence of higher-order thinking. There is an urgent need to reinvent traditional courseware into AI-driven, dynamically interactive, and generative smart courseware to break through the limitations of knowledge representation.

Second, the knowledge of some courses such as Computer Networks and Data Structure is highly fragmented and abstract, making it difficult for traditional lectures to bridge the cognitive gap. Thus, building AI-driven multimodal interaction and dynamic deduction systems to reconstruct a concrete and systematic teaching environment for micro-level knowledge is necessary.

Third, traditional classroom teaching models create a vacuum of personalized guidance before and after class. Therefore, it is important to introduce AI learning companions to provide zero-latency Q&A and a customized learning foundation, thereby reshaping a student-centered, self-driven learning workflow.

Moreover, the absence of highly simulated, feedback-rich practical platforms for research and

competitions leads to a disconnect between theory and practice. Constructing a teacher-student-machine collaborative engineering decision-making sandbox and an intelligent evaluation matrix, creating a hands-on training ecosystem dedicated to solving complex engineering problems, is much needed at present.

Case Implementation Status

Centering on the core goal of empowering top-tier innovative talents in emerging engineering education, we combine LLM engines and real-world engineering scenarios to implement a five-dimensional panoramic reconstruction, thereby establishing an AI-driven, full-lifecycle educational closed-loop that seamlessly integrates content carriers, pedagogical processes, value-shaping guidance, evaluation feedback, and an extended ecology.

(1) Demand analysis

We combine the digitalization, intelligence, theory, and practice in our teaching model (Figure 1) and aim to facilitate digital, intelligent, and multidimensional reconstruction of courseware resources and fusing cutting-edge fundamental theories with laboratory practices. The demands are divided into four aspects:

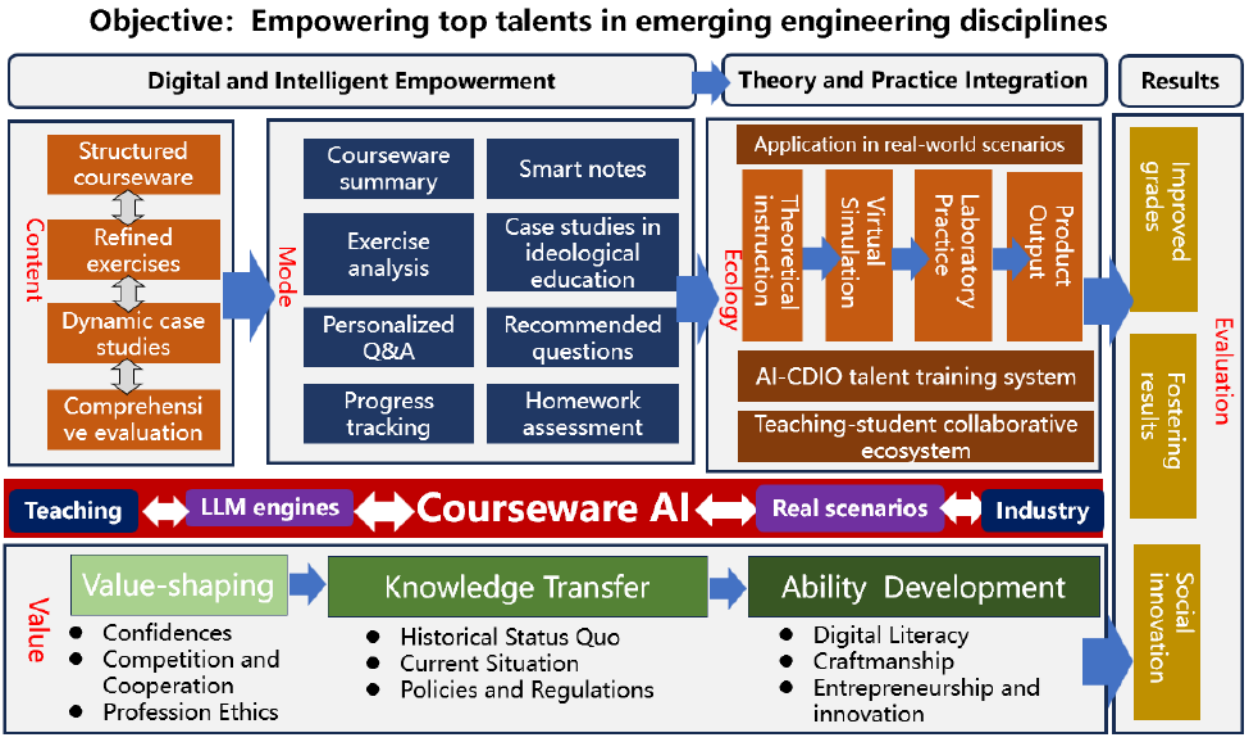

Figure 1 Overview of our AI-enabled teaching reform

Digitalization: Leveraging emerging IT such as GenAI, multimodal interaction, and virtual simulation experiments to provide comprehensive support for the analysis of students' learning profiles, the reconstruction of course content, and the integration and analysis of full-process teaching data across pre-class, in-class, and post-class phases.

Intelligence: Driven by the demand to enhance the quality and effectiveness of value-shaping education within courses, this dimension utilizes GenAI to construct a multimodal case library, which

promotes the achievement of personalized learning objectives, personalized value-shaping practices, and value-added teaching evaluation empowered by full-scenario teaching data.

Theory: By establishing a pedagogical ecology characterized by data-driven evidence, dynamic scaffolding, and higher-order creation, we white-box underlying knowledge principles from the text books with GenAI. The AI-generated animation enables students to deeply understand and evaluate complex problems, thereby achieving higher-order competency assessments that remain unattainable in traditional teaching.

Practice: We also explore an AI driven CDIO (Conceive, Design, Implement, Operate) comprehensive engineering talent cultivation system deeply integrated with AI, which we call AI-CDIO. This framework encourages students to step into laboratories and actively engage in scientific exploration and hands-on technological practices.

(2) Technology research and development

Based on the aforementioned pedagogical philosophies, we have implemented AI-driven teaching innovations across five dimensions—Content, Mode, Value, Evaluation, and Ecology—to support scenarios such as resource integration, multidimensional feedback, human-machine collaborative teaching, and personalized learning support. We develop a platform called Courseware AI, which achieves following objectives with consistent research and development. The architecture of our platform is shown in Figure 2. Figure 3 is the key home page of a course in our platform integrated with AI chat box for AI-enabled teaching and learning.

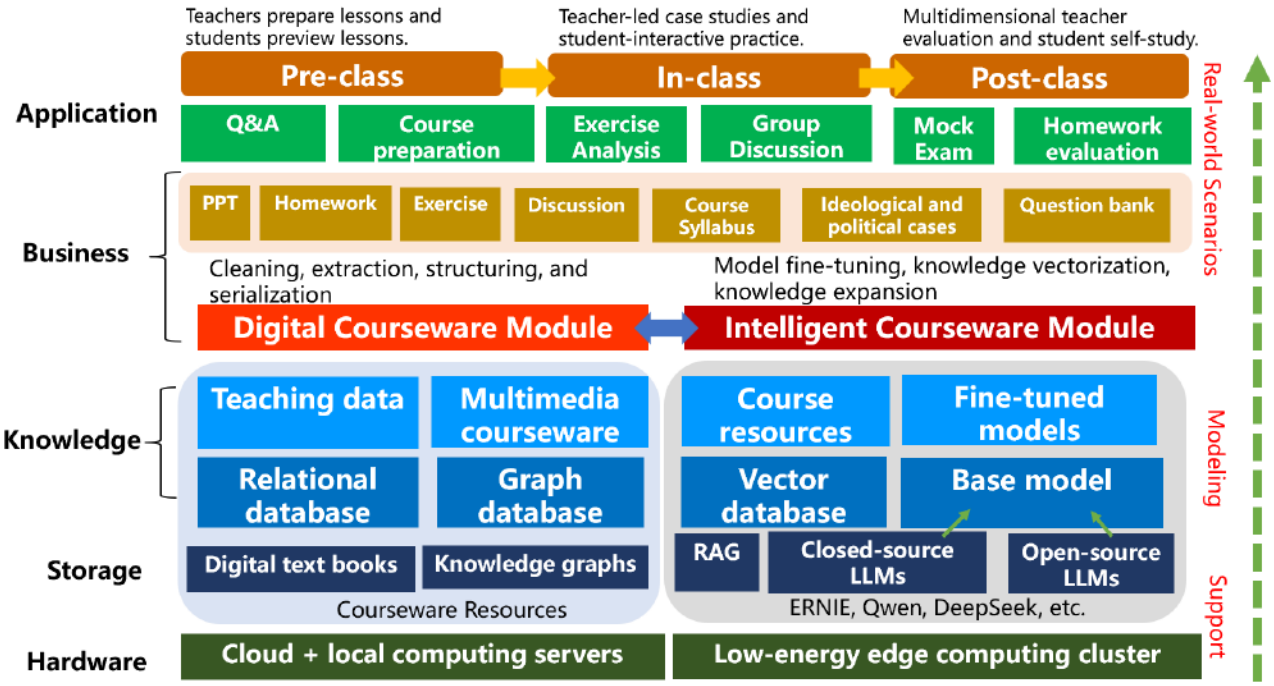

Figure 2 Our Courseware AI platform architecture

Figure 3 Key page of our Courseware AI platform integrated with an AI chat box

The five innovative measures are as follows.

1) Reconstructing Teaching Content through Full-Process Digital and Intelligent Empowerment

On one hand, we integrate AI-driven functions—including courseware summarization and Q&A, exercise generation and analysis, multimodal case generation, and value-shaping recommendations—into our teaching materials. This achieves a digital, intelligent, and multidimensional transformation of courseware resources.

On the other hand, we integrate a full-process intelligent teaching mode that encompasses data collection, interaction design, data analysis, and comprehensive evaluation, facilitating seamless collaboration between teachers, students, and AI in our platform.

2) Innovating Pedagogical Paradigms through Multimodal Intelligent Interaction

We established a dynamic cognitive foundation with 24/7 AI digital learning companions in the platform. Students are encouraged to query the AI at any time while reviewing courseware. Based on specific contexts and the knowledge base, the AI provides zero-latency, highly accurate guidance and Q&A. This marks a paradigm shift from delayed feedback to instant cognitive intervention.

We also break the "One-Size-Fits-All" mode with data-driven adaptive personalized learning paths. By continuously capturing students' interaction trajectories, quiz feedback, and cognitive weak points, the system provides personalized recommendations for exercises, questions, and value-shaping cases. This transforms uniform syllabus-based teaching into an adaptively evolving personalized learning journey.

Our platform drives higher-order thinking with immersive human-machine collaborative precise assessment. Through interactive modules such as in-class exercises and simulated exams, combined with an intelligent scoring system, the platform precisely identifies blind spots in problem-solving. Gamified learning and in-class quizzes are designed to stimulate students' higher-order thinking skills.

3) Enhancing Ideological and Political education through Multimodal Real-World Scenarios

By introducing videos featuring the achievements of prominent Chinese scholars in the field of the course, supplemented by AI-assisted explanations, students are immersed in the knowledge points while gaining a deep appreciation for the craftsmanship spirit and patriotism embodied by these pioneers.

GenAI is utilized to distill core problems, generate in-class exercises, and formulate post-class reflections, helping students understand the strategic importance of knowledge in the development of China's key industries.

4) Closing the Ecological Loop via Teacher-Student-Machine Collaborative Evaluation

By capturing multimodal learning trajectories—including courseware reviews, intelligent Q&A, assignment submissions, and mock exams—alongside the pedagogical warmth of teachers' subjective evaluations, the AI provides teachers with fine-grained cognitive profiles. This empowers students to take control of their own learning progress.

We establish a full-cycle adaptive data flow by building an efficient and burden-reducing ecology.

- Pre-class: Learning analytics empower teachers to prepare lessons efficiently.
- n-class: On-demand resource generation supports the expansion of higher-order knowledge.
- Post-class: Intelligent companions guide students through personalized self-study.

This achieves a dual-directional workload reduction and efficiency enhancement for both teaching and learning.

5) Cultivating Top-Tier Talent through the Fusion of Theory and Practice

We also have established an AI-empowered experimental teaching model: "Theoretical Instruction → Autonomous Virtual Experiments → Laboratory Practice." This ensures a seamless transition from theory to hands-on operation, particularly for students for engineering.

The "Learning by Doing" strategy aims to build a collaborative teacher-student ecology through competitions. Based on the AI-CDIO talent cultivation framework, we have built experimental platforms for scenarios like Smart Healthcare, Smart Education, and Smart Cities. Students are guided to conduct "AI+X" innovative practices. This competition-led learning approach creates an elite engineering talent ecosystem oriented toward the needs of emerging markets.

Case Innovation and Breakthroughs

The Courseware AI platform is an intelligent platform driven by LLM for the digitalization and intelligent transformation of course resources. Its primary objective is to leverage LLMs to assist students in resolving course queries, thereby enhancing learning efficiency and deepening their understanding of course content.

(1) Major innovation

1) Building an AI-Enabled Digital-Intelligent Teaching System

During platform construction, we prioritize a human-oriented approach, emphasizing the value alignment and technical orientation of AI-enabled digital transformation in higher education. Centering on student learning scenarios, the platform enhances the agency of students, facilitating a paradigm shift from instruction-based learning to learning-based instruction. Furthermore, we utilize student profiling to promote personalized learning and formative evaluation.

2) Leveraging LLM Reasoning and Generative Capabilities for Interactive Intelligent Teaching

By utilizing the reasoning capabilities of LLMs, the Courseware AI platform achieves functions such as courseware summarization, exercise analysis, open Q&A, and the mining of the keys of ideological and political education in curriculum. This breaks the spatio-temporal boundaries of traditional teaching, improves the efficiency of reviewing materials, boosts student engagement, and establishes an integrated "AI + Value-Shaping" educational and intelligent evaluation system.

3) Respecting Offline Teaching Values while Providing an Autonomous Online Intelligent Environment

Our practical application preserves the unique value of traditional in-person classroom teaching, utilizing the Courseware AI system as a supplementary tool. This hybrid model—where students are the primary subjects, GenAI serves as an auxiliary, and online/offline modes are integrated—respects the role of teachers while providing students with an autonomous, controllable learning environment.

(2) Technical Breakthroughs

Using traditional course resources as the entry point, the platform leverages cutting-edge ITs such as document parsing, Natural Language Processing (NLP), and LLMs to extract structured and unstructured knowledge, constructing a comprehensive knowledge system for courses.

The platform features an integrated, Web-based interactive interface that allows students to engage with core concepts directly via a browser. As students browse their courseware, the AI provides page-specific summaries, expanded explanations, illustrative cases, sample questions, and answer analyses.

By utilizing both closed-source and open-source models (e.g., ERNIE Bot, Qwen), we also built a Retrieval-Augmented Generation (RAG) application based on courseware resources and knowledge bases to provide highly accurate academic support. Simultaneously, the platform records and analyzes student interaction data, using LLMs to generate personalized revision plans or error summaries, thus creating a comprehensive and intelligent learning companion.

(3) Breakthroughs in Application and Practice

Relying on our self-developed platform, we empower education through the digitalization and intelligent reconstruction of course materials. Significant practical innovations have been achieved in the following areas:

- Deep digitalization and intelligent enhancement of course resources.
- The seamless integration of AI-driven Q&A with traditional courseware browsing.
- The construction of intelligent learning workflows that align with pedagogical principles.
- AI-enabled group discussions and assignment submissions.

These practices provide a valuable reference for the digital transformation of AI-powered education in China.

This platform has reached a user base of more than 2,000 students in our university. By securing software copyright, we have successfully implemented a self-developed AI teaching framework that is entirely independent and manageable.

Promotion Value and Risks

(1) Implementation and Practical Effectiveness

The Courseware AI platform has been successfully deployed across multiple courses, covering both undergraduate and postgraduate levels. These courses include Computer Networks, Data Structures, Spark Big Data Processing, Knowledge Graphs, Systems Science and Systems Engineering, and AI+X.

Practical pedagogical applications have been carried out in various scenarios—such as PPT pre-study,

intelligent Q&A, assignment submission, group discussion, and ideological and political education in curriculum—yielding significant positive outcomes in teaching effectiveness.

(2) Reference Value and Strategic Significance

This case provides a proactive and practical reference for Chinese universities on how to effectively utilize accumulated legacy courseware resources in the intelligent era. By applying digital and intelligent processing to traditional PPTs, exercise banks, and case libraries, we can revitalize the value of historical academic assets.

Integrating these resources with the latest knowledge allows for a deeper interpretation of course connotations, significantly enhancing teaching quality and student learning efficiency. This model holds immense potential for broad promotion and adoption in the future.

(3) Challenges and Future Directions

Despite its success, the implementation process revealed several challenges, ranging from technological barriers in digitizing outdated courseware formats to faculty concerns regarding data sovereignty and the security of closed-source LLMs we used in the platform. Furthermore, privacy preservation remains a critical priority to ensure the continued confidentiality of student-AI interaction data.

Moving forward, we aim to build a secure, reliable, and efficient digital-intelligent solution for university courseware. This will be achieved by strengthening data encryption technologies and implementing local deployment of LLMs to ensure robust data security and privacy protection.

Other Relevant Information

1. Case award status

We won the First Prize in the 2nd Teaching Evaluation Exhibition Activity Competition (Artificial Intelligence Track) at the University of International Business and Economics in 2025 using our case. In 2026, the use of our case also won the first prize of the Beijing Education and Teaching Achievement Award.

2. Third-Party Evaluation

Based on the tracking of teaching data from approximately 400 students over the past two years, the average final exam scores of students using the AI teaching platform have increased by approximately 5% (Figure 4), indicating students using our platform have a more solid foundation in basic knowledge. The lead teacher, who applied the AI teaching platform, received an anonymous student teaching evaluation score of 99.43, a significant improvement from the previous score of 96.25, and was recognized with an "Excellent" teaching evaluation from the school (Figure 5).

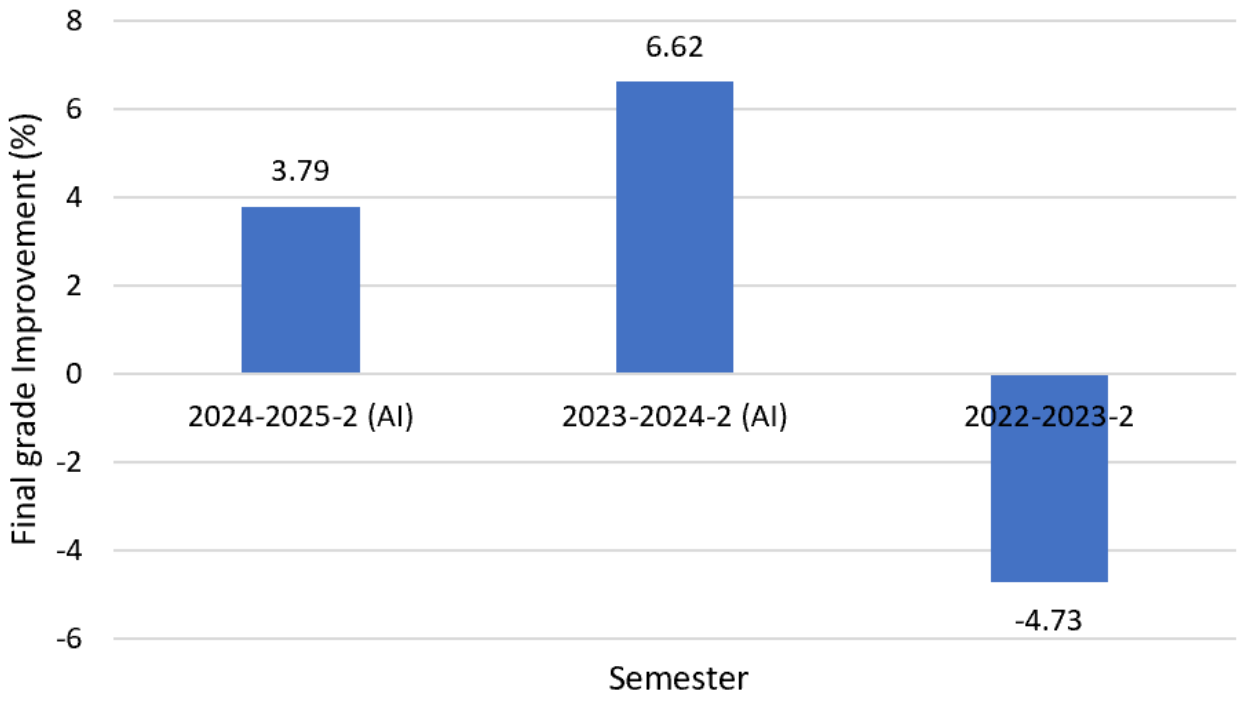

Figure 4 Analysis of the improvement in final grades for students who used AI and those who did not in different semesters.

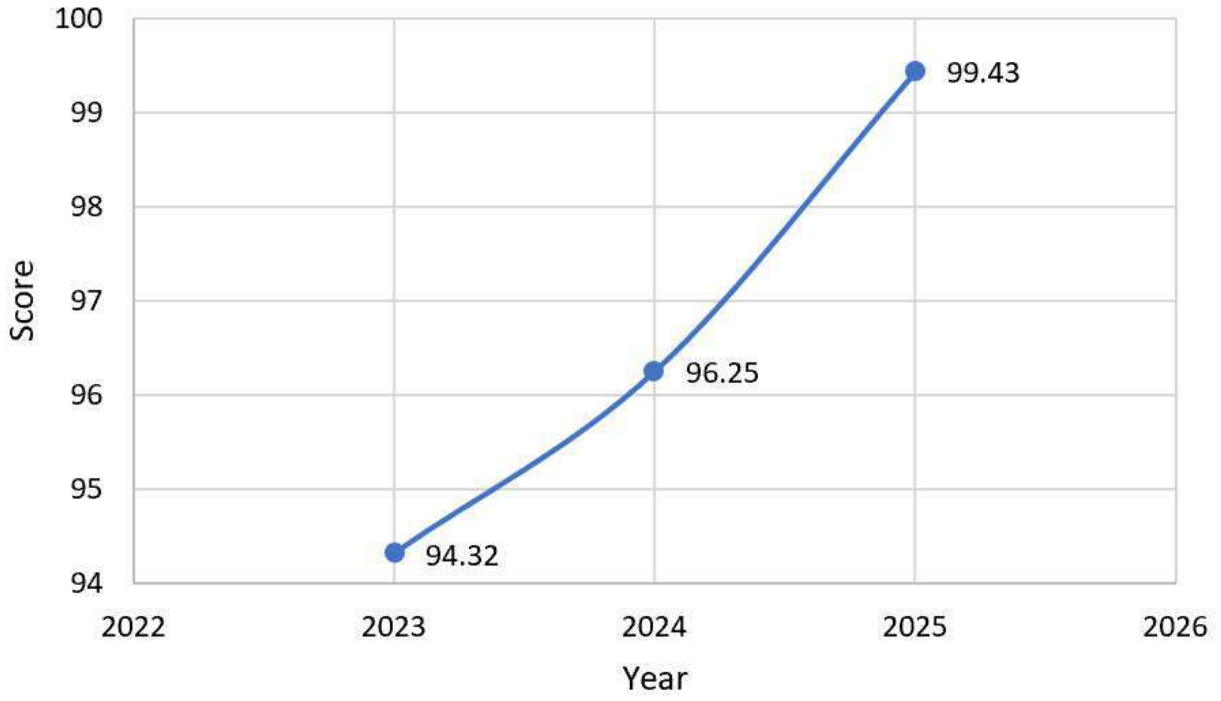

Figure5 Comparison of teaching evaluation scores of the main lecturer over the past three years using AI teaching

After AI empowering teaching, students' comprehensive application abilities have achieved remarkable results. For example, in 2025, students in the class taught by the lead teacher participated in the municipal round of the China Collegiate Computer Design Competition and won 2 second prizes and 5 third prizes, accounting for more than 30% of the total awards won by the entire school that year, demonstrating significant educational achievements (Figure 6).

Figure 6 Student-award-wining works during post-class of AI teaching

In 2025, students participated in 8 undergraduate research groups led by the main instructor, recruiting more than 30 students in total. Their abilities in hands-on practice, product development, and technical engineering practice were greatly improved. Last year, two software copyright registrations were approved for student works, demonstrating outstanding scientific research achievements.

3. Case-related images, videos, and other materials.

Some screenshots of our Courseware AI platform are as follows:

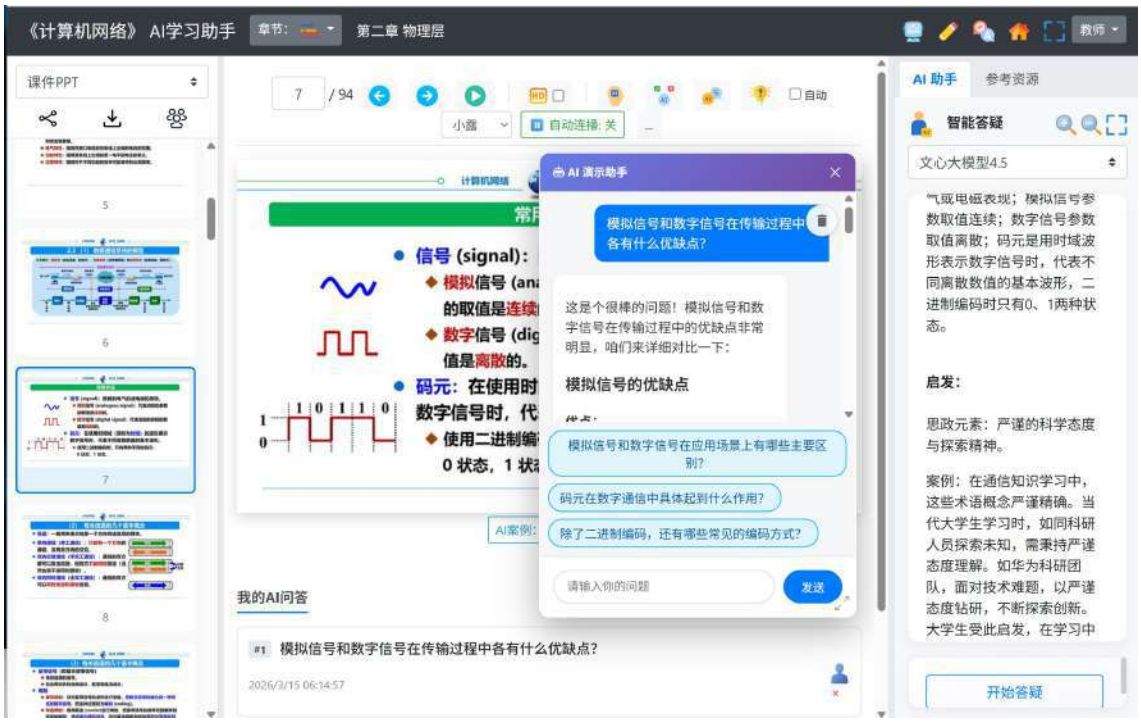

Figure A1 Question & answer about slide content

Figure A2 AI-generated multimodal case demonstration

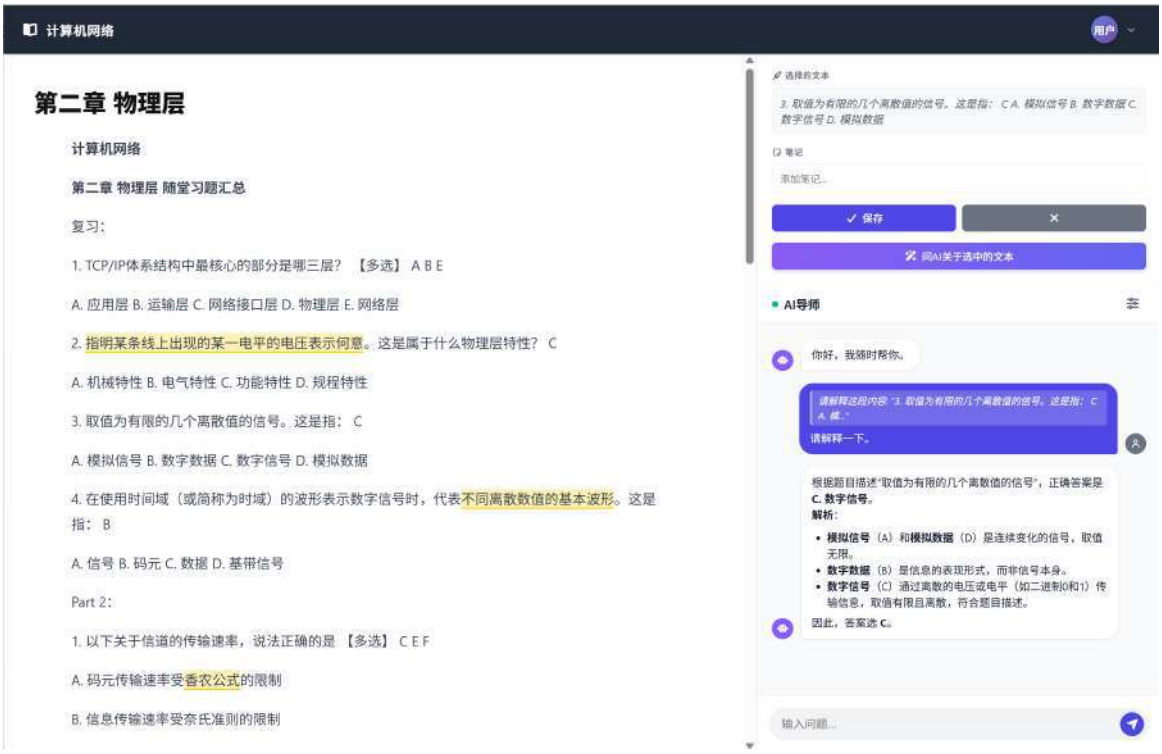

Figure A3 Smart note analysis

Figure A4 Assisting teacher preparation for courses

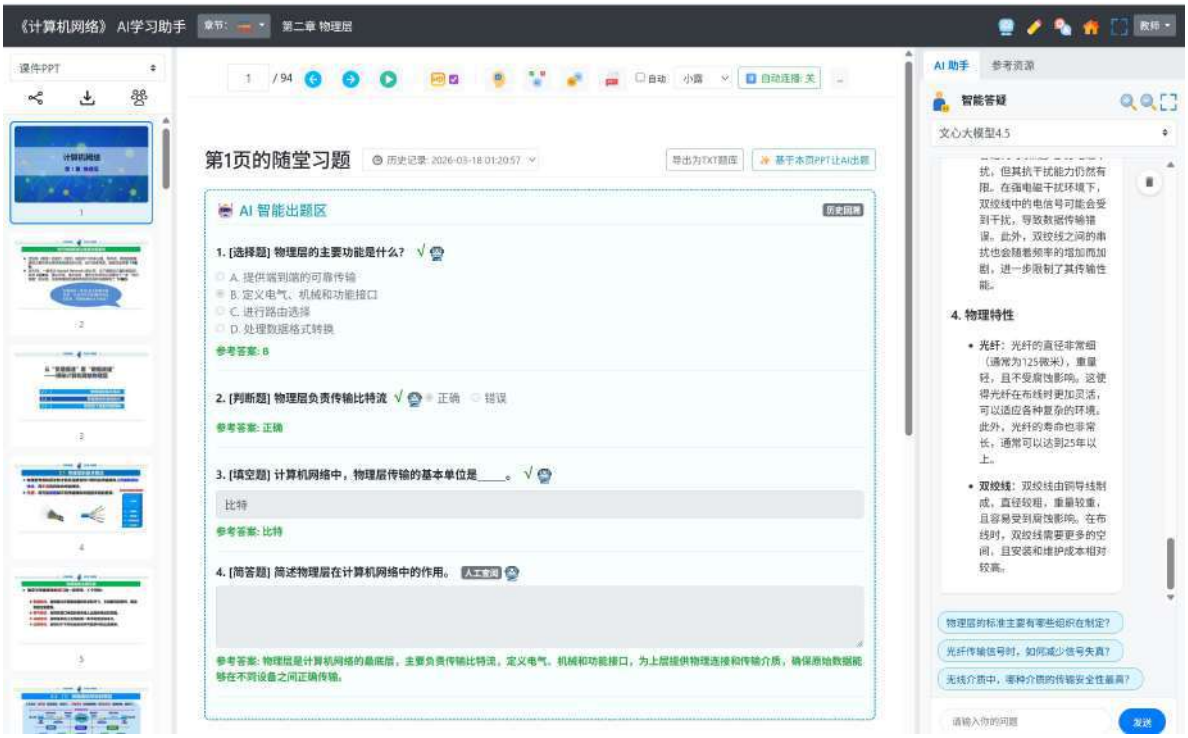

Figure A5 Intelligent question generation and assessment based on content

Figure A6 Generate personalized learning guides based on student historical records

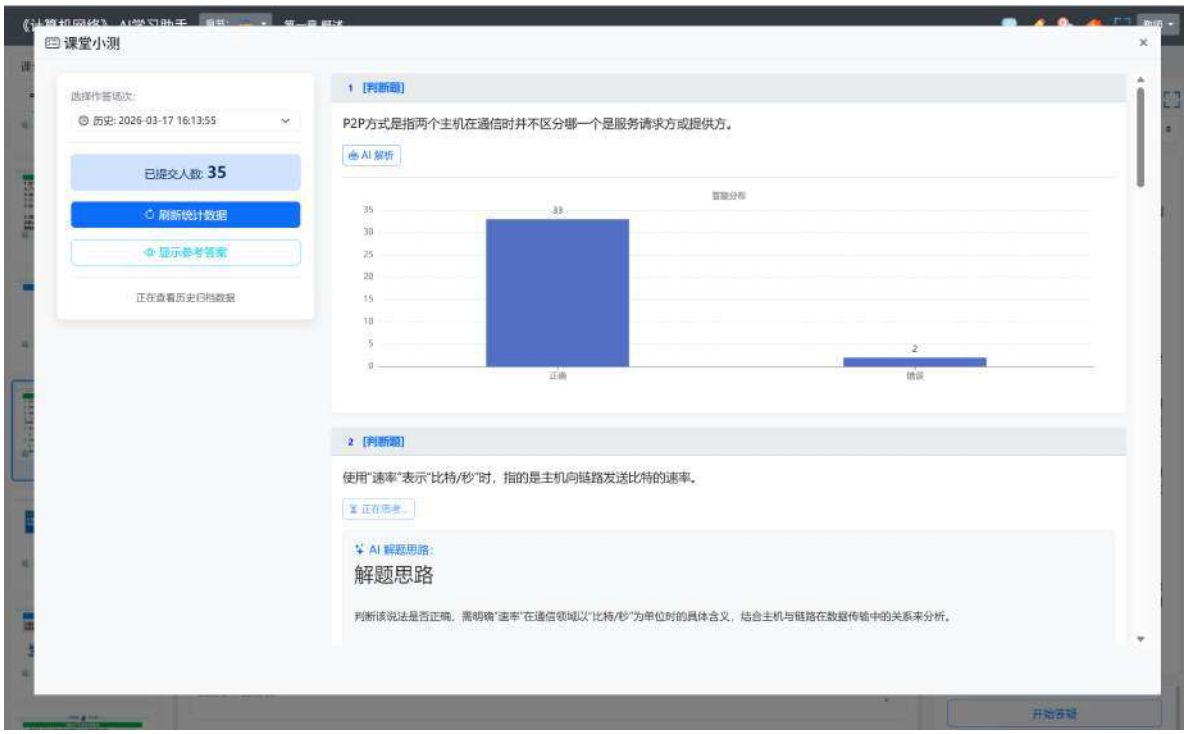

Figure A7 In-class QR code quizzes and AI analysis

Figure A8 AI-powered automatic homework grading system

Case 64

AI-Driven Educational Transformation in North Macedonia: Best Practices and Pathways from Digital Readiness to Smart Learning Environments

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Introduction

Artificial intelligence (AI) is increasingly reshaping the way education systems design instruction, support teachers, personalise learning, and govern digital environments. In North Macedonia, the use of AI in education has emerged within a broader process of digitalisation, smart education reform, and institutional efforts to modernise teaching and learning practices. Although AI has not yet been fully institutionalised across all educational levels, the country offers an illustrative case of how a smaller education system is gradually moving from digital readiness toward more intelligent and adaptive learning environments.

This chapter presents North Macedonia as a case of emerging AI use in education. It examines the educational challenges that created the need for AI-supported solutions, the implementation pathways through which AI tools have entered educational practice, the innovative characteristics of this evolving model, the currently available evidence of effectiveness, and the prospects for wider promotion and institutional scaling. The central argument is that the Macedonian case demonstrates a gradual, practice-driven, and context-sensitive transition toward AI-supported education, where the most promising outcomes arise when AI is used to support rather than replace pedagogical judgement, institutional responsibility, and human interaction.

Case Background: Educational Challenges and the Need for AI

The case of North Macedonia is rooted in several structural educational challenges that have intensified the need for more adaptive and technologically supported learning environments. First, the

education system has faced uneven levels of digital readiness across schools and institutions. While some higher education institutions and urban schools have developed stronger digital infrastructure and capacities, many settings continue to experience disparities in connectivity, access to devices, teacher preparedness, and the effective pedagogical use of digital tools. This unevenness has limited the system's ability to provide consistent and high-quality digital learning opportunities.

Second, teachers in North Macedonia, as in many other educational systems, work under increasing pressure to modernise instruction, respond to diverse learner needs, prepare differentiated materials, and adapt to rapidly changing technological expectations. Traditional methods of lesson preparation and classroom management are often time-intensive, while digital transformation requires new forms of content development, assessment design, and learner engagement. In this context, AI offers potential support by reducing routine workload, assisting in content creation, and enabling more flexible and personalised teaching strategies.

Third, students increasingly learn in digital environments characterised by information overload, diverse learning paces, and growing expectations for immediate feedback and individualised support. Standardised one-size-fits-all approaches are often insufficient, particularly in contexts where learners differ in terms of language competence, digital skills, socio-economic background, and prior knowledge. AI-supported learning tools can help address these challenges by providing adaptive explanations, self-paced study support, automated feedback, and multilingual assistance.

In the current Macedonian context, the most visible use of AI is found in higher education, training activities, research, and instructional support, rather than as a fully system-wide tool embedded across all schools. This reflects the country's transitional stage between digital readiness and broader smart education integration. At the policy level, the topic has become increasingly visible as part of the national discussion on educational modernisation. In 2025, the Ministry of Education and Science publicly framed the introduction of AI as a next step in the digital transformation of education, with an emphasis on quality, efficiency, and inclusiveness. This indicates that AI is no longer perceived merely as a technological novelty, but as part of a strategic discourse on the future of education in North Macedonia.

For these reasons, AI is increasingly perceived in North Macedonia as a practical and strategic response to educational modernisation. The case is therefore not one of fully mature system-wide AI integration, but rather of an emerging transformation in which AI serves as a bridge between existing digital readiness and the future development of smart learning environments.

Implementation Process: Measures, Technical Solutions, and Timeline

The implementation of AI in education in North Macedonia has not followed a single nationally centralised model. Instead, it has developed through a combination of institutional initiatives, teacher-led experimentation, university-based innovation, training activities, and gradually increasing policy attention. This makes the Macedonian case particularly relevant as an example of bottom-up and semi-structured implementation.

The first stage of the implementation process can be described as the **digital readiness phase**. This stage preceded explicit AI use and involved the broader expansion of ICT-supported teaching, digital learning platforms, online communication systems, and technology-enhanced instructional practices. This phase created the infrastructural and pedagogical conditions necessary for future AI integration. It

included increased use of digital classrooms, remote learning tools, and e-learning resources, especially in the period during and after the COVID-19 pandemic. In this regard, AI in North Macedonia has generally been understood as a next phase following the development of digital competences, ICT infrastructure, STEM-oriented learning, and broader smart education initiatives.

The second stage can be characterised as the **exploratory AI adoption phase**, most visible in higher education and professional practice. During this period, educators, researchers, and students began using generative AI tools such as ChatGPT and similar large language model-based systems for lesson planning, academic writing support, summarisation, content generation, translation, idea development, and quiz preparation. The type of AI technology used in this stage was primarily **generative AI**, particularly natural language processing systems capable of producing text-based educational outputs. In practical terms, these tools were applied as support technologies rather than autonomous systems. Teachers used them to generate draft teaching materials, simplify concepts, prepare discussion prompts, and create differentiated exercises. Students used them for clarification of concepts, language improvement, structuring of academic tasks, and self-directed learning support.

The third stage involved **teacher capacity-building and institutional guidance**. In this phase, universities and academic actors began developing practical guidelines, webinars, and educational discussions on how AI could be responsibly used in teaching and learning. A particularly important example is the 2025 promotion of the *Artificial Intelligence Guide*, developed with the participation of Goce Delčev University. The guide provided practical directions for recognising and using AI tools in teaching, with examples from mathematics, natural sciences, languages, and social sciences, and included an overview of more than 70 tools. This is an important implementation marker because it shows that AI integration in North Macedonia is supported not only through use, but also through structured pedagogical guidance.

The fourth stage can be identified as the **smart education integration phase**, which remains ongoing. In this stage, AI is increasingly framed not only as a classroom tool, but as part of a broader vision of smart learning environments. This includes connecting AI with digital literacy, robotics, STEM education, educational innovation, inclusion, adaptive learning, and future policy frameworks. University-level initiatives further illustrate this trend. At Ss. Cyril and Methodius University in Skopje, activities such as RoboMac 2025 have demonstrated the growing visibility of AI in robotics, automation, electronics, and student-centred innovation. This shows that AI in North Macedonia is not only used as a support tool for teaching, but is also increasingly present as a field of academic engagement, practical experimentation, and innovation culture.

A realistic implementation timeline for this case can therefore be presented in four steps:

1. **Digital readiness and platform expansion** – development of digital infrastructure and online teaching practices;
2. **Exploratory adoption of generative AI tools** – teacher and student use of AI for practical instructional and learning support;
3. **Guidance and training activities** – development of professional support, webinars, guides, and responsible-use discussions;
4. **Toward smart learning environments** – integration of AI into broader educational transformation strategies, institutional innovation, and policy discourse.

This implementation model is significant because it reflects the actual pathways through which AI tends

to enter smaller and reforming education systems: not through immediate full-system replacement, but through layered adoption, institutional learning, and gradual normalisation.

Innovation Highlights: What Makes the Case Distinctive

The North Macedonian case is innovative not because it already represents a fully formalised national AI-in-education system, but because it demonstrates how AI can be integrated meaningfully in a context of gradual transformation, limited resources, and uneven institutional capacity. Several innovation highlights distinguish this case from more standard technology-adoption narratives.

The first innovation lies in the fact that AI use in North Macedonia is strongly connected to pedagogical support rather than automation for its own sake. The most visible applications are not based on replacing teachers, but on helping them design better materials, prepare more flexible content, and respond more effectively to learner diversity. In this sense, the Macedonian case reflects a human-centred model of AI use.

The second innovation is the linking of AI adoption with the broader concept of smart education. Rather than treating AI as an isolated digital novelty, institutions and practitioners increasingly connect it with digital readiness, educational modernisation, teacher development, STEM innovation, and future learning environments. This integrative logic makes the case conceptually stronger than many fragmented AI pilots.

The third innovation concerns the role of generative AI as an accessible entry point. In a context where advanced institutional AI systems may be financially or technically difficult to deploy, the use of readily available generative tools has allowed educators and students to experiment with AI in low-cost and flexible ways. This makes the case particularly relevant for small states and transitional education systems.

The fourth innovation is the growing incorporation of ethical and governance-oriented thinking into the discussion. The Macedonian case increasingly recognises that AI in education must be developed in line with transparency, accountability, privacy, fairness, and learner protection. The relevance of principles associated with the EU AI Act and the Digital Services Act is especially important here, because it frames educational AI not merely as an instructional issue, but as part of responsible digital governance.

The fifth innovation lies in the way AI is being integrated simultaneously in teaching practice, teacher training, university research, and student innovation ecosystems. This is visible in the coexistence of classroom-oriented generative AI use, institutional guides such as the *Artificial Intelligence Guide*, academic discussion on AI pedagogy, and university-based innovation activities such as RoboMac 2025. This combination gives the Macedonian case a broader ecosystem dimension.

The sixth innovation concerns the growing body of local academic reflection on AI. In North Macedonia, AI is not only used as a tool, but is also becoming a subject of scholarly analysis. Macedonian academic work has already addressed the use of ChatGPT by students, AI-related learning practices, AI in English language teaching, and AI in robotics, cybersecurity, and computer science. This dual role of AI—as both educational instrument and object of research—strengthens the maturity of the case.

Effectiveness Proof: Evidence, Emerging Outcomes, and User Value

Because AI in education in North Macedonia is still in an emerging and partly decentralised phase, the available evidence is stronger in terms of practical value, institutional visibility, academic uptake, and user-oriented functionality than in terms of large-scale national performance metrics. Nevertheless,

several types of evidence support the view that the case has generated meaningful effects.

First, the continued and expanding use of generative AI tools by teachers and students indicates practical usefulness. Educators use AI for preparing teaching materials, formative tasks, summaries, prompts, translation support, and differentiated content, suggesting that these tools are seen as efficient and relevant to instructional work. Students use AI for self-study, revision, clarification, language support, and academic structuring, which points to perceived usefulness in daily learning practice.

Second, university-level studies and academic reflections from North Macedonia on ChatGPT use among students provide an initial evidence base that AI has already become part of the educational experience, particularly in higher education. While these studies do not yet constitute a unified national assessment framework, they demonstrate that AI use is sufficiently established to be observed, studied, and critically evaluated within the local academic context.

Third, the promotion of the *Artificial Intelligence Guide* developed with the participation of Goce Delčev University in 2025 serves as concrete institutional evidence of implementation. A guide of this kind does not merely reflect interest in AI; it represents an organised effort to support practical adoption in teaching through structured recommendations, disciplinary examples, and tool mapping. Similarly, webinars and other educational activities dedicated to AI in the Macedonian context indicate that the issue has moved from informal experimentation toward more visible educational engagement.

Fourth, university-level activities such as RoboMac 2025 at Ss. Cyril and Methodius University in Skopje demonstrate that AI is present not only as a teaching aid, but also as a field of student innovation, robotics, automation, and applied academic engagement. This matters because it expands the case beyond classroom support and shows that AI contributes to institutional innovation culture and future-oriented competencies.

Fifth, from a qualitative perspective, the main implementation effects can be summarised as follows:

- improved efficiency in lesson preparation and educational content development;
- expanded opportunities for student self-directed learning;
- stronger awareness of AI literacy and responsible-use issues;
- increased institutional openness toward smart education models;
- broader academic and public discussion of ethical and governance questions in educational technology.

At the current stage, the case would benefit from more systematic empirical tracking, including teacher satisfaction scores, comparative learning outcome data, institutional adoption rates, or student feedback surveys. However, even in the absence of full national metrics, the existing evidence supports the conclusion that AI is already generating observable functional benefits in the Macedonian educational context.

Promotion Plan: Feasibility, Transferability, and Scaling Potential

The Macedonian case has strong potential for promotion to other institutions and regions, precisely because it is based on scalable, relatively low-cost, and pedagogically accessible forms of AI use. Its promotion feasibility is high if supported by guidance, training, and institutional coordination.

One possible promotion path is horizontal scaling across educational institutions within North Macedonia. Universities, secondary schools, teacher-training institutions, and vocational education settings could adopt structured AI-support models focused on lesson preparation, learning support,

formative assessment, and responsible AI use. This would require the development of national or institutional guidance documents, teacher training modules, and examples of good practice. The experience already developed through higher education and academic initiatives can serve as a foundation for broader transfer.

A second path is regional adaptation across the Western Balkans. Many neighbouring education systems face similar conditions: uneven digital readiness, constrained institutional resources, growing interest in smart education, and pressure to align with European digital governance frameworks. Because the Macedonian case is not based on expensive or highly centralised infrastructure, it is relatively transferable to comparable settings. Adaptation suggestions would include contextualising language support, aligning with local curricula, and building governance principles into implementation from the outset.

A third promotion path is integration through teacher professional development programmes. AI can be mainstreamed not only through technology procurement, but through educator training. If teachers are equipped to use generative AI critically and ethically, adoption can expand more organically and sustainably across institutions. In the Macedonian case, the importance of guides, webinars, and practice-oriented support already demonstrates the feasibility of this pathway.

A fourth path concerns policy-driven promotion. Ministries and educational authorities could use the Macedonian case as a basis for drafting broader national recommendations on AI in education, covering issues such as AI literacy, transparency, human oversight, privacy, non-discrimination, and child protection. This is where alignment with European norms becomes especially important. The 2025 European Commission report on North Macedonia highlighted the need for further alignment with the EU AI Act and the establishment of relevant implementation structures. This suggests that promotion of AI in education should proceed not only through innovation discourse, but also through ethics, data protection, and regulatory preparedness.

The expected promotion effects include greater teacher efficiency, stronger student support, better institutional preparedness for smart education transition, more responsible and ethically aware use of educational AI, and improved regional cooperation around AI in education practices. The feasibility of promotion is strengthened by the fact that the case does not depend on a single proprietary platform or a large-scale technical overhaul. Instead, it can be replicated through phased introduction, training support, ethical guidance, and adaptation to local educational conditions.

Conclusion

North Macedonia offers an illustrative and evolving case of how artificial intelligence can be introduced into education through gradual, practice-based, and context-sensitive processes. The experience so far shows that AI in the Macedonian educational context has been used primarily in higher education, training, research, instructional support, and student learning assistance, rather than as a fully institutionalised or system-wide tool embedded across all schools. This is an important characteristic of the Macedonian case, as it demonstrates a human-centred approach in which AI complements rather than replaces the role of teachers and educational institutions.

The Macedonian experience also indicates that AI adoption in education is most effective when it builds on existing digital readiness and when it is linked to broader goals of smart education, inclusion, innovation, and pedagogical flexibility. Current practice shows growing use of generative AI tools for

lesson preparation, summaries, translation, quiz generation, academic writing support, and personalised learning assistance. It also reveals the importance of supporting structures such as the *Artificial Intelligence Guide*, university-based innovation activities, academic research on AI use, and broader public and institutional discussion. At the same time, the case reveals important limitations, including uneven institutional capacity, differences in teacher preparedness, the absence of fully standardised implementation models, and the need for clearer ethical and regulatory guidance.

These experiences suggest that the transition toward smart learning environments in North Macedonia cannot be reduced to access to technology alone. It must also include AI literacy, human oversight, transparency, data protection, learner protection, and institutional responsibility. The growing relevance of the EU AI Act and the broader European digital governance agenda reinforces the need for North Macedonia to approach educational AI not only as a matter of innovation, but also as a matter of trust, rights, and accountability.

Although the use of AI in education in North Macedonia is still developing, the experience to date provides valuable lessons. It suggests that meaningful implementation can begin with accessible generative AI tools, practical teacher support, and institution-led experimentation, but that long-term success depends on strategic coordination and evidence-based governance. In this respect, North Macedonia represents a relevant example of how a small and reform-oriented education system can approach AI-driven educational transformation gradually, critically, and in alignment with both educational goals and emerging European standards for trustworthy and responsible AI use.

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Case 65

From Inquiry to Insight: Leveraging AI Assistant to Transform Student Engagement and Institutional Efficiency in Higher Education

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Background

The rapid acceleration of artificial intelligence (AI) in higher education has fundamentally reshaped student expectations around access to information, responsiveness and personalised academic support. The adoption of AI in education is strategically prioritised under the AI Talent and Capacity Development pillar of Zimbabwe's National AI Strategy (Government of Zimbabwe, 2026). This pillar underscores the need for the systematic integration of AI and data literacy across all levels of the education ecosystem. Within this framework, universities are positioned as key delivery vehicles, expected to institutionalise programmes on AI and Society that foreground social and behavioural change communication, thereby ensuring that AI deployment is not only technically proficient but also socially responsive and ethically grounded. Universities are increasingly leveraging AI to foster deeper engagement with their diverse stakeholders such as students, staff and the broader community by integrating intelligent digital technologies into daily operations (Mele et al., 2024).

The Women's University in Africa (WUA) has a multi-campus system with five physical campuses and a global virtual campus that accommodates students located in different countries supporting a population of 5,500 students. Where there are multiple campuses and virtual learning environments, AI assistants can standardise information dissemination and support services, ensuring equitable access to resources regardless of geographical location (Chukwuere, 2024). One of the University's strategic pillars in the 2026-2027 Transformational Strategy is Student Experience and Success which focuses on producing a globally connected, well-rounded student who thrives during and after their studies (Women's University in Africa, 2025).

At WUA, a key institutional challenge identified was the fragmentation of student support services, limited real-time engagement mechanisms and gaps in student understanding of university processes, academic requirements, and available resources.Students often encounter delays in accessing critical information related to admissions, course registration, academic policies, ibrary services and

administrative procedures. These inefficiencies affect student satisfaction and contribute to misinterpretation of institutional processes, increased administrative workload and reduced academic effectiveness.

The University conducts periodic customer satisfaction surveys through the Quality Assurance Department. The 2025 survey revealed a critical service delivery gap in the university's communication ecosystem, with a particular emphasis on delayed response times to student queries. While some respondents reported acceptable experiences, a significant proportion rated responsiveness at 3 out of 5 or below, indicating inconsistent and often slow turnaround times, especially from the ICT department and during key processes such as applications and financial enquiries. Students highlighted persistent challenges, including lack of clarity on financial balances, delayed portal updates and limited access to timely information on institutional policies. These have emerged as primary sources of dissatisfaction, compounding frustration and eroding trust. These findings pointed to inefficiencies in the manual query-handling mechanisms, where reliance on manual processes constrained the institution's ability to deliver real-time, scalable support.

To address these challenges, WUA initiated the implementation of an AI-powered assistant as a strategic intervention aligned with digital transformation and AI literacy priorities. By automating routine enquiries and integrating with existing systems to provide real-time updates, the chatbot directly addresses the identified bottleneck of delayed responsiveness, thereby enhancing service efficiency, improving student experience, and strengthening institutional credibility. The AI Assistant, affectionately named Fay (first name of one of the university's co-founders, Dr Fay Chung), is designed to provide real-time, intelligent responses to student queries, thereby enhancing accessibility, improving student experience and strengthening institutional communication.

The primary objective of this initiative is to leverage AI to create a scalable, student-centric support ecosystem that improves understanding, engagement and navigation of university systems while promoting responsible and ethical AI use in education.

Case Implementation Status

The text below showcases the exploratory practices carried out in aspects such as demand analysis, technology research and development or personalized customization, and application optimization. Where applicable pictures are used for better illustration.

1. Evidence-Based Demand Analysis

The development of the WUA Chatbot was informed by a structured needs assessment incorporating the following:

- Analysis of frequently asked student queries from all the student-interfacing departments (Academic Registry, ICT, Library, Student Affairs, Bursary, among others)
- Stakeholder consultations (students, faculty, administration)
- Review of service delivery inefficiencies

Findings revealed a high demand for:

- 24/7 access to institutional information
- Simplified interpretation of academic policies and procedures
- Faster response mechanisms
- Digitally mediated student support

2. Technology Customisation and Platform Integration–The AI EcoSystem

The implementation of the AI Assistant required customisation to ensure that it understood the academic and administrative context of the University. Execution was done across three platforms:

- University Learning Management System (myHope): Integration with myHope, a Moodle derivative, allowed the AI Assistant to serve as an asynchronous tool for academic and administrative support. The AI assistant was trained to help students navigate the myHope environment, access/locate course material, communicate university activities, and resolve minor issues without waiting for someone to come online.
- University Website: The AI Assistant was embedded on the website as a persistent, floating widget guiding university stakeholders on general inquiries, faculty offerings and university campuses, among other information needs
- Online Application Portal: The university is currently training the assistant on university admissions criteria and workflows to better support applicants in real-time on issues that include document uploads, admission requirements and troubleshooting submission errors to reduce applicant drop-out rates.

The chatbot leverages Natural Language Processing (NLP) and Generative AI models to simulate human-like interaction and deliver contextually relevant responses.

Key design features include the following:

- Institution-specific knowledge base trained on academic regulations, policies, and services
- Conversational interface enabling intuitive student interaction
- Adaptive learning capability through continuous data inputs

This represents a localised AI solution, tailored to the socio-educational context of Zimbabwe. Functional domains include:

- Academic advising support
- Administrative query resolution
- Research and library guidance
- General institutional navigation

The chatbot functions as a frontline digital assistant, streamlining access to information and reducing reliance on manual processes.

Figure 1 Mapping between the UNESCO AI Competency Framework for Students and the Pearson AI Certification Pathway (Adapted from the Pearson–UNESCO alignment guide).

Fay undergoes continuous knowledge base development and regularly reviews the interaction logs to identify gaps and insights into student queries and updates the knowledgebase accordingly. This ensures that Fay's responses are accurate and contextually relevant.

Case Innovation and Breakthroughs

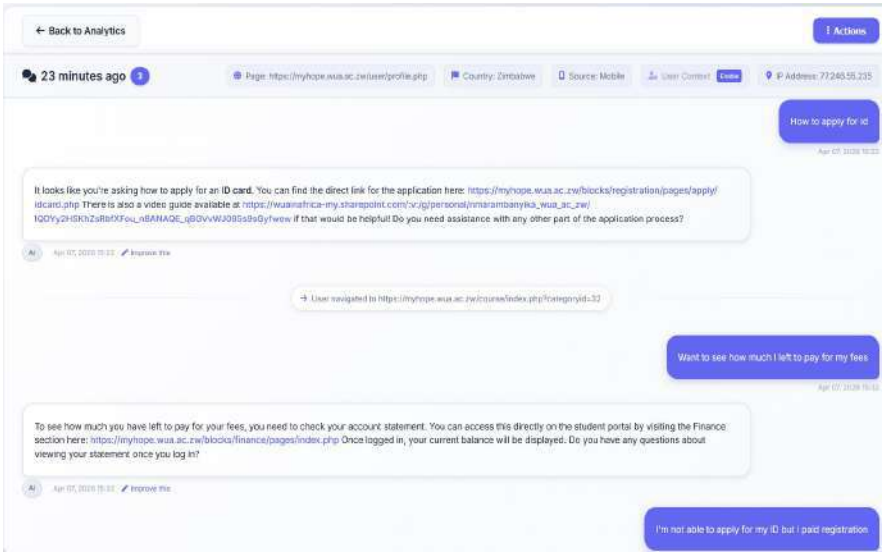

Figure 2 Anonymised student interaction with Fay

The deployment of AI in higher education not only streamlines administrative tasks and enhances the learning experience but also provides valuable data for informed decision-making regarding student recruitment and personalized interventions (Segova-Garcia, 2024). Data obtained from Fay Virtual Assistant provide insights on what current and prospective students need as shown in Figure 2.

1. Educational and Pedagogical Innovation

Fay advances a student-centred, AI-augmented support model, shifting from reactive administrative services to proactive, intelligent engagement.

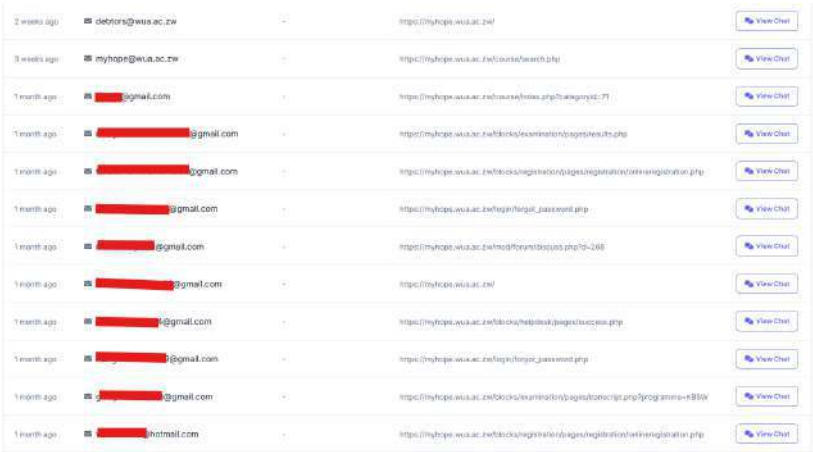

Figure 3 Leads from student engagement for additional human follow-p and support

2. Technological Breakthrough

The chatbot demonstrates a bespoke AI deployment in a resource-constrained environment by:

- Utilising generative AI for dynamic response generation for successful omnichannel conversational continuity
- Adapting NLP to recognise and accurately process localised educational contexts
- Enabling scalable, low-cost digital support infrastructure

This positions the solution as a benchmark for AI adoption in emerging higher education systems.

3. Application Practice Breakthrough

Key breakthroughs include the following:

- Elimination of the weekend/holiday blackout to student engagement
- Reduction in administrative bottlenecks
- Increased efficiency in student service delivery
- Improved clarity and accessibility of institutional information
- Strengthened student engagement metrics
- Information provided in three main languages including English and two main vernacular languages of Shona and Ndebele.

The AI assistant effectively bridges the gap between institutional complexity and student understanding.

4. Intellectual Property and Knowledge Contribution

The underlying neural architectures and core machine learning models are the proprietary intellectual property of Asyntai. However, the university has full ownership of custom-developed knowledge bases, training datasets and all student interaction logs generated during deployment. The solution is institutionally developed and customised, with ownership retained by WUA. It presents opportunities to contribute to global AIED knowledge repositories.

Promotion Value and Risks

1. Application Prospects and Achievements

Figure 10: Fay's usage statistics from the pilot in January to implementation in March 2026

Fay demonstrates strong scalability and institutional integration potential as an AI-enabled student support system.

Currently, Fay has been deployed across key digital touchpoints, including the university website and student learning portal, where it operates as a first-line interface for academic, administrative and research-related enquiries. Its application spans multiple functional domains such as admissions, registration, academic policies and library services, thereby ensuring both depth and breadth of use.

From an operational perspective, the Fay follows a hybrid management model combining automated AI-driven responses with human oversight for quality assurance and escalation of complex queries. Early implementation outcomes indicate improved response times, reduced administrative workload and enhanced student access to information.

Looking forward, the solution presents prospects for large-scale promotion. Its modular architecture enables replication across faculties, campuses and other higher education institutions. With further optimisation, the chatbot can evolve into a fully integrated institutional intelligence system, supporting predictive analytics, student success interventions and personalised learning pathways.

2. Social and Economic Value

The WUA Chatbot generates substantial social and economic value by democratising access to institutional information and enhancing student empowerment. It ensures equitable, 24/7 access to critical academic and administrative information, particularly benefiting students with limited physical access to campus services. Oluusolo et al., (2024) highlighted that challenges addressed by AI Virtual Assistants in answering student queries. AI-powered chatbots, for instance, can provide immediate, accurate responses to frequently asked questions, thereby reducing response times and improving overall service delivery. This capability enhances student satisfaction by providing instant access to information and frees up staff to focus on more complex issues requiring human intervention (Popescu et al., 2023).

Economically, the system contributes to cost efficiencies by reducing reliance on manual administrative processes and optimising staff time allocation. Khan et al (2025) pointed out that use of AI-powered assistants is critical in resource-constrained settings where there is often an acute shortage of human capital for administrative and support functions. Furthermore, the automation of routine administrative tasks through AI tools, such as attendance tracking, grading and report generation, significantly eases the administrative burden on educators, allowing them to dedicate more time to strategic responsibilities and direct student engagement (Suazo-Galdamés & Chaple-Gil, 2025).

This results in improved student satisfaction and retention further translate into institutional sustainability and performance gains. Additionally, the initiative contributes to national digital transformation agendas by promoting practical AI adoption within the education sector.

3. Demonstration and Leading Role in Education

WUA's AI Assistant serves as a pioneering model for AI integration in higher education within Zimbabwe and the broader African context. It demonstrates how conversational AI can be effectively leveraged to enhance student engagement, improve institutional communication and streamline service delivery.

As a proof of concept, the initiative provides a replicable framework for other institutions seeking to adopt AI-driven solutions. Its alignment with global trends in AI in Education positions it as a benchmark for innovation, particularly in resource-constrained environments. Furthermore, it contributes to building institutional capacity in AI literacy and responsible AI use, reinforcing its leadership role in digital education transformation.

4. Potential Risks and Mitigation Strategies

Technical Risks

- Inaccurate or outdated responses due to incomplete datasets
- System downtime or performance limitations

Mitigation: Continuous system training, regular updates to the knowledge base, and robust IT infrastructure support

Ethical Risks:

- Data privacy and security concerns
- Algorithmic bias in responses
- Over-reliance on AI reduces human interaction

Mitigation: Implementation of data governance policies, adherence to ethical AI frameworks (e.g., UNESCO Recommendation on AI Ethics, Zimbabwe's National AI Strategy 2026-2030 and the

University's AI Policy), and maintaining a human-in-the-loop support model.

Operational Risks:

- Resistance to adoption by users
- Misinterpretation of AI-generated responses

Mitigation: User training, awareness campaigns and clear communication on the scope and limitations of the chatbot.

Other Relevant Information

1. Case Award Status: None

2. Third-Party Evaluation

Preliminary evaluation of the WUA Chatbot has been conducted through internal user feedback mechanisms and stakeholder consultations involving students, academic staff and administrative personnel.

User Evaluation (Students):

- Reported significant improvement in response time and accessibility of information
- Enhanced understanding of academic processes such as registration, course requirements and institutional policies
- Increased satisfaction with the availability of 24/7 support

Institutional Feedback (Staff and Administration):

- Reduction in repetitive inquiries handled manually by administrative offices
- Improved efficiency in service delivery and communication workflows
- Positive reception as a complementary support tool rather than a replacement for human interaction.

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Case 66

Building a "Foundation + Application + Service" Ecosystem to Empower Holistic Intelligent Governance in Schools

Ling Zhou

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Case Background

Xinmin Primary School in Dongzhou Subdistrict, Fuyang District, Hangzhou, addresses the needs of educational digital transformation with the core goal of "Technology Empowering Education, Digital Intelligence Illuminating the Campus." Leveraging technological advantages in AI, IoT, big data, and structured audio-video, the school has constructed a "1+4+7+N" digital-intelligent campus holistic solution. It clearly defines its role as "Foundation Building, Application Enabling, Service Quality Enhancement" to drive the transformation of campus management from experience-driven to data-driven. This initiative aims to create a smart campus benchmark characterized by "One School's Innovation, Sharing Across the District, Radiation Across the Region," injecting robust digital-intelligent momentum into high-quality regional educational development.

Implementation Process

1. Overall Architecture Design

The solution adheres to the principles of "Integrated Coordination, Full-Scenario Coverage, Replicability, and Scalability." It is structured into four layers: Foundation Layer, Support Layer, Application Layer, and Scenario Layer. These layers work in synergy to form a complete architecture of "Solid Foundation, Powerful Support, Diverse Applications, and Scenario Adaptability," achieving comprehensive coverage of campus teaching, management, service, and security scenarios.

1.1 Core Foundation: The Campus Digital Application Foundation deeply integrates underlying technical components, standardized data interfaces, and comprehensive specification systems. It seamlessly connects with third-party resource platforms such as the regional education platform and the provincial "Zhi Jiang Hui" platform, breaking down data silos and business isolation within the

education ecosystem. It provides unified data, technical, and security support, laying the groundwork for regional sharing and solving resource integration challenges.

1.2 Support Centers: The Smart Campus Basic Support Center (hardware and network operation), NAS Data Resource Center (full-volume data storage), Data Governance Center (data standardization management), and IoT Perception Center (IoT terminal integration) construct a comprehensive support system. This ensures stable solution operation and secure, usable data.

1.3 Collaborative Systems: Seven collaborative systems covering Teaching, Safety, Evaluation, Internal Control, Home-School Communication, IoT, and Publicity & Education span five key domains: "Teaching, Safety, Evaluation, Management, and Control." They enable full-process collaboration in campus operations, breaking down departmental barriers.

1.4 Characteristic Applications: Based on the seven collaborative systems, 23 characteristic applications tailored to actual campus needs have been developed. These cover scenarios like collaborative lesson planning, AI-based early warning, and intelligent duty management. They are configurable on-demand, flexible for iteration, adaptable to schools of different scales, and allow room for future expansion.

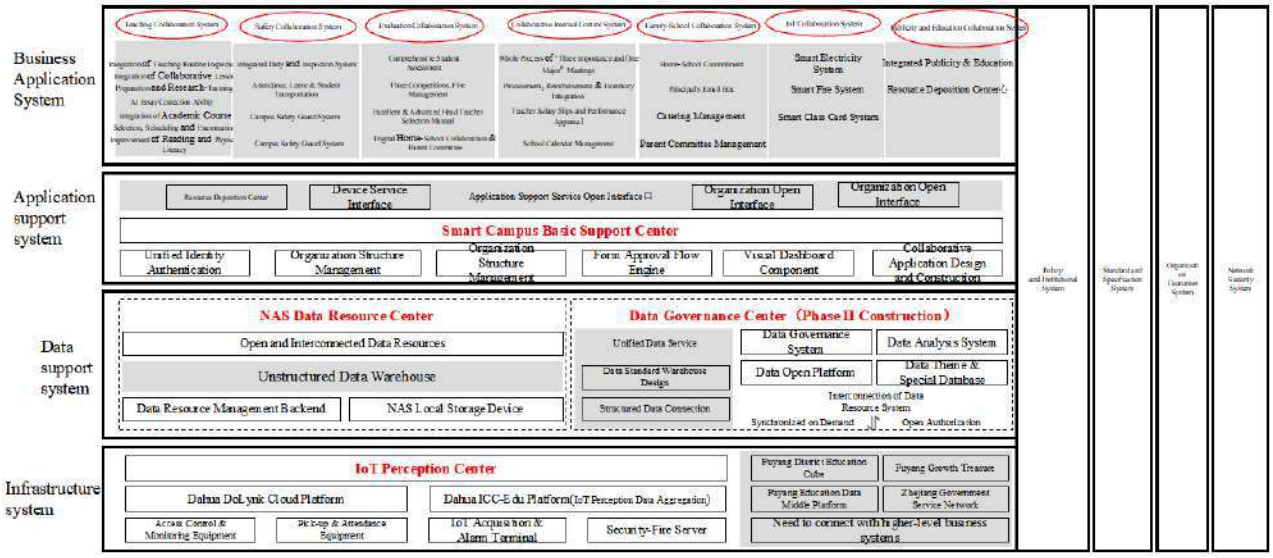

Figure 1 Overall Framework of the School's Digital Campus Construction

2. Defining Functional Positioning

2.1 Foundation Support Positioning: Achieves unification of technology, data, and standards, breaking system fragmentation and data silos, supporting regional application sharing, and reducing the cost of regional educational digitalization.

2.2 Teaching Empowerment Positioning: Assists teachers in efficient lesson preparation and precise teaching. Through personalized learning pushes and process-oriented evaluation, it empowers students' holistic development, addressing pain points like unreasonable teacher structure and weak student foundations.

2.3 Management Quality Enhancement Positioning: Leverages big data and AI to achieve intelligent campus management. Provides decision-making basis through data visualization, driving the management model transformation from experience-driven to data-driven, and campus safety from reactive response to proactive early warning.

2.4 Service Upgrade Positioning: Creates a convenient and efficient service system, improves the experience of teachers/students and parent satisfaction, builds a new collaborative education pattern involving "Home, School, and Community," and perfects the smart campus service ecosystem.

Innovative Highlights

1. Technical Enhancement Highlights

1.1 Deep Integration of Multiple Technologies: Integrates cutting-edge technologies like AI intelligent recognition, big data, and IoT to achieve comprehensive perception and intelligent analysis of campus scenarios (e.g., intelligent early warning for abnormal events, classroom behavior analysis, non-intrusive attendance, device linkage). This enhances application effectiveness.

1.2 Foundation-based and Modular Design: Unifies technical standards and data interfaces, seamlessly connecting with various platforms. Supports flexible addition, removal, and iteration of applications, adaptable to different school types, avoiding redundant construction.

1.3 Comprehensive Data Security: Builds a full-process data security protection system. Applies technical means like data encryption, access control, and security audit tracing to comprehensively safeguard sensitive campus information, ensuring compliance and strictly adhering to educational data internal control standards and privacy baseline.

1.4 Lightweight Deployment: Enables low-cost implementation, simplifies operational procedures, and is adaptable to the digital literacy levels of primary/secondary school teachers and administrators. Ensures high application adoption and practical usage rates, aligning with actual school needs.

2. Innovative Breakthroughs

2.1 Model Innovation: Establishes a "School-Enterprise Cooperation, Top-Level Design, Pilot Promotion, Regional Sharing" model. Collaborates with enterprises like Digital Intelligence Fuchun to form a virtuous cycle, reducing regional construction costs and elevating overall levels.

2.2 Scenario Innovation: Breaks through the drawback of "emphasizing management over teaching." Creates a full-scenario application system, deeply integrates AI with classrooms, innovates safety protection and evaluation models, closely aligning with the core needs of teachers and students.

2.3 Service Innovation: Constructs a full-cycle service system of "Technical Support + Application Training + Continuous Iteration." Conducts over 100 online/offline seminars, collects needs for ongoing optimization of solution adaptability.

Case Achievements

1. Scenario Description

The solution is adaptable to various primary and secondary schools, covering five major domains: "Teaching, Safety, Evaluation, School Operations, Management." It clearly defines the application environment and implementation targets. Combined with Xinmin Primary School's practice, it demonstrates the solution's practicality and operability, providing a referable path for digital transformation.

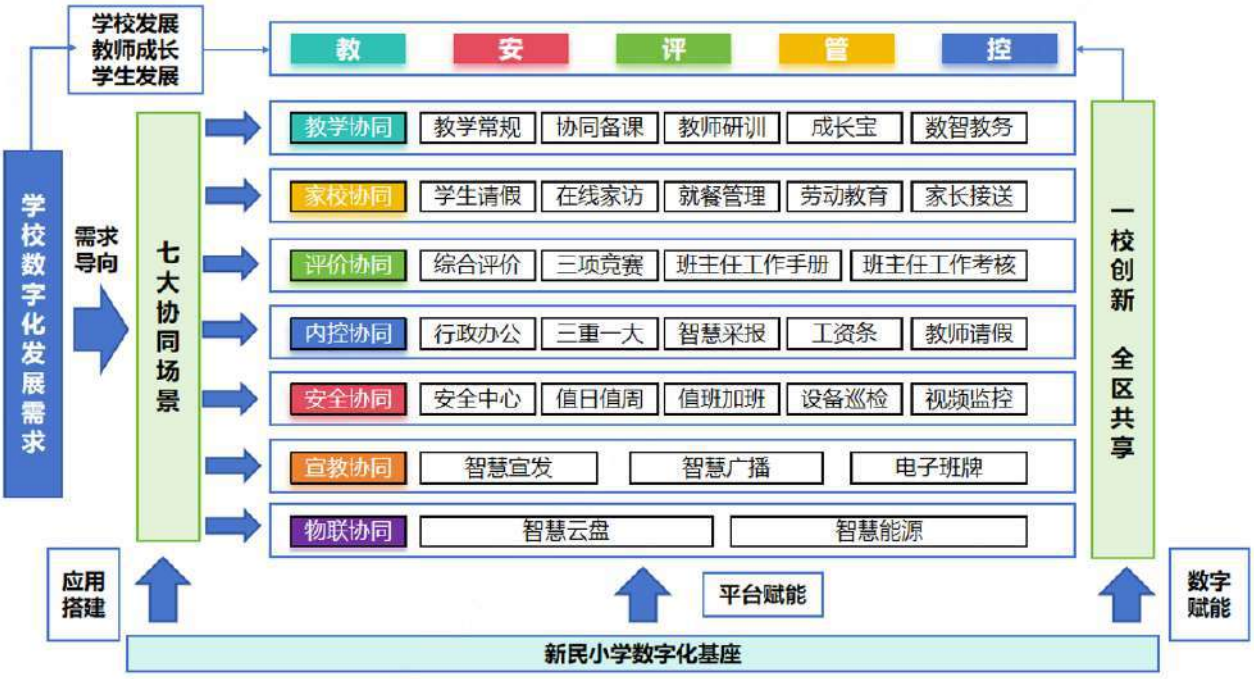

Figure 2 School Digital Campus Demand Collaboration Scenarios

2. Application Environment

Requires no large-scale hardware renovation, enabling lightweight deployment based on existing school infrastructure: Hardware supports gigabit campus networks and is compatible with existing equipment; customizable IoT terminals. Software is compatible with mainstream operating systems and seamlessly integrates with regional education platforms and office platforms like DingTalk. Personnel requires only 1-2 digital specialists; teachers and parents can operate after simple training.

3. Implementation Targets

Covers all stakeholders in primary/secondary schools: School level (various types, focusing on schools with urgent transformation needs), Teacher level (all faculty/staff, providing personalized services), Student level (all students, adaptable to different foundations), Parent level (enabling home-school communication), Regional education management level (supporting coordinated decision-making).

4. Typical Application Scenario Examples

4.1 Precision Teaching Scenario: Adaptable to schools with mismatched faculty structure. Leverages the teaching collaborative system to achieve: pre-class collaborative lesson preparation ("Lead Preparer + Assistant Preparer" model, introducing good quality resources), post-class teaching inspection (class observation scoring, real-time feedback), and spare-time training enhancement (closed-loop management). Xinmin teachers have conducted 8 provincial/city-level demonstration lessons, effectively promoting professional growth.

4.2 Campus Safety Scenario: Adaptable to various schools. Integrates IoT hardware to achieve: AI active early warning (event pop-ups, process closing the loop), intelligent duty management (schedule reminders, real-time feedback), intelligent inspection (closed-loop handling of hazards), and safe student pickup (staggered dismissal, parent inquiry). Xinmin's hazard handling efficiency increased by over 60%, with no safety incidents occurring.

Figure 3 Intelligent Duty Management

4.3 Home-School Collaboration Scenario: Adaptable to schools with inconvenient home-school communication. Through the home-school collaborative system, it enables: (reassuring dining - menu),assured home visit (digital home visit management), and smart class displays (information presentation). Xinmin achieved full coverage of home visits, with parent satisfaction rising to over 95%.

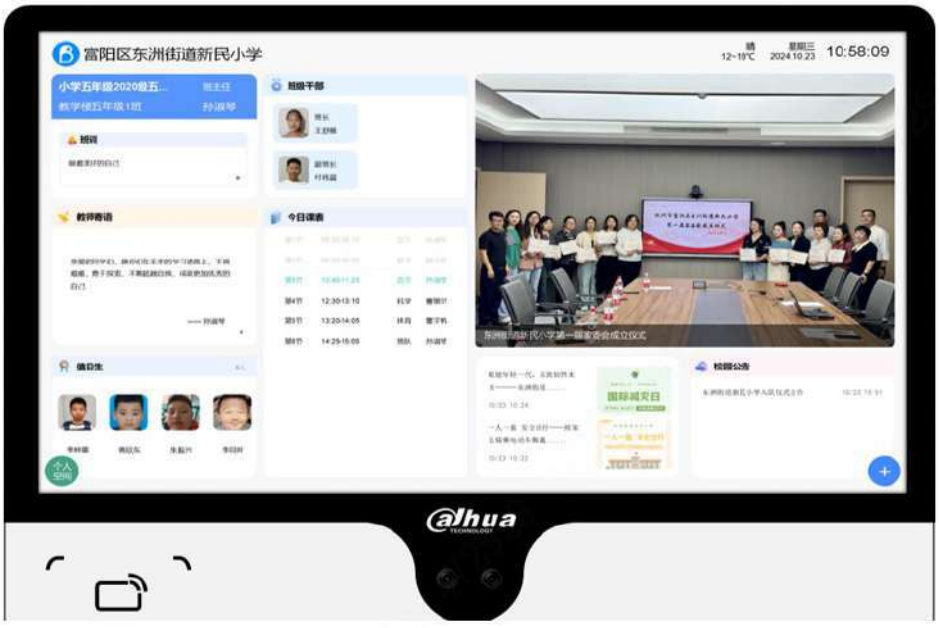

Figure 4 Smart Class Display

4.4 Evaluation Collaboration Scenario: Adaptable to schools needing to optimize evaluation systems. Leverages the evaluation collaborative system to achieve: teacher evaluation (data-supported teacher allocation) and student comprehensive quality evaluation (process-oriented, personalized). Xinmin's teacher allocation efficiency increased by over 50%, with student evaluation coverage reaching 100%.

4.5 Internal Control Management Scenario: Adaptable to schools needing refined management. Through the internal control collaborative system, it enables: intelligent procurement (closed-loop management, asset early warning), intelligent document handling (standardized circulation), and intelligent meeting management (full-process management). Xinmin's internal control management efficiency increased by over 70%, and document circulation cycle shortened by 60%.

Replicability

The solution, with the school as the core pilot, has been continuously optimized with significant results, forming replicable and scalable experience. The following details this with real data and cases, providing solid support for digital education forums.

1. Implementation Results

1.1 Significant School Digital Transformation Results: Xinmin rapidly established its digital campus, launching 6 reassuring services and 17 intelligent management applications. It passed the district data bureau‘s final acceptance in December 2024. The case was reported by the district education bureau and provincial education department. Management efficiency improved by over 70%, and internal control standardization rate reached 100%.

Figure 5 Zhejiang Provincial Education Department News Website Report on the School's

1.2 Outstanding Teaching Quality and Teacher/Student Outcomes: Enhanced digital capabilities of Xinmin teachers, who conducted 8 provincial/city-level demonstration lessons and 16 classroom analyses, with over 300 attendees. Average student academic performance improved by over 15%, and

wins in district-level science and technology competitions increased by over 40%. Overall literacy of teachers and students improved.

1.3 Prominent Regional Radiation Effect: Applications reached 5 schools and 140,000 teachers/students in Fuyang District. Cultivated the Fuchun Science Education lecturer group to promote practical methods. Attracted visits and exchanges from over 20 institutions and 500+ individuals, expanding the solution's influence.

1.4 Deepened School-Enterprise Collaboration: Deepened cooperation with Fuyang District Education Bureau, Xinmin Primary School, etc. Conducted over 100 online/offline seminars, cumulatively training over 800 teachers. Deepened international exchanges and continuously optimized the solution.

2. Replicability and Scaling Potential Analysis

2.1 Replicability: Modular architecture allows flexible configuration for various schools. The "School-Enterprise Cooperation + Pilot Promotion" model is replicable elsewhere. The 23 characteristic applications are user-friendly for quick trial promotion.

2.2 Scaling Potential: Multiple national policies provide support, and regions urgently need mature solutions. The solution accurately solves industry pain points, fitting broad needs. Dahua provides strong technical and service guarantees. Pilot cases have received official recognition, demonstrating strong leading demonstration effect.

3. Typical Implementation Case Description

Case: Digital-Intelligent Campus Construction Project at Hangzhou Fuyang District Dongzhou Subdistrict Xinmin Primary School

3.1 Case Background: Xinmin, a newly established school with 39 teachers and 780 students, faced challenges like an unreasonable faculty structure and weak student foundation. As a district digitalization pilot, it urgently needed digital transformation for leapfrog development, entering deep cooperation with Dahua.

3.2 Implementation Content: Dahua has tailored the “1+4+7+N” solution, implementing 23 characteristic applications, setting up the foundation, support centers, and collaborative systems. Introduced digital specialists. Applications were optimized through over 50 seminars to promote implementation.

3.3 Implementation Results: The school built an "Education Brain" and passed district final acceptance; the case received official reports. Teacher/student quality improved significantly; management effectiveness increased substantially. Applications benefit surrounding schools, establishing the school as a benchmark for digital transformation in new schools, demonstrating the solution's practicality and innovativeness.

In summary, through the integrated design of "Foundation + Application + Service," Xinmin Primary School has accurately resolved the pain points of digital transformation in primary and secondary schools, achieving significant, replicable results. Moving forward, the school will continue to deeply cultivate the field of educational digitalization, optimizing the solution and deepening cooperation to assist high-quality educational development.

Case 67

Seeing, Understanding, Supporting: Reconstructing a New Ecology of Diversified Evaluation in Basic Education Driven by AI "Holographic Portrait"

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Background

Pain Points and Challenges: The “Grade-Centric” Paradigm and “Invisible Students”

Historically, basic education assessment has been deeply mired in a “grade-centric” paradigm, where core competencies like moral character, aesthetic appreciation, labor practice, and innovation remain difficult to quantify. Consequently, students who do not excel academically are reduced to “invisible students,” their unique potential largely overlooked. Furthermore, traditional moral evaluations rely on subjective impressions and summative end-of-term comments. Lacking process-oriented data, such evaluations suffer from latency, bias, and arbitrariness. They fail to reflect a student's holistic developmental trajectory, constraining the integration of the “five domains of education” (moral, intellectual, physical, aesthetic, and labor). Ultimately, this deprives the assessment system of its motivating functions, posing a severe challenge to educational equity.

Necessity and Significance: Constructing a “Data-Driven, Multidimensionally Integrated” Ecosystem

Aligning with the Outline of the Strategic Plan for Building a Leading Country in Education and the "AI + Education" initiative, national policy mandates deepening assessment reform, rectifying deviations like "grades supremacy," and building scientific evaluation systems supported by big data and AI. Closely addressing this mandate, this case leverages "School Brain 3.0" and Multi-Agent Technology to dismantle data silos. It transforms non-academic data—behavioral performance, course participation, social practices, and psychological states—into quantifiable assessment variables, reconstructing a closed-loop system of "data collection, analysis, diagnosis, and incentivization." This realizes a fundamental paradigm shift from "experience-based commendation" to "data-driven talent

identification," and from a "one-size-fits-all" approach to "individualized strategies." Ultimately, it actualizes the vision of "seeing, understanding, and supporting every child," providing a replicable digital solution for fostering virtue through education.

Case Implementation Status

Over a span of more than a decade, Jianlan Middle School has undertaken a spiral iterative progression across three distinct developmental phases. By deeply integrating the pedagogical philosophy of diversified assessment with continuous technological evolution, the institution has ultimately architected an intelligent, comprehensive evaluation ecosystem predicated on omni-channel, full-scale data.

Phase I (2017-2020): The school launched the "School Brain" with Academician Wang Jian's team, focusing on precision academic evaluation. A personalized question recommendation system realized automatic student learning data collection and preliminary analysis, laying a solid foundation. School Brain v1.0 shifted evaluation from experience-based to data-driven.

Phase II (2021-2024): School Brain v2.0 achieved growth data visualization, expanding evaluation to moral, intellectual, physical, aesthetic, and labor education. Integrating multidimensional data, a preliminary five-domain evaluation system was built, covering 16 provinces and 2 municipalities.

Phase III (2025-Present): School Brain v3.0 introduced DeepSeek technology and "Agent intelligent entities", building a "one-center-multi-model" architecture. It forms a closed-loop mechanism of "multimodal perception-intelligent analysis-Agent decision-making", supporting dynamic portrait generation, growth planning, etc.

Scenario I: Agent-Assisted Dynamic Student Portrait Generation — Making "Invisible Students" Visible

Agents integrate multidimensional heterogeneous data sources including academic assessment, physical health monitoring, psychological health evaluation, activity participation, honor records, and behavioral performance. Utilizing large models for deep correlation mining and pattern recognition, they construct dynamically evolving visualization models such as learning situation radar charts, five-domain development maps, and career potential maps, comprehensively presenting students' comprehensive status and development trends across core competency dimensions including knowledge, ability, character, health, and interests.

Taking student Wang Rui as an example, the ability radar chart upon(As shown in Figure 1) entering seventh grade showed relatively weak self-management and communication abilities, with team collaboration awareness requiring improvement. After two years of cultivation through the intelligent evaluation system, the ninth-grade ability radar chart demonstrated significant changes: markedly enhanced self-management ability, significantly elevated self-development awareness, substantially optimized communication ability, and obviously strengthened team collaboration consciousness, indicating comprehensive personal quality improvement. This comparison clearly demonstrates the evaluation system's role in promoting comprehensive student development.

Figure 1 Radar chart of ability distribution of students at the beginning of Grade 7 and two years later

Furthermore, agents utilize multimodal perception technologies (classroom audio-video analysis, online platform logs, IoT device records, etc.) to automatically collect unstructured behavioral data in authentic contexts, including learning engagement, collaborative participation, innovative performance, and emotional states. Through time-series analysis and pattern recognition, massive process data is transformed into quantifiable, interpretable behavioral characteristic cloud maps and growth curves, revealing internal patterns and critical nodes in habit formation, social development, and character cultivation. In the physical-mental health domain, through cross-analysis of emotional states, behavioral manifestations, and physical fitness data, potential risks are identified early, enabling timely warning and intervention.

Scenario II: Agent-Linked Personalized Growth Path Planning — Providing Direction for Growth

Agents, relying on large model-driven intelligent Q&A and dialogue engines, serve as students' dedicated AI learning companions. They analyze students' real-time questions, error feedback, learning preferences, and interaction trajectories to instantly generate highly personalized learning recommendations, difficulty analysis, and extended resource suggestions. When students experience emotional fluctuations or increased stress, agents timely provide psychological adjustment suggestions and positive guidance.

Taking extended course recommendation as an example(As shown in Figure 2), based on comprehensive analysis of student Wang Rui (honors: Five-Good Student, Outstanding Student Cadre, Learning Activist; physical characteristics: 50m sprint 7.87s excellent, standing long jump 205cm excellent, vital capacity 2828ml good, flexibility sit-and-reach 5cm needs improvement, endurance 1000m run 3:01 good), the agent intelligently recommends leadership and teamwork courses, sports specialty development courses, and public welfare practice and social responsibility courses, providing detailed recommendation rationales. Such precision recommendation respects individual characteristics while promoting comprehensive development.

Figure 2 Scalable Curriculum Planning

Agents also deconstruct long-term growth visions into hierarchical goal systems based on students' current levels and development potential. Short-term goals focus on specific, quantifiable outcomes (e.g., "run 2 kilometers daily," "participate in 1 volunteer service monthly"), while long-term goals anchor capability advancement directions (e.g., "establish science subject advantage," "achieve Five-Good Student standards"). Each goal is matched with resource lists (micro-courses, personalized question banks, nearby venue resources, etc.), enabling students to clearly perceive the progress and direction of their growth paths. Relying on the multi-agent collaborative framework, continuous collection of multidimensional process data during path execution automatically generates path adaptation assessment reports. When identifying unachieved short-term goals, the system immediately links with AI growth consultant agents and other agent resources, deeply analyzing causes and intelligently generating optimized subsequent plans, driving information distribution processes to push stage adjustment explanations containing specific family cooperation points to parents, and providing teachers with classroom extension suggestions, ensuring each student's growth path remains highly aligned with their actual development rhythm.

Scenario III: Agent-Empowered Home-School Collaborative Education — Creating Support Networks

Agents deploy 24-hour online parent assistant agents, utilizing natural language interaction technology to enable parents to access their children's growth information through conversational dialogue at any time. For example, when parents input "view this week's mathematics learning situation," the system automatically generates a concise report including classroom performance, homework completion, and knowledge point mastery, accompanied by specific family education suggestions. When parents inquire

"how to improve my child's attention," the Agent not only provides professional recommendations but also automatically pushes relevant training resources and successful cases, helping parents understand their children's situation from the student's perspective, achieving better empathetic communication.
Agents also provide powerful data analysis support for teachers. Intelligent dashboards simultaneously present class-wide learning situations and individual student deep analysis, with different-colored progress bars below names representing the interaction intensity between agents and students, teachers, and parents. Teachers can quickly access three core types of information: class academic level distribution and common weaknesses, personalized profiles of students with special needs, and data analysis-based teaching improvement suggestions. One homeroom teacher reported after using the tool: "Lesson preparation efficiency has improved significantly; Agents always provide different perspectives, enabling me to conduct differentiated teaching more precisely."

Case Innovation and Breakthroughs

The fundamental innovation of this case study resides in thoroughly dismantling the entrenched cognitive paradigms and technological bottlenecks inherent in traditional evaluation. By achieving a synergistic, tripartite breakthrough across conceptual, technological, and systemic dimensions, it architects a novel pedagogical paradigm defined by “Assessment as a Service” and “Assessment for Lifelong Development.” Ultimately, it furnishes a profoundly innovative blueprint for the strategic reform of assessment within basic education.

1. Conceptual Innovation: Transitioning from Hierarchical Stratification to Developmental Incentivization to Humanize the Assessment Ecosystem

This paradigm-shifting case study fundamentally repudiates the deeply entrenched functional orientation of traditional educational assessment, which has historically been monopolized by the rigid imperatives of hierarchical stratification, quantitative sorting, and exclusionary selection. In a radical departure from this archaic model, the institution has firmly established the progressive pedagogical philosophies of “Assessment as a Service” and “Assessment for Lifelong Development.” Empowered by the sophisticated algorithmic analytics of the “School Brain” architecture, evaluation is no longer weaponized as a punitive mechanism to affix monolithic, deterministic labels onto students. Instead, it has been entirely repurposed as a highly empathetic, diagnostic instrument. Its primary objectives are to systematically uncover latent, non-academic aptitudes, scientifically diagnose individualized developmental bottlenecks, and dynamically chart highly customized cognitive and behavioral growth trajectories. Most notably, the synergistic integration of continuous formative assessment with longitudinal value-added evaluation mechanisms transforms the assessment process into a powerful psychological engine that ignites the students’ intrinsic motivation. This conceptual metamorphosis ensures that every single learner can discover profound self-confidence and directional clarity within a diversified evaluation framework. By authentically actualizing the ethos of “promoting holistic growth through continuous assessment,” this model successfully restores evaluation to its fundamental humanistic purpose: nurturing character. Ultimately, it ensures that every child fundamentally experiences the profound psychological warmth of being understood and the empowering security of being structurally supported by their educational environment.

2. Technological Innovation: Pioneering an Intelligent Evaluation Mechanism for High-Precision Visibility

Transcending the severe methodological limitations of conventional assessment frameworks—which are overwhelmingly reliant on laborious manual data entry, self-reporting, and highly subjective, biased scoring rubrics—this initiative pioneers a sophisticated, intelligent evaluation model predicated on advanced multimodal data fusion. This state-of-the-art architecture seamlessly integrates heterogeneous data streams, encompassing behavioral temporal logs, granular course engagement records, complex social interaction dynamics, and digitized portfolios of creative outputs. By leveraging distributed Multi-Agent Technology, the systemic architecture can autonomously, continuously, and accurately recognize even the most microscopic advancements a student makes across crucial non-academic dimensions, including technological innovation, peer leadership, philanthropic engagement, and aesthetic expression. Furthermore, the system is engineered to intelligently dispatch contextualized, highly personalized incentivizing feedback in real-time. This achieves an unprecedented paradigm of evaluation that is unobtrusive (utilizing stealth assessment protocols), heavily automated, and rigorously objective. This innovative “data-articulated, algorithmically nominated” operational modality unequivocally guarantees the systemic equity, fairness, and scientific rigor of the diversified assessment ecosystem. It stands as a canonical, frontier-defining exemplar of the deep, structural application of artificial intelligence in the field of educational measurement. By exponentially elevating the temporal efficiency and diagnostic accuracy of evaluations, the technology ensures that every minute “sparkle” of student brilliance and potential is systematically captured, ensuring no talent remains hidden or marginalized.

3. Systemic Innovation: Architecting an Integrated Closed-Loop Ecosystem to Sustain Lifelong Developmental Support

Diverging significantly from isolated, fragmented, and often superficial evaluation reforms, this comprehensive case study organically and deeply cross-pollinates the domains of “curricula and extracurricular activities” with the frameworks of “evaluation and incentivization.” It successfully constructs an integrated, closed-loop pedagogical ecosystem operating on a robust cybernetic principle: “Curricular engagement continuously generates empirical data; this longitudinal data algorithmically drives assessment and nomination; and the precise assessment outcomes, in turn, dynamically recalibrate and feed back into the curriculum design.” Within this ecosystem, a student’s authentic, real-world performance is seamlessly translated into the foundational, quantifiable criteria for computational commendation. Concurrently, the subsequent allocation of honors and institutional validations serves as a powerful psychological catalyst, inspiring the learner to proactively engage in an even broader, more demanding spectrum of diversified courses and practical applications. This highly sophisticated architectural design entirely obliterates the structural and administrative silos that have traditionally segregated coursework, extracurricular engagement, and formalized assessment. Consequently, the holistic integration of the “five essential domains of education” (moral, intellectual, physical, aesthetic, and labor) authentically takes root, cultivating a self-sustaining, virtuous pedagogical ecology. This integrated design ensures that assessment is not a terminal event, but a continuous thread that permeates the entirety of the student’s longitudinal developmental journey, providing unwavering, continuous structural support for every child across their educational lifespan.

4. Governance and Intellectual Property Framework

Grounded in over a decade of rigorous empirical practice and continuous systemic iteration, Jianlan Middle School has successfully pioneered an advanced innovation ecosystem dedicated to Artificial Intelligence (AI) Educational Agents. Within this collaborative framework, the intellectual property (IP) rights pertaining to the core proprietary technologies—specifically the "School Brain" platform and the "Scholarly Companion Agent" (Shutong)—are legally and equitably vested in the respective constituent entities comprising the "School Brain Alliance." The constituent members of this consortium operate synergistically, pooling their collective multidisciplinary expertise and computational resources to continuously propel cutting-edge technical research, algorithmic development, and systemic optimization. This highly structured and legally sound collaborative consortium model provides an extraordinarily robust intellectual property safeguard and a formidable technological support foundation, thereby guaranteeing the uninterrupted, long-term iterative upgrading and sustainable scaling of the intelligent assessment ecosystem.

Promotion Value and Risks

1. Promotion Value: From Campus Practice to Sector Benchmark

The implementation of this ecosystem has transcended institutional boundaries, integrated diverse educational values, and established a replicable model.

(1) Facilitating Holistic and Individualized Growth

The diversified assessment system has fundamentally bolstered students' psychological safety by validating non-academic aptitudes. Longitudinal data reveals that among students in "Competency Courses," over 95% identified at least one specific non-academic talent, and 80% demonstrated improved self-efficacy. Furthermore, the "Smart Course Recommendation Engine" achieved a 100% coverage rate for personalized learning pathways, realizing the vision of "One Student, One Schedule." This optimization significantly reduced the daily homework burden while enhancing learning quality, allowing every child to flourish within a framework of understanding and support.

(2) Catalyzing Professional Metamorphosis

Educators have transitioned from reliance on subjective impressions to data-substantiated "Holographic Portraits." The system reduced time spent on transactional administrative tasks (e.g., grading, statistics) by roughly 40%, while increasing time allocated to deep, data-informed mentoring by 50%. This shift redefines the teacher's role from an "empirical judge" to an "evidence-based growth mentor," enabling a focus on emotional intelligence and value leadership.

(3) Establishing a Global Paradigm

Recognized with the National Teaching Achievement Award and selected as a Ministry of Education "AI + Education" scenario, this case was featured in the 2025 Global Smart Education Conference and 2024 WAIC. Academician Wang Jian noted, "Jianlan's exploration has made data the new yardstick… ensuring every child is fairly seen." Scaled to 16 provinces, 350+ schools, and benefitting 400,000 students, it offers a robust "Chinese Paradigm" for global assessment reform.

2. Risk Governance: Safeguarding Equity and Ethics

To mitigate systemic risks inherent in AI deployment, the institution established a comprehensive, multi-layered governance framework.

(1) Technical Defense: Human-in-the-Loop (HITL)

Addressing algorithmic opacity ("Black Box" risks), the school enforces the principle of "Intelligent Augmentation, Human Decision." The system provides diagnostic insights, but final authority over evaluation and resource allocation remains strictly vested in stakeholders (teachers and parents), ensuring human wisdom and temperature prevail in decision-making.

(2) Ethical Defense: Privacy and Anti-Labeling

To prevent privacy breaches and data ossification, strict adherence to the "Minimum Necessary" collection principle and Informed Consent protocols is mandated. By employing dynamic algorithm optimization and emphasizing multidimensional metrics, the system minimizes rigid labeling, ensuring students are viewed through a developmental lens.

(3) Fairness Defense: Algorithmic Justice

To counter algorithmic bias, an Algorithmic Fairness Auditing Mechanism was established to transparently verify core logic. Assessing the risk of "technological coldness," the framework mandates the preservation of offline interaction spaces, ensuring technology subserves the fundamental mission of "Fostering Virtue through Education" and equitably benefits every life.

Case 68

Generative Artificial-Intelligence Assessment System

Frankie LAM

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Solution Introduction

1.Function Overview:

A. Core Functions of Generative Artificial-Intelligence Assessment System (GAAS)

GAAS (Patent No. 32025114009.3) is an AI-driven educational assessment system designed to transform the assignment feedback and assessment process for university-level courses.

- Automated Assessment Feedback: GAAS uses advanced Generative AI models to provide rapid, high-quality feedback on student assignments. It analyses written submissions to identify strengths, weaknesses, achievement of learning outcomes, and specific areas for improvement.
- Teacher Support Tools: The system assists instructors by automating parts of the grading and feedback process, reducing manual workload and improving consistency in marking.
- User Management and Security: GAAS includes comprehensive user account management, database integration for courses and assignments, and robust security measures such as secure sockets layers (SSL) encryption.
- Formative Assessment Support: The system enables iterative formative assessments with AI-generated rubrics and feedback processes, providing and supporting continuous student improvement against the learning outcomes.
- International Recognition: The innovation and impact of GAAS have been internationally acknowledged. GAAS was awarded a Bronze Medal at the 51st International Exhibition of Inventions Geneva, Switzerland, and a Bronze Medal at the 5th Asia Exhibition of Innovations and Inventions held in the Hong Kong Special Administrative Region (HKSAR) of the People's Republic of China, demonstrating its global relevance, originality, and contribution to educational technology.

B. Educational Pain Points Addressed

GAAS is specifically developed to address challenges in university assessment processes. It provides timely, consistent and personalised feedback to students and support formative and student-centred approaches in assessment. GAAS also aligns with the mission set out in the Suggestions of the Central Committee of the Communist Party of China on Formulating the 15th Five-Year Plan for National Economic and Social Development, particularly the transition from scale-focused expansion to

quality-driven development, from independent practices to integrated progress, and from online education to artificial intelligence–enabled education:

- Delayed Feedback: Traditional feedback cycles are often slow, reducing their value for student learning and improvement. GAAS overcomes this pain points by delivering rapid, timely, consistent AI-generated feedback, significantly enhancing the timeliness and instructional value of assessments. This directly aligns with the 15th Five-Year Plan's emphasis on improving educational quality and learning outcomes.
- Instructor Workload: Manual grading and feedback are time-consuming and susceptible to inconsistencies, especially in large classes. By automating routine assessment tasks, GAAS reduces instructor workload and enables educators to focus on higher-value teaching activities. This also aligns with the 15th Five-Year Plan's emphasis of integrating artificial intelligence with teaching and academic management.
- Quality Assurance: GAAS uplifts the quality of teaching and learning by ensuring the feedback quality, consistency, and alignment with learning outcomes which is challenging across diverse disciplines. GAAS applies unified AI-driven evaluation frameworks and rubrics, strengthening consistency, transparency, and outcome alignment. This also supports the shift from quantity-oriented education to quality-assured, standards-based talent cultivation.
- Scalability: Existing assessment systems struggle to efficiently handle increasing numbers of assignments and diverse assessment types. GAAS offers scalable, intelligent assessment support capable of handling large student populations without compromising feedback quality. GAAS also provides feedback to students regarding their achievements of several essential attributes such as communication, critical thinking, problem solving, and students are able to understand their progress on these attributes overtime. The scalability aspect aligns with the 15th Five-Year Plan's objective of achieving high-quality education at scale.
- Adaptive Assessment Needs: There is a growing need for adaptable, formative assessment tools that support personalised learning and higher-order thinking. GAAS fulfils this need by embedding artificial intelligence into formative assessment cycles, enabling personalised feedback, iterative improvement, and the development of critical and analytical thinking. This reflects the 15th Five-Year Plan's strategic shift from basic online education to intelligent, AI-driven education systems.

C. Core Value Proposition

The core value of GAAS lies in its ability to significantly enhance the efficiency, accuracy, and impact of assessment practices by employing cutting-edge AI technologies. Key value points include:

- Timeliness: Immediate, actionable feedback empowers students to learn and improve more effectively.
- Instructor Empowerment: Reduces workload, allowing instructors to focus on higher-value teaching activities and personalised feedback.
- Scalability and Consistency: Delivers consistent, high-quality feedback across large cohorts and multiple disciplines.
- Support for Innovative Pedagogy: Enables formative, collaborative, and higher-order thinking assessments aligned with best practices in modern education.
- Data-Driven Insights: Provides real-time learning analytics to inform teaching strategies and institutional decision-making.

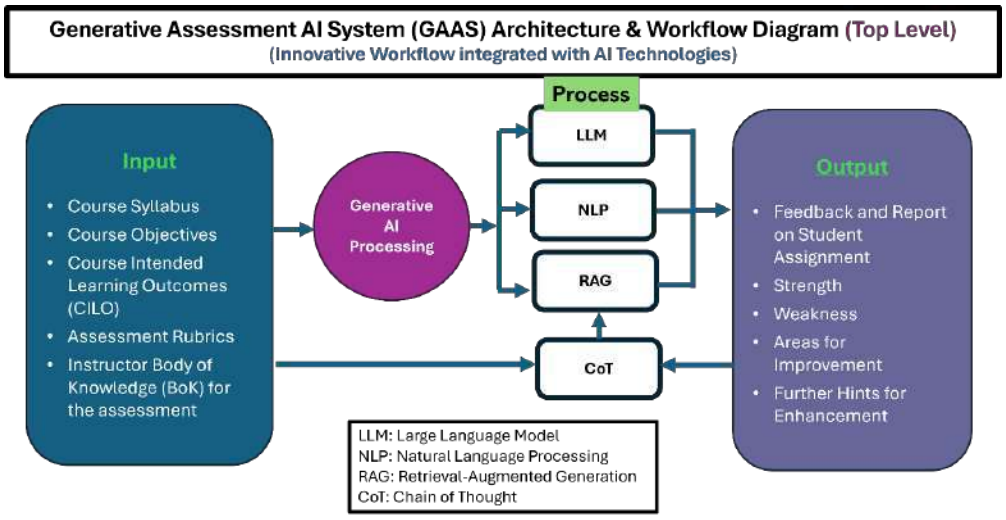

Figure 1 GAAS Architecture & Workflow Diagram

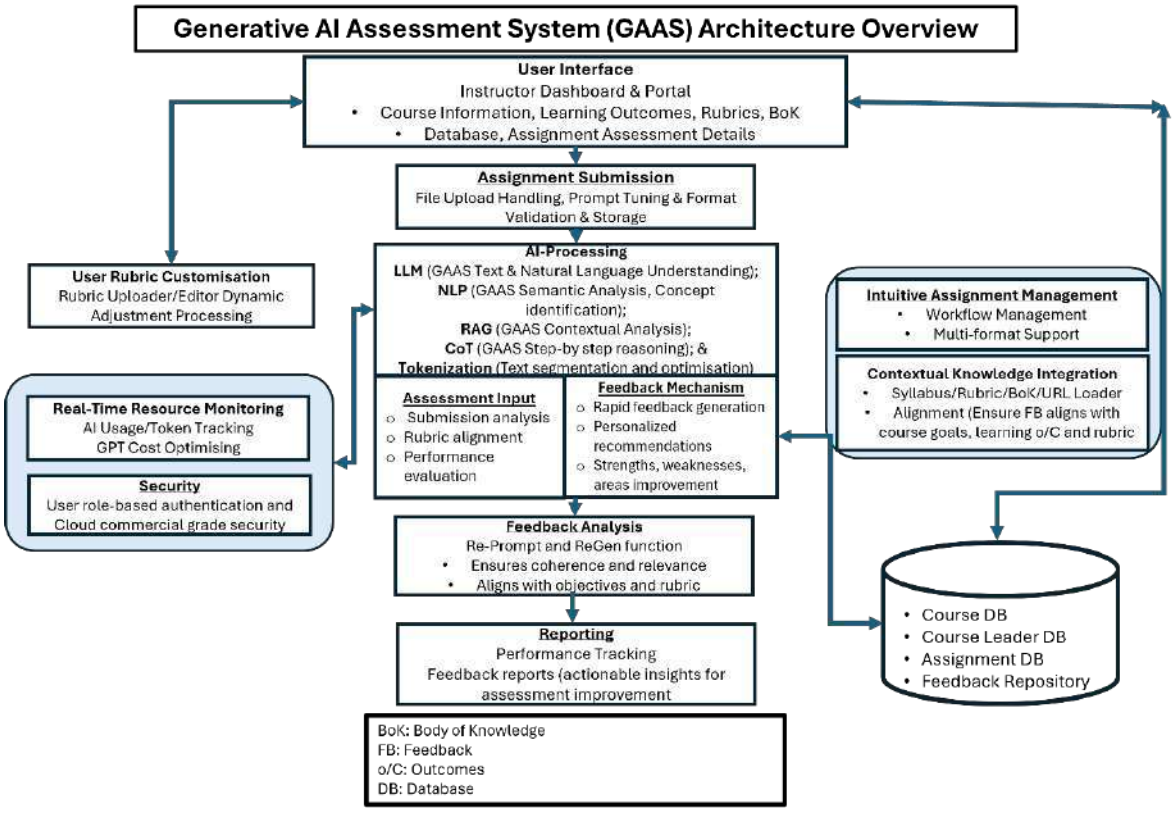

Figure 2 GAAS Architecture Overview

2.Technical Highlights or Innovations:

A. Differentiating Advantages

GAAS stands out from traditional and existing AI assessment tools through the following innovations and differentiators:

Advanced GAI Technologies

- Rigorous benchmarking and best practices: GAAS was rigorously benchmarked against leading AI assessment tools currently available on the market (e.g., Gradescope, CoGrader and EduSage AI). GAAS also benchmarked against popular tools (e.g., Magic School AI, PrepAi, Perplexity). Unlike the generic off-the-shelf solutions, GAAS leverages cutting-edge Retrieval-Augmented Generation (RAG) techniques combined with custom training on an institution's course materials, enabling it to deliver significantly higher response accuracy and alignment with the specific Course Intended Learning Outcomes (CILOs), assessment criteria and rubrics. Moreover, GAAS adapts dynamically by providing precise marking and feedback while supporting personalised learning pathways through the identification of individual student strengths and areas for improvement.
- Machine training: Machine training on actual course materials (syllabi, rubrics) ensures high relevance to the Course Intended Learning Outcomes and accuracy in feedback and question generation.

User-Centred Development

- Pilot User Group Involvement: 11 full-time academics from 7 disciplines actively shaped system usability and effectiveness, ensuring cross-disciplinary applicability.
- Double-Blind Validation: Independent benchmarking and double-blind testing by the Teaching and Learning Centre validated GAAS against industry-leading solutions on key metrics (accuracy, speed, user interface (UI)).

Security and Data Privacy

- Security: Security with SSL certification and secure application domain (ln-gaas.net) for hosting.
- Privacy-by-Design: The system is engineered to maintain confidentiality of student and course data, meeting institutional and regulatory standards.

Automated Formative Assessment

- AI-Generated Rubrics: Automated creation of detailed rubrics for iterative feedback cycles, supporting continuous improvement in student work.
- Real-Time Learning Analytics and Monitoring: Data-driven insights into student learning progression, enabling timely pedagogical interventions.

Scalability and Sustainability

- Progressive Rollout: GAAS is designed for rollout by stages, with broad adoption, enhancement and customisation across courses and disciplines.
- Sustainability: Benchmarking and research ensure that the system remains competitive and can integrate other emerging Generative AI technologies.
- GAAS is highly scalable for adoption by education institutions with customised quality assurance standards and data security measures.

B. Comparison with Industry Practices

Most existing AI-based assessment solutions (e.g., Magic School AI, PrepAi) offer rapid feedback but are often generic, not customised to specific institutional needs, quality assurance standards, and lack the integration and alignment with Course Intended Learning Outcomes and assessment rubrics. GAAS distinguishes itself by:

- Customised Training on Education Institutional Data: Unlike commercially available tools, GAAS is trained on actual course materials, ensuring feedback and assessment are contextually accurate and aligned with university-specific or regional quality assurance standards. It can also be customised to

align with other international education standards. For example, in the HKSAR, GAAS aligns with the Hong Kong Qualifications Framework (https://www.hkqf.gov.hk/en/about-hkqf). This enables GAAS to provide timely, outcome-based feedback that explicitly measures student performance against defined learning outcomes and qualification level descriptors, rather than offering generic or descriptive comments.

- Iterative, User-Led Development: Direct involvement of academic staff ensures the solution addresses authentic and practical challenges.
- Comprehensive Validation: In addition to users' feedback, the double-blind method of validation ensures the feedback and development are independently verified, not just based on user feedback.
- Integrated Formative Assessment: GAAS supports ongoing student development through AI-generated feedback measured against rubrics, Course Intended Learning Outcome and attributes.

GAAS is not just a tool for faster feedback. It is a catalyst for transforming assessment culture into higher education. Its unique combination of institutional customisation, formative assessment features, robust validation, and future-ready architecture positions it as a leader in AI-powered educational assessment.

Application Scenarios

1.Application Environment and Implementation Targets:

A. Educational Scenarios

GAAS is designed for international higher education environments. It is highly adaptable to a variety of academic settings where formative and summative assessments are crucial to student learning and course evaluation. Key educational scenarios include:

- Undergraduate Core Curriculum Courses: These often have large student cohorts, high frequency of written assignments, and a profound need for consistent feedback and marking, making them ideal for GAAS deployment.
- Professional Disciplines and Electives: With a diverse range of disciplines (e.g., Humanities, Science, Management), these courses benefit from GAAS's ability to generate discipline-specific questions and feedback.
- Capstone Projects: These require high levels of critical thinking and personalised, iterative feedback. GAAS supports complex assessment tasks, peer evaluation, and the development of higher-order thinking skills.
- Experiential and Case-Based Learning: Courses involving authentic scenarios, case studies, and experiential assignments are supported through GAAS's context-aware feedback functions.

B. Hardware and Software Environments

Hardware Environment

- For Students and Teachers:
  - o Standard desktops, laptops, or tablets with web browsers
  - o Internet connectivity (wired or wireless)

Software Environment

- Web-Based Application: GAAS is delivered via a secure web portal (ln-gaas.net), requiring no specialised local installations.
- AI Model Hosting: Robust backend supporting LLMs (GPT-4) and Retrieval-Augmented Generation (RAG).

- Security Features: SSL encryption, role-based access control, and compliance with institutional/regional data privacy regulations.

C. Implementation Targets

Primary Users

- Teachers/Academics: Course leaders, instructors, and teaching assistants who design assessments and provide feedback.

Secondary Users

- Institutional Administrators: Quality assurance offices, teaching and learning centers, and IT support teams responsible for oversight, benchmarking, and technical support.
- Education Policy Makers: At the university/college or regional education bureau level, interested in scalable, equitable, and innovative assessment practices.

Deployment Scale

- Initial Focus: 3 core common courses and 8 cluster streams, with progressive extension to additional programs.
- Scalability: Designed to support thousands of users simultaneously across multiple faculties/disciplines.

2.Examples of Typical Application Scenarios

Scenario 1: Enhancing Feedback and Assessment in a Large Undergraduate Core Course

Location: Lingnan University, HKSAR

Course: CCC8011 Critical Thinking: Analysis & Argumentation

Background:

This compulsory core course enrols 450 students annually from diverse disciplines. Assignments include argumentative essays, critical analysis, and reflective pieces. Traditionally, instructors and TAs face overwhelming grading loads, leading to delayed and inconsistent feedback.

Implementation with GAAS:

1.Integration: The course leader uploads assignment rubrics, syllabi, and sample essays for the team to train the system for the course-specific context.

2.Assignment Submission: Students submit their essays through GAAS for analysis.

3.Automated Feedback: GAAS generates personalised feedback for each student, structured as:

  o Summary of strengths (e.g., logical coherence, evidence use)

  o Identification of weaknesses (e.g., unsupported claims, lack of counterargument)

  o Actionable suggestions for improvement, aligned to course objectives

4.Instructor Review: Instructors can review, edit, and supplement AI-generated feedback before release, ensuring quality control and addressing nuanced cases.

Benefits Highlighted:

- Scalability: One instructor can efficiently manage feedback for hundreds of students.
- Consistency: All students receive feedback aligned with the official rubric.
- Timeliness: Feedback turnaround drops from weeks to hours/days.
- Personalisation: Each student receives targeted advice based on their actual submission.

Scenario 2: Formative Assessment and Peer Collaboration in Capstone Projects

Location: Lingnan University, HKSAR

Course: Master of Technology Capstone Project (CDT508)

Background: The Capstone Project immerses students in authentic, real-world industry challenges, requiring them to apply interdisciplinary knowledge and project management skills. Students work in groups to research industry problems, design solutions, and present outcomes. Assessments include class participation, group project reports and presentations, and individual critical evaluation reports.

Implementation with GAAS:

1.Custom Configuration: The instructor configures GAAS to handle multi-stage assessment tasks and uploads project-specific rubrics, milestone templates, and evaluation criteria.

2.Assignment Workflow: Students submit project proposals, progress reports, and final presentations to instructors for GAAS submission. GAAS analyses submissions using LLMs trained to recognise domain-specific terminology and best practices in capstone projects.

3.Formative Feedback: GAAS provides detailed formative feedback on each submission.

4.Learning Analytics: GAAS identifies teams at risk (e.g., low engagement or recurring mistakes) and alerts the instructor for timely intervention.

5.Ethical Oversight: The system provides guidelines for academic integrity and ethical challenges, flagging potential plagiarism or inappropriate content.

6.Continuous Improvement: Instructor feedback on the system is collected to refine AI models and rubrics for subsequent cohorts.

Benefits Highlighted:

- Formative Focus: Students receive iterative, actionable feedback throughout the project lifecycle, promoting deeper learning and engagement.
- Instructor Support: Instructors can focus on mentoring and higher-level guidance rather than routine tasks.
- Scalability: The system can manage multiple teams and projects across the university, ensuring consistent standards and data-driven oversight.

Impact and Case Evidence

1.Implementation Results, Evaluation Data or Practical Experience:

A. User Acceptance Testing (UAT) Outcomes:

- Pilot User Group: 11 full-time academics from 7 disciplines (Data Science, Chinese, Economics, Philosophy, Ageing Studies, Accountancy, and Marketing) participated in the pilot (Dec 2024 – Apr 2025).
- Number of Courses: Implemented across 3 core courses and 8 cluster courses during the pilot phase, representing a broad cross-section of the curriculum.
- Coverage: System designed to scale to 5 core courses and 5 cluster streams (>120 cluster courses) for full implementation.

B. Key Performance Indicators (KPIs) Achieved:

- Instructor Time Savings: Course leaders reported time savings on feedback tasks.
- Feedback Quality: Course leaders rated the AI-generated feedback as “highly useful” or “useful” for student improvement.
- System Usability: All pilot users were able to set up and use the system with minimal training.
- Accuracy and Consistency: Double-blind benchmarking by the Teaching and Learning Centre (TLC) showed GAAS matched or exceeded leading tools (Magic School AI, Perplexity) in accuracy and feedback quality.

C. Practical Results and Experiences:

- Iterative Improvement: The system's analytics enabled instructors to identify common student misconceptions and adjust teaching strategies mid-semester.
- Instructor Feedback: Teachers appreciated the ability to review, edit, and supplement AI feedback, maintaining academic oversight.
- Security and Privacy: The integration of SSL certificates and secure domain hosting ensured compliance with university and regional data regulations.

2.Replicability, Sustainability and Promotion Potential:

Long-Term Operation Model:

- Ongoing Support & Training: Dedicated user training materials (including video tutorials) and helpdesk features ensure smooth onboarding and continuous support.
- Iterative AI Model Updates: Regular updates based on user feedback and benchmarking against new AI tools keep the system current with technological advances.
- Institutional Ownership: After initial deployment and pilot validation, the system can be managed by the university, minimising reliance on external vendors.

Cost Efficiency:

- Reduced Administrative Overhead: The system's automation features free up staff time for higher-value academic work, contributing to long-term cost savings.

C. Promotion Potential

Wider Adoption Value:

- Regional and International Interest: The GAAS project's success and benchmarking against other popular AI tools have made it a model for similar implementations in Asia and worldwide.
- Demonstrative Value: The project has been showcased in regional and international educational forums, with positive feedback from policymakers and educators.
- Scalability: The solution's flexible architecture supports scaling from pilot projects to institution-wide or even multi-institutional deployments.

3.Illustration of a Typical Case:

Case: Implementation in CCC8011 Critical Thinking: Analysis & Argumentation and Cluster Stream Courses

Time: Dec 2024 – Apr 2025 (Pilot); Mar 2025 (Full Launch)

Location: Lingnan University, HKSAR

Scale:

- 11 academics, 3 core courses, 8 cluster courses in pilot
- Potential reach: 5 core courses + 5 cluster streams (120+ courses)

Process:

1. User Requirement Analysis (Jan–April 2024):

- Collaboration with course leaders to collect syllabi, rubrics, and sample assignments.
- Identification of unique feedback needs for both core and cluster courses.

2. System Design and AI Training (Feb – June 24):

- Custom AI prompt training using discipline-specific assessment materials.

3. Pilot Implementation (Dec 2024–Apr 2025):

- Academics introduced to the system.

- Assignments (essays, reports, case studies) submitted via GAAS.
- Real-time feedback and analytics provided to instructors.

4. Evaluation and Enhancement (Jan–Apr 2025):

- UAT conducted, with iterative improvements to UI, database for managing student assignments, and data security.
- Double-blind benchmarking against leading AI tools.

5. Full Launch (Mar 2025 Onwards):

- Expanded to more courses, with ongoing support.

Key Outcomes:

- Feedback Turnaround: Reduced.
- Instructor Productivity: Reduction in time spent on grading and feedback.
- User Satisfaction: Instructors expressed high satisfaction with the system's usability, efficiency, and quality of feedback.

4.Exhibition Materials:

A. Conceptual Renderings and Design Visuals

Exhibition Display Components:

- Interactive Demo Kiosk: Touchscreen interface allowing visitors to experience the assignment submission and feedback process.
- Dashboard Visuals: Live displays of the GAAS analytics dashboard showcasing real-time feedback, student progress rubric-based feedback.
- Demo videos: Explaining system setup, training, and use cases (e.g., a teacher uploading an assignment, a student receiving feedback).
- Infographic Panels: Summarising key impacts, user testimonials, and before/after comparisons for feedback turnaround and quality.

B. Hardware and Software Configuration

- Hardware:
  - o 1 or 2 touchscreen monitors or laptops
  - o Network connection for accessing the GAAS demo
  - o Optional: wall-mounted displays or projectors for analytics dashboards
- Software:
  - o Web browser with secure access to demo GAAS portal (ln-gaas.net)
  - o Preloaded demo accounts for teacher roles

Basic Information of the Institution

1. Institution Introduction:

Lingnan University has a heritage dating back to 1888 as the Christian College in China. The university was re-established in the Hong Kong Special Administrative Region (HKSAR) of the People's Republic of China in 1967 and officially conferred university status in 1999. Today, Lingnan aims to become a research-intensive liberal arts institution in the digital era, while maintaining its position as a leading liberal arts university in Asia committed to quality education and impactful research.

Lingnan focuses on providing whole-person higher education through a broad spectrum of undergraduate and postgraduate programmes spanning the arts, sciences, business, and social sciences.

The service scope of Lingnan University is comprehensive and global. It boasts a vibrant residential campus in Tuen Mun, HKSAR, and urban learning hubs such as Lingnan@WestKowloon.

Lingnan's vision is to excel as a leading Asian liberal arts university with international recognition, distinguished by outstanding teaching, learning, scholarship, and community engagement. Its motto, "Education for Service," epitomises its commitment to nurturing socially responsible global citizens.

2. Experience or Qualifications in the Field of Digital Education:

Lingnan University is at the forefront of digital education and innovation. Its Teaching and Learning Centre has pioneered the integration of digital tools and AI-driven platforms to enhance teaching and learning outcomes. In 2023, Lingnan became one of the first universities in the region to provide universal access to cutting-edge generative AI tools such as ChatGPT and DeepSeek for all students and staff. In 2024/25, Lingnan launched Generative AI as a compulsory common core course for all first-year students, underscoring its commitment to preparing graduates for the digital era.

The establishment of the School of Data Science and the Lingnan Institute for Advanced Study reflects the university's dedication to interdisciplinary digital skills and advanced research. Lingnan's research and innovation capacity is supported by its High-Performance Computing (HPC) Data Centre, HPC NexT, which delivers world-class AI research capabilities.

In 2025, forty-three academic staff members of Lingnan University were ranked among the world's top 2% scientists by Stanford University. Among them, nineteen scholars were included in the global top 100 in their respective disciplines, underscoring the international recognition of Lingnan's research excellence and its rising global impact.

3. Past successful projects in digital education include:

Lingnan University's IDEAL-GenAI platform, developed by its Teaching and Learning Centre, is a leading AI-assisted course development tool that has been activated by over 10,000 users internationally.

Lingnan University's GAAS (Generative AI Assessment System), developed by its Teaching and Learning Centre, is a pioneering initiative to transform assessment practices with AI by enabling scalable, timely, and personalised feedback for students.

- Patent No.: 32025114009.3
- International recognition:
  - o 51st International Exhibition of Inventions, Geneva, Bronze Medal
  - o 5th Asia Exhibition of Innovations and Inventions, Bronze Medal

Case 69

Empowering Every Child to Become Their Best Self: Practical Strategies for AI-Enabled Comprehensive Student Evaluation

Dihui Zhao, Huilan Wang

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Background and Problem Statement

As a seed school in the Ministry of Education's Basic Education Comprehensive Reform Pilot Zone, our school has long been dedicated to reforming student comprehensive evaluation, specifically focusing on its digital transformation. From 2022 to 2024, we iteratively improved and optimized the functions of our comprehensive evaluation system through continuous usage and refinement. However, during this process, we identified several persistent pain points and challenges in traditional evaluation systems, including limited coverage, poor timeliness, and the difficulty of implementing itemized evaluations.

To address these issues, Ningbo High-Tech Zone Experimental School constructed the **"AI + 'Sunshine Youth' Comprehensive Evaluation System"** based on the **"Si·Xiang·Hui" (Think·Share·Wisdom) AI Interactive Classroom Platform.** Guided by the core philosophy of "Let Every Child Shine," the system leverages four key scenarios—human-machine collaboration, universal participation, instant diagnosis, and data-driven insights—to implement the digitalization of "Three-Wide Education" (educating everyone, throughout the entire process, and in all aspects). By establishing a project team and deepening teaching practices, we have achieved an integration of evaluation and instruction, significantly enhancing both student competencies and teaching quality. Recognized as a municipal pilot school, our experience has been extended to multiple regions. The school will continue to expand system functionalities and deepen the integration of "Teaching-Learning-Evaluation" to support the holistic growth of students.

Implementation Process

Building upon our existing digital comprehensive evaluation system, our school actively promoted the construction and application of the **AI + "Sunshine Youth" Comprehensive Evaluation System**. Driven

by technological innovation and grounded in teaching practice, we utilized generative artificial intelligence and large language models (LLMs) to build a complete ecosystem of "Technical Support - Teaching Application - Management Optimization." This approach effectively resolved the pain points of traditional evaluation methods, achieving the goal of intelligent governance through the fusion of AI and comprehensive evaluation.

(A) Technical Solution: Building an Intelligent Evaluation Platform to Solidify Digital Foundations

1. Construction of the AI + "Sunshine Youth" Comprehensive Evaluation System

Based on prior research and assessment of various digital hardware and software, the school selected the "Si·Xiang·Hui" AI Interactive Classroom Platform. This mature, highly intelligent system, supported by large models and voice-response terminals, provides the foundational infrastructure for the AI + "Sunshine Youth" Comprehensive Evaluation System, specifically targeting the aforementioned challenges.

Figure 1 Core Functions of the "Si·Xiang·Hui" AI Interactive Classroom Platform

2. Exploration of AI-Empowered Application Scenarios for Comprehensive Evaluation

We fully harnessed the power of AI to explore viable application scenarios that empower student comprehensive evaluation, addressing the bottlenecks of existing digital systems and adding value to the evaluation process.

Scenario 1: Human-Machine Collaboration – Equipping Students with an All-Around AI Learning Companion

Students use the voice function of response terminals to ask questions to the large model. The model provides answers and offers scientifically feasible suggestions. This human-machine collaborative mutual evaluation method serves to motivate students through feedback.

Scenario 2: Universal Participation – Providing Equal Evaluation Opportunities for All

Leveraging the multi-channel voice output, advanced noise cancellation of the voice terminals, and the backend large model's speech-to-text capabilities, student ideas are displayed on screens in real-time. This ensures every student has an opportunity to participate, truly achieving classroom coverage for every individual.

Scenario 3: Cognitive Sharing – Constructing Knowledge through Self and Peer Evaluation

Based on universal coverage and the holistic presentation of individual ideas, the system provides AI-

driven analysis of different perspectives. It automatically ranks student answers based on quality and extracts the best responses. In this process, students can view their peers' ideas alongside their own self-assessments, learning from each other's strengths to compensate for weaknesses, thereby achieving knowledge construction.

Scenario 4: Instant Assessment – Precise Targeting for Itemized Evaluation

Utilizing the system's autonomous question-generation feature combined with selection keys on the response terminals, students can rapidly answer questions covering various knowledge points within a lesson. All response data is instantly displayed on the screen for immediate feedback and evaluation. Based on the results, the system instantly awards points to students and syncs this data to the comprehensive evaluation system as a component of itemized evaluation.

Figure 2 Classification and Sorting Analysis of Evaluation Results

(B) Teaching Application and Management: Constructing a Diversified Evaluation System to Deepen Educational Practice

1. Establishment of a Project Team

Centered on the application of the AI + "Sunshine Youth" Comprehensive Evaluation System, a special project team was formed. We selected teachers with high acceptance of AI technology and strong practical abilities—those who "want to use, know how to use, and use well" the technology—to create a vanguard force. This team provides talent support for the system's promotion and deep application.

2. Conducting Research and Exploration in Teaching Applications

We promoted the enhancement of teachers' AI-empowered educational levels through diverse activities:

(1) Participation in Competitions and Exchanges: Organizing teachers to participate in district-level or higher forums and integrated lesson case competitions. Through competition and exchange, teachers broaden their pedagogical horizons, absorb cutting-edge concepts, and optimize teaching practices based on the AI evaluation system.

(2) Investment in Curriculum Development and Training: Encouraging teachers to engage in the development and training of informatization and AI-related courses. For instance, developing featured

courses for the Ningbo Smart Education Platform and the Zhijianghui Platform. This deepens their understanding of technology-teaching integration while sharing experiences through training to improve technical application capabilities across the region.

(3) Implementation of Remote Teaching Support: Arranging for vanguard teachers to represent the school and region in remote teaching activities with partner schools (e.g., "Mountain-Sea Cooperation"). This transmits the application experience and teaching methods of the AI + "Sunshine Youth" system to more areas, exerting a radiating and driving effect. These activities not only hone the professional skills of vanguard teachers, growing them into backbone forces for technology-empowered teaching, but also promote common skill improvements among all teachers through a "point-to-area" approach, facilitating widespread and efficient application of AI in education.

Innovative Highlights

1. Constructing a "Three-Wide Education" Digital Evaluation System to Achieve Educational Equity

Problem Addressed: Traditional classrooms often focus only on a few active students, depriving introverted students of evaluation rights.

Solution: The system aims to ensure equal evaluation opportunities for every student (regardless of personality or academic foundation) through technology-enabled universal participation.

Specific Path: Utilizing supporting voice response terminals and the "Si·Xiang·Hui" AI Interactive Classroom Platform to enable multi-channel voice output and noise cancellation. This ensures every student's viewpoint is recorded and displayed by the system, truly achieving "classroom coverage for every student."

Core Vision: Implement a practice model of "Universal Participation - Full-Process Integration - Comprehensive Support" to eliminate polarization and guarantee fairness in the educational process.

2. Creating a Closed Loop of "Teaching-Learning-Evaluation" Integration to Enhance Teaching Efficiency

Problem Addressed: Traditional evaluation is often lagging, with a disconnect between teaching and evaluation.

Solution: Leverage generative AI technology to achieve immediacy and precision in evaluation, thereby feeding back into teaching to reduce burdens and increase efficiency.

Specific Path: Through instant assessment, automatic question generation, and AI analysis, the system enables immediate feedback on classroom responses and automatic data syncing. AI generates ranked best answers and writes personalized comments, assisting teachers in making precise instructional decisions.

Core Vision: Interweave the evaluation, teaching, and learning processes. Harness the power of AI large models to transform the teaching model from "experience-driven" to "data-driven."

3. Establishing a Multi-Dimensional Incentive and Holistic Growth Mechanism to Promote Comprehensive Student Development

Problem Addressed: The reliance on single-score evaluations.

Solution: Establish a diversified evaluation and incentive system covering morality, intelligence, physique, aesthetics, and labor (the "Five Domains"). Digital means are used to record the entire growth process of students, aiding the improvement of comprehensive qualities.

Specific Path: Establish a "Growth Bank" and "Digital Mall," combining spiritual and material rewards;

select school-level honors based on six primary dimensions and 13 secondary dimensions; accumulate process data via home-school collaboration platforms (e.g., WeChat Official Accounts) to generate growth radar charts.

Core Vision: Through all-around data recording and positive incentives (such as redemption activities and honor selections), promote comprehensive student growth in aesthetics, sports, intelligence, etc., realizing the goal of "Simultaneous Development of the Five Domains."

4. Cultivating a Digitally Competent Teaching Force to Form a Regional Benchmark

Objective: Beyond student goals, this case focuses on teacher professional development and experience radiation. It aims to cultivate a group of vanguard teachers who "want to use, know how to use, and use well" the technology through project team construction, and to propagate successful experiences to a wider region.

Specific Path: Form a special project team and enhance teachers' technical application capabilities through competition exchanges, curriculum development, and remote teaching support (e.g., Mountain-Sea Cooperation).

Core Vision: Create the "Gao-Shi Solution" (High-Tech Zone Experimental School Solution) for new-era education evaluation reform, becoming a benchmark for regional digital education transformation and providing replicable, promotable experiences for other schools.

Case Effectiveness

Against the backdrop of AI empowering education and teaching, the school relied on the **AI + "Sunshine Youth" Comprehensive Evaluation System.** Through model innovation, practical exploration, and technological integration, we achieved a comprehensive upgrade of the education evaluation system, forming a new educational paradigm with demonstrative significance.

(A) Innovative Application Models and Practical Paths

The school constructed a "Three-Wide Education" digital evaluation system, innovating the practice model of "Universal Participation - Full-Process Integration - Comprehensive Support."

Universal Participation: A home-school-student collaborative platform was built. Parents upload student achievements in aesthetics, sports, etc., in real-time via WeChat Official Accounts, accumulating over 100,000 pieces of process data. Students use exclusive cards for attendance and growth coin redemptions, with daily interactions exceeding 5,000 times. Multi-dimensional data automatically generates growth radar charts, achieving real-time information interchange between home and school.

Incentive Mechanism: The "Growth Bank" mechanism, carried by the "Digital Mall," launched dual-track rewards (spiritual and material). Combined with special redemption activities during traditional festivals, 12,000 reward redemptions were completed within the academic year, with home-school joint activity participation rates exceeding 95%. Simultaneously, based on six primary and 13 secondary dimensions, over ten school-level honors were selected according to class population ratios, constructing a robust incentive system.

Full-Process Curriculum Integration: Fourteen evaluation dimensions were deeply integrated with basic and extended curricula.

Chinese: Process evaluation via the "Reading Growth Manual," selecting over 200 "Scholarly Families."

Mathematics: Organized over 500 puzzle games via the "Unlocking Mathematical Thinking" project.

English: Project-based practical homework stabilized the excellence rate in final assessments at over **90%.**

Science: Established a "Home Laboratory" evaluation system, cultivating over **300 school-level "Science Experiment Experts."**

Strategy: Subject evaluation adopted a "Unified + Personalized" strategy; homework followed a "Classroom + Featured" mode; exams implemented a "Paper-and-Pencil + Non-Paper-and-Pencil" dual-track system; and physical/arts subjects achieved a "Precise + Personalized" transformation, forming an all-subject, full-process evaluation matrix.

Research Support: Under the "Research Support" characteristic strategy, teachers refined itemized evaluations, designed personalized assignments and tests, and wrote exclusive comments for students. A total of **15,000 "Comprehensive Student Development Reports"** were generated, achieving AI-based precise teaching.

(B) Significant Results and Widespread Impact

The reform integrating artificial intelligence and digital evaluation has yielded remarkable results:

The excellence rate in student physical health reached a new high.

The Xinhui Campus won first prizes in the OM (Odyssey of the Mind) competition for **11 consecutive years.**

The Xiangyun Campus held high-level New Year's Concerts.

Scores in sampled subjects and graduation exams ranked among the top.

Campus distinctive brands continued to flourish。

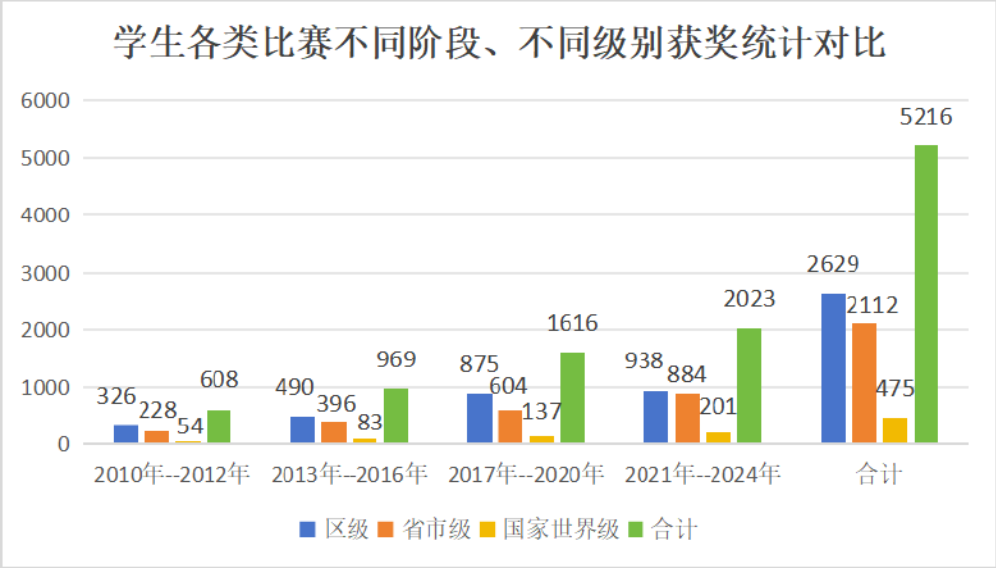

Figure 3 Statistics of Student Awards in Various Competitions

The school was awarded titles including **Provincial AI Pilot School, Provincial Digital Education Pilot School,** and **Ningbo City Primary School Comprehensive Evaluation Reform Municipal Pilot School.** The "E+" Smart Education Teaching Research Group was honored as a **National Female Civilization Post.** Recognized as a **Ningbo Smart School Benchmark School,** our case based on application scenarios was selected as a **Provincial Typical Case**. Our digital reform experience has radiated to over **10 regions** including Hangzhou, Shangyu, and Xiangshan, becoming a benchmark case for regional digital education transformation and providing a replicable, promotable "Gao-Shi Solution" for new-era education evaluation reform.

Scalability and Replicability

In the construction of the AI + "Sunshine Youth" Comprehensive Evaluation System, we built a diversified evaluation system that integrates multi-subject evaluation perspectives, comprehensively and accurately reflecting student development and promoting holistic growth. By leveraging AI-based digital technology to achieve data-driven evaluation, we provide strong support for teaching decisions and precisely assist student development.

Our data-supported digital quality report card has been maturely used for many years, playing a strong demonstrative and leading role in the region. Currently, our school is the **only one in the district** to realize these specific functions, receiving unanimous praise and wide adoption from other schools in the region.

Future Outlook:

The school will continue to deepen the exploration of AI application scenarios in education, teaching, evaluation, and management. We will meticulously refine the daily operation of the "Five Domains" comprehensive evaluation system and continuously expand its functionalities. This includes integrating data from AI sports equipment, classroom observation systems, and AI homework correction tools to better assist the school in scientifically and comprehensively inspecting the teaching and learning situations of teachers and students, providing a solid basis for educational decision-making.

We aim to achieve a deep fusion of "Teaching-Learning-Evaluation," allowing these three processes to interweave and complement each other. By using evaluation as a lever, we strive to reduce burdens and increase efficiency, comprehensively promoting the healthy and holistic growth of students.

Projected Goals (by February 2027):

Within the next academic year, the school plans to further complete the integration and refinement of:

AI Composition Correction System

AI Homework Correction System (focusing on Mathematics)

AI Sports System into the evaluation framework

This will enrich process data and provide higher-quality sample data for comprehensive evaluation.

Case 70

Frugal AI in Education: A Zero-Hardware, Privacy-First Classroom Evaluation System

Shenzhen Middle School, Guangdong, China

Background

Currently, basic education is entering a critical phase of digital transformation; however, the acquisition of high-quality classroom process data has long been constrained by the "impossible triangle" of quality, cost, and privacy. Traditional manual pedagogical evaluation suffers from pain points such as high subjectivity and delayed feedback, whereas existing "smart classroom" solutions rely heavily on expensive visual capture and biometric hardware. This not only imposes a heavy financial burden on under-resourced schools in central and western regions (exacerbating "stealth privatization"), but also sparks severe ethical controversies concerning biometric privacy and data surveillance.

Particularly in under-resourced areas, the focus of educational inequality has shifted from "enrollment rates" to "classroom learning quality," with many students trapped in a dilemma of superficial engagement, often described as "schooling without learning." Therefore, this case aims to explore an inclusive educational AI solution that breaks through hardware barriers. By developing a zero-hardware-investment, privacy-first generative AI classroom evaluation system, this initiative transforms AI into a routine environmental variable. This setup triggers a "digital Hawthorne effect," thereby enhancing students' cognitive engagement, providing precise feedback to disadvantaged learners, and advancing the high-quality, balanced development and comprehensive equity of basic education.

Case Implementation Status

1.Demand Analysis

In authentic classroom ecosystems, teachers and students urgently require routine, unobtrusive, and timely feedback on teaching interactions. However, the complex and noisy physical environments of classrooms place extremely high demands on Automatic Speech Recognition (ASR) technologies. Meanwhile, increasingly stringent global data compliance requirements mandate that educational

systems must absolutely refrain from collecting sensitive biometric features, such as facial data. Most importantly, the introduction of any new technology must provide frontline teachers with an "out-of-the-box" experience, preventing complex device configurations from increasing their cognitive load and avoiding the pitfall of "technology for technology's sake."

2. Technology R&D and Customization Explorations

Guided by the principles of "lightweight deployment" and "Privacy-by-Design," the R&D team pioneered a "Classroom Analyst" AI agent based on a browser-native edge computing architecture (deployed at www.aiphysic.site).

Zero-Perception Edge Processing Architecture: Completely discarding dedicated microphones and GPU computing clusters, this system directly invokes the native Web Speech API of modern browsers. Audio streams are transcribed in real-time within the RAM of the teacher's computer, achieving a "transcribe-and-discard" workflow. Raw audio is never saved to local storage or uploaded to the cloud, completely eliminating the risk of biometric data leakage at the physical source.

Roster Injection Disambiguation Mechanism: To address the challenge of identity misattribution caused by homophones in the absence of visual sensors (e.g., mistaking a student's name for a phonetically identical but differently written word), the R&D team innovatively integrated the DeepSeek Large Language Model (v3.2) with structured JSON class rosters. By analyzing the contextual semantics of instructional commands (e.g., "please answer," "sit down"), the LLM performs precise fuzzy matching within a closed-loop roster, achieving high-precision entity disambiguation in a text-only environment.

Quantification of the Substantive Engagement Index (SEI): Moving beyond superficial "word frequency counts," the system applies differentiated weighting based on John Hattie's feedback model (e.g., routine validation responses +10 points; higher-order cognitive praise +20 points; disciplinary reprimands -20 points). This empowers the AI to precisely distill and evaluate higher-order cognitive processes embedded within classroom dialogues.

3. Application Practice and System Optimization

A 16-week quasi-experimental deployment study (N=98) was conducted in the 12th grade of a public high school, adopting a dual-track "intervention and control" design:

Refinement of Minimalist Interaction Flow: The system interface has been radically simplified into a three-step native browser operation (Load Roster -> Record Session -> One-Click Report Generation). This ultra-low barrier design successfully liberates teachers from the exhausting role of "data recorders," transforming them into efficient "data consumers."

Construction of Bidirectional Feedback Loops: During the 14-week core intervention phase, the system facilitated two-way data empowerment. *On the supply side:* Post-class, teachers intuitively monitor metrics such as the "proportion of higher-order questions" via an interactive dashboard. This prompts them to consciously reduce ineffective didactic lecturing and increase exploratory follow-up questioning. *On the demand side:* Trend charts of the entire class's "cognitive engagement" are presented to the student cohort (i.e., capitalizing learning analytics as student assets). This activates students' metacognitive awareness and their psychological need for competence. Practice has proven that this "invisible observer" model, which requires no external hardware, integrates seamlessly into the existing pedagogical ecosystem.

Case Innovation and Breakthroughs

1. Main Innovation Content

Reconstructing the Classroom Interaction Ecology (Triggering the "Digital Hawthorne Effect"): This case pioneers the elevation of Generative AI from a "passive data-mining tool" to an "environmental variable" embedded within the physical classroom. By constructing a low-intrusion, continuous "Transparent Feedback Environment," it successfully triggers a long-lasting "digital Hawthorne effect." Realizing that their verbal contributions are transformed into cumulative "digital assets," students shift from passive listening to active knowledge construction; meanwhile, under the professional gaze of data, teachers proactively optimize their instructional delivery.

Establishing a "Human-Machine-Human" Ternary Symbiotic Evaluation Model: This breaks the traditional "teacher-student" binary interaction framework by introducing AI as an objective and tireless "third-party analyst." The evaluation system shifts from a singular "results-oriented" approach to a formative assessment process focused on "Substantive Engagement."

2. Technological Breakthrough Content

Edge-Cloud Synergy and Contextual Semantic Disambiguation Technology: This overcomes the technical blind spot of homophone confusion in audio-only classroom analysis. Through the "Roster Injection" mechanism, it proves that in vertical educational scenarios, utilizing the powerful contextual logical reasoning capabilities of Large Language Models (LLMs) to establish "engineering constraints" yields more practical penetrative power than blindly expanding model parameters or stacking multimodal sensors.

The Ethical Breakthrough of Data Minimisation: While mainstream "smart classrooms" in the industry are mired in controversies over comprehensive biometric surveillance, this case's pioneering "RAM-based transcribe-and-discard pure-text conversion technology" establishes a highly exemplary technical security baseline for resolving the ethical dilemmas of educational AI. This architecture sits at the industry's leading edge in terms of low-cost ubiquity and absolute privacy protection.

3. Application Practice Breakthrough Content

Breaking through the "Short-Term Novelty Effect" and Constructing an Academic "Safety Net": Through long-term longitudinal validation, the active classroom participation of the experimental class achieved a sustained, non-decaying surge (skyrocketing by 376.9%). Of greater practical value, the higher-order interactions quantified by AI demonstrated a powerful "safety net effect"—effectively preventing academic collapse among students (especially the low-interaction cohort) during final exams. After strictly controlling for baseline abilities, the experimental group achieved a significant net academic gain (partial $\eta^2 = 0.063$, representing a medium effect size).

Catalyzing an Equity-Promoting "Catch-up Effect": This practice breaks the inherent curse where new technologies often exacerbate the "Matthew Effect." Data reveals that low-achieving students gained a marginal benefit from the AI scaffolding that was 29% higher than that of top-performing students. This holds immense significance for domestic basic education: it proves that relying on "Frugal Innovation"—characterized by zero hardware investment and low-cost algorithmic empowerment—schools in central, western, and remote rural areas can identically popularize high-frequency interactive evaluation at scale. It acts as a killer application for bridging the digital divide and achieving a high-quality, balanced educational ecosystem.

4. Intellectual Property Status

The underlying logic, system architecture, core "Roster Injection" mechanism, and customized Prompt Engineering optimized based on DeepSeek in this project are all originally developed by the research team.

Upholding the spirit of open science and technological inclusivity, the system platform has been launched online (www.aiphysic.site) relying on a Web-native architecture. Its innovative, imperceptible classroom evaluation workflow and core algorithms have laid a completely independent and autonomous intellectual property foundation for subsequent applications for relevant software copyrights and educational technology invention patents. There are no external commercial conflicts of interest.

Promotion Value and Risks

1. Application Prospects and Scalability Potential

This case holds exceptionally broad application prospects. A long-term, in-depth quasi-experimental application has already been conducted in public high schools, successfully validating a lightweight operational model combining "cloud-based large language models + local browsers." Leveraging its "zero new hardware, out-of-the-box" feature, large-scale adoption faces virtually no physical or financial barriers. The system can be rapidly expanded from individual schools to broader county, township, and remote areas, demonstrating high feasibility for large-scale replication into regional or even national inclusive education platforms.

2. Economic and Social Value

Economically, this solution replaces expensive sensors with "software-defined computing," completely eliminating the millions in hardware procurement and long-term maintenance costs associated with traditional smart classrooms, thereby significantly conserving local education budgets. Socially, the verified "catch-up effect" demonstrates that frugal AI can provide a robust academic safety net for lower-achieving students. By bridging the gap in classroom feedback quality across different regions at a very low cost, it serves as a powerful tool to genuinely promote high-quality, balanced basic education and narrow the digital divide.

3. Demonstrative and Pioneering Role

This case serves as a landmark and pioneer in the field of basic education. It breaks from the long-standing path dependency in educational informatization that prioritized "hardware over software, and monitoring over empowerment." It establishes the fundamental principle of "Privacy-by-Design" and pioneers a new paradigm of "Frugal AI in Education," offering a green, safe, and sustainable approach to the digital transformation of basic education nationwide.

4. Potential Application Risks

Two types of risks require attention in practical application. First are technical risks: the system heavily relies on the audio pickup quality of terminal devices (teachers' computers) and the network environment, and the large language model may still produce occasional "hallucinations" leading to individual attribution errors. Second are ethical and managerial risks: close vigilance is needed to prevent the "alienation" of metrics. This could manifest as teachers and students engaging in "performative interactions" to please the AI algorithm, or education authorities misusing AI indicators intended for formative feedback as punitive "teacher performance KPIs," thereby undermining the original intent of technology-empowered teaching.

Other Relevant Information

1. Case Award Status: Include the award time, award name, and awarding institution.

2. Third-Party Evaluation: Present evaluations received by the case regarding its application effects, innovative practices, etc., such as user evaluations, expert review opinions, third-party testing and certification, positive public opinions, etc. (If available, the evaluation subject, information source, and other relevant supporting documents should be specified).

3. Case-related images, videos, and other materials. (Can be attached via cloud drive or provided as separate attachments). 2. Third-Party Evaluations

This case has received high recognition from multiple parties over its long-term implementation. The specific evaluations are as follows:

Frontline User Evaluations (Teacher and Student Feedback):

Teacher Feedback: A frontline teacher from the public high school participating in the quasi-experiment stated in an end-of-term in-depth interview: "The system truly adds no extra burden to lesson preparation or classroom operations—it's genuinely 'out-of-the-box.' The automatically generated interaction reports after class not only give me a clear view of the engagement of 'invisible students,' who are often overlooked in class, but also push me to consciously reduce ineffective lecturing and increase higher-order inquiry-based questioning." (Source: End-of-term qualitative interview records from the study)

Student Feedback: Students in the experimental classes generally reported that seeing the overall class "participation" trends greatly boosted their learning motivation and sense of competence. They felt that every active contribution they made was "truly seen and recorded."

Expert and Peer Review Opinions (Academic Evaluation):

The core innovations of this case have undergone rigorous international peer review. The reviewers unanimously agreed that this practice "successfully breaks through the hardware limitations of asset-heavy 'smart classrooms,' offering a new paradigm of Frugal AI for the digital transformation of education in low-resource and central-western regions—one that is ethically conscious, privacy-protecting, and inclusive in value." (Source: Blind peer review comments from a core academic journal/conference)

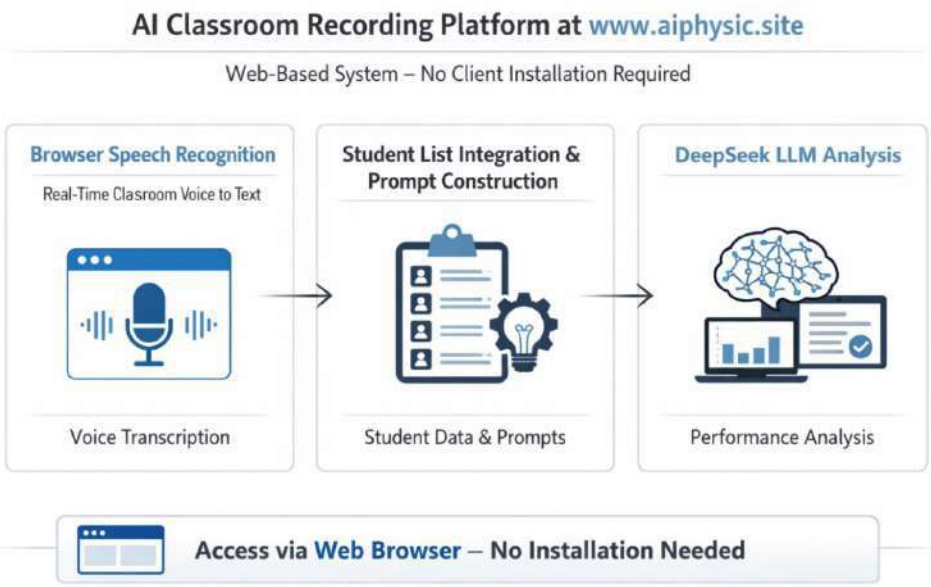

Figure 1 The data flow diagram of the privacy-preserving classroom analysis architecture. The workflow illustrates the three-stage transformation process: local audio capture and transcription via the browser's Web Speech API (ensuring raw audio never leaves the client), integration of student data to construct contextual prompts, and semantic reasoning conducted by the DeepSeek LLM to generate performance analysis.

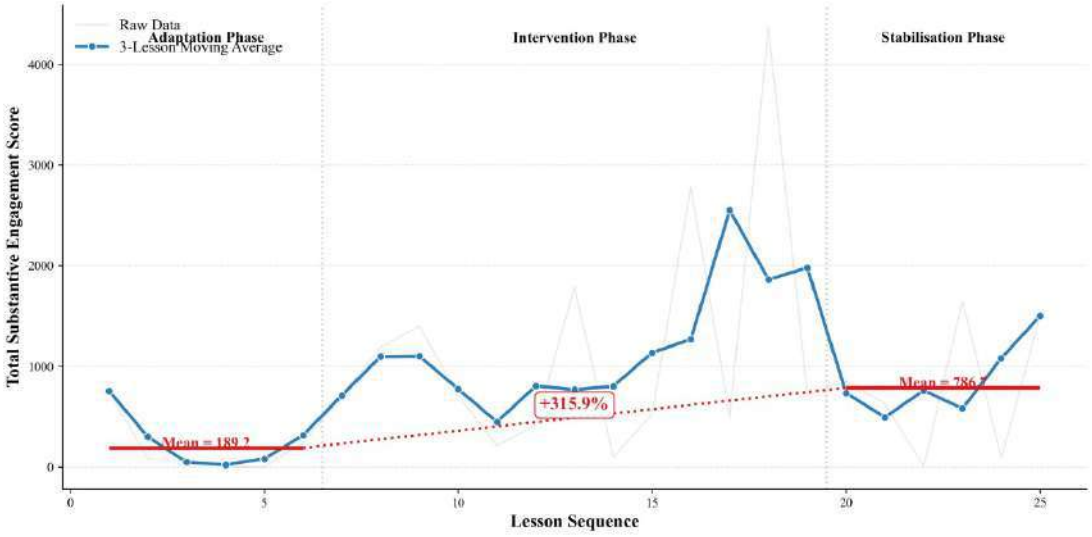

Figure 2 Longitudinal time-series analysis of the Total Substantive Engagement Score across 25 consecutive lessons.

Note. The faint grey line represents the raw daily scores, reflecting natural day-to-day classroom variance (e.g., lecture vs. practice sessions). The thick blue line depicts a 3-lesson moving average to highlight the underlying behavioral trend. Red horizontal lines indicate the mean scores during the initial adaptation phase (Mean = 189.2) and the final stabilisation phase (Mean = 786.7), demonstrating a robust cumulative growth rate of +315.9%.

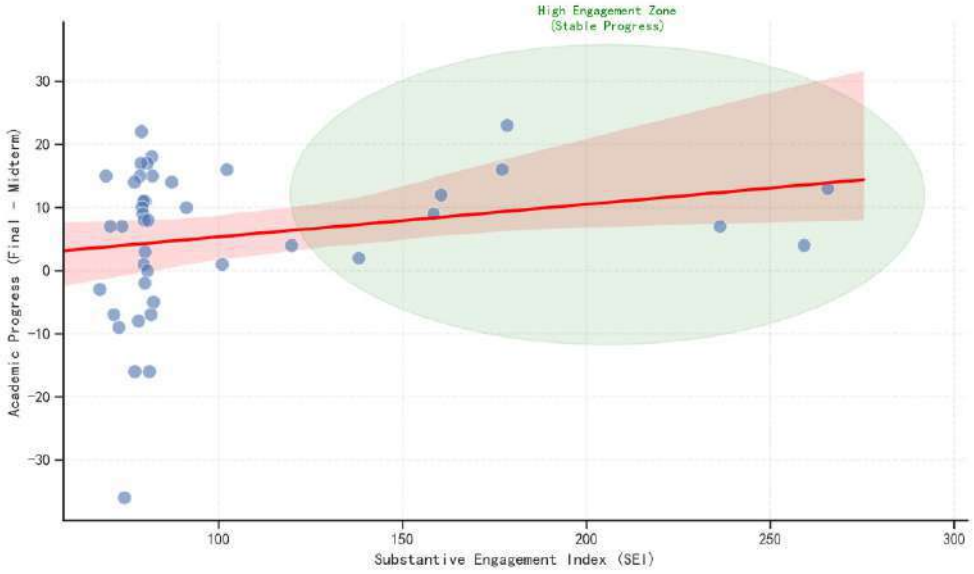

Figure 3 Correlation between AI-quantified Substantive Engagement Index (SEI) and academic progress. The scatter plot illustrates a positive trend between students' cumulative interaction quality (SEI) and their net academic gain (Final - Midterm scores) (N=42, Pearson's r=0.228, p=0.146). The red line represents the linear regression fit with a 95% confidence interval (shaded area). Notably, an asymmetric distribution pattern is observed: while students with low engagement scores (left cluster) exhibit high variance in outcomes (ranging from regression to progression), students with high engagement (right quadrant, SEI > 150) consistently achieve positive academic gains. This suggests that substantive engagement serves as a protective factor against academic regression. Note: 5 students from the experimental group were excluded due to missing interaction logs, resulting in a valid sample of N=42.

Case 71

Times Higher Education: Artificial Intelligence-Digital Maturity Index

Ashley Mok, Louise Lee

Times Higher Education, UK

Case Brief

Times Higher Education's Artificial Intelligence-Digital Maturity Index (AI-DMI) is a framework consisting of assessment tools designed to facilitate universities' understanding of their digital transformation process and use of artificial intelligence. It offers a standardized benchmarking framework, clear comparison indicators, and a common language for communication across functional areas within universities and between institutions globally.

This allows universities to have a clear understanding of their digital infrastructure and staff capabilities in leveraging the tools provided to maximize their efficiency in their individual roles, this includes emerging technologies like artificial intelligence which have already impacted the way universities operate. Institutions can utilize the results to design or adjust their digital transformation strategies as the results provide direction for areas of investment and skill gaps.

Background

The Artificial Intelligence-Digital Maturity Index (AI-DMI) was born from conversations with corporate digital capabilities providers and universities that wanted to find out their internal stakeholder perceptions of their digital transformation process and strategy. Speaking with institutions, we discovered that many universities invest in their digital capabilities without a clear strategic plan of integration and progression, often leading to underutilized technologies or platforms which serve as hinderances rather than the benefits they were intended to be. Additionally, since the inception of the Index, artificial intelligence usage has increased exponentially across the globe, impacting the way industry and higher education institutions have traditionally understood functional structures and pedagogies.

Amongst different internal stakeholders, ranging from administrative staff to star researchers, everyone had a different perception of how institutional digital transformation had affected them, positively or negatively, in their individual roles. The AI-DMI is designed to collate those perceptions into a quantifiable grade which senior leadership can review to discover where their resource allocation should be focused on within their university, be it augmenting research capabilities through the ethical usage of AI or enabling better student registration forecasts for the administrative office. The goal is for decision makers to have the necessary data to make prioritization possible.

There are three audience groups most interested in the results:
1) Individual universities that utilize the AI-DMI to design or augment their digital transformation strategy
2) Corporate entities who provide digital solutions to higher education institutions
3) Governments that can leverage a national AI-DMI framework in understanding budgeting and resource allocation amongst different institutions
The audience have been reached via global survey (almost 5,000respondents worldwide) and relevant events (Times Higher Education's Digital Universities regional conferences). Additionally, a whitepaper was published and is available publicly, displaying the results of the latest iteration.

Implementation Process

Designed from the ground up, the AI-DMI was built with industry consultation – both higher education institutions and corporate partners provided key insights into their priorities when considering the maturity level of a university's digital transformation strategy. Some key steps taken included:

1) Development of a comprehensive survey structure encompassing 2 Core University Stakeholder Groups (Education & Research and Governance & Administration) and 5 Dimensions (elements of digital transformation – Strategy, People, Utilization, Strategy (Data and AI Ethics), Technology). Challenges included length of interview as well as co-development of survey questions with multiple feedback channels (e.g. differing agendas between HEIs and corporate entities).

2) Deployment of global survey to stakeholders from around the world. Audience reach was a particular challenge here as the target respondents included senior management from HEIs as one of the pillars. Through THE's extensive reach and partners, we were able to obtain a substantial global response of almost 5,000completed surveys.

3) Analysis of the data set was the next step and the benchmarking and trend analysis for a truly global survey provided both a challenge and an opportunity to view the results through a regional lens. The decision to include a geographical centered perspective allowed an in-depth look at the differences between HEIs across the world.

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Innovation and Breakthroughs

The AI-DMI draws from many existing digital transformation insight threads to focus specifically on the higher education landscape. Whereas the majority of digital transformation frameworks are targeted at corporate and/or government utilization, the AI-DMI was designed to allow HEIs access to internal stakeholders' perceptions in order to understand what pain points existed within specific roles. The insights provided are granular, with actionable outcomes that can be derived at individual question level – be it at organizational level with a lack of staff understanding of the university's overall digital transformation strategy, or an administrative staff level lacking the necessary data storage facilities to hold student records securely.

As an example, one of the 5 Dimensions is 'Technology', referring to the actual digital product or platform that the HEI has purchased or leases for staff to utilize in support of its strategic goals, which means different things to different roles. The DMI endeavors to provide actionable outcomes for the HEI across all roles individually:

Table 1 University Stakeholder Group Specific Questions (Technology Dimension)

Pillar	Dimension	Question
Education and Research	**Technology**	**Which technologies are provided by your university?** Learning Management Systems (e.g., Moodle, Canvas) Conferencing Systems (e.g., Zoom, Teams) Automated Grading Systems
Governance and Administration	**Technology**	**Are the following digital systems are used by your university?** Student systems (e.g., Student Information Systems, retention/early warning tools) Academic and research systems (e.g., Library Information Systems, research grant management)

Across all questions, the University Stakeholder Groups are surveyed on each dimension specific to their operational roles and needs. This in turn allows decision makers to understand both the overarching perspective of their HEIs digital transformation process and what it means to each individual working there in their own capacity, ensuring no one's opinion is left out.

Effectiveness Proof

The expected impact is for universities to utilize their results to both benchmark against regional peers, though not from a rankings perspective since the grading is based upon internal stakeholder perception, and more importantly as an internal tool to design or augment their existing digital transformation strategy across operational roles.

Scale will be achieved as increasing number of universities participate in the annual survey, providing historical precedent in time to come for universities to track average progress and determine their individual timelines for improvement. The AI-DMI is set to provide a global view of HEI transformation across the globe for years to come.

Case 72

Innovative Practice of Generative AI-Empowered Engineering Education Evaluation and Accreditation

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Background

With the advancement of educational digitalization, higher education is accelerating the transformation of its curriculum and teaching systems toward digital and intelligent development. At the same time, engineering education accreditation, grounded in the Outcome-Based Education (OBE) philosophy, emphasizes student-centeredness, learning outcomes, and continuous improvement, requiring a closed loop of objectives, implementation, evaluation, and improvement around student competency development.

However, existing general-purpose teaching platforms often prioritize resource display over process support, making it difficult to connect key stages such as performance data collection, attainment analysis, and accreditation report generation. Teaching and learning data are often scattered across third-party platforms, hindering unified governance, intellectual property protection, and continuous improvement. In addition, programming practice and courses such as Introduction to Artificial Intelligence still lack suitable practical training platforms. Therefore, an intelligent support platform covering program development, course implementation, evaluation, improvement, and practical training is needed to advance engineering education evaluation and accreditation from experience-based practice to data-driven and process-oriented governance.

Case Implementation Status

To meet the needs of higher education digital transformation and engineering education evaluation and accreditation, the university independently developed “Zhixiaoxin,” a generative AI-powered smart teaching platform that brings together teaching, learning, assessment, management, research, service, and innovation. Guided by the core principles of student-centeredness, outcome-based orientation, and continuous improvement, the platform applies generative AI to goal setting, learning diagnosis, pathway planning, resource recommendation, and feedback. It has gradually formed an integrated framework that covers data acquisition, knowledge modeling, intelligent application, and

feedback-based improvement, providing support for program development, curriculum governance, teaching implementation, learning evaluation, and practical training.

(1) Building a Smart Teaching Platform to Strengthen the Foundation for End-to-End Governance

Focusing on the key needs of engineering education self-evaluation and accreditation, the project team conducted systematic demand analysis across core scenarios such as program development, curriculum construction, classroom teaching, learning evaluation, and quality monitoring. Particular attention was given to addressing three major challenges: the misalignment between program design and industry demand, students' loss of direction during the learning process, and delayed evaluation feedback that hinders timely improvement. On this basis, the team independently developed the “Zhixiaoxin” platform. By leveraging reinforcement learning, learning behavior modeling, and related technologies, the platform continuously captures, aggregates, and stores data throughout the entire teaching and learning process, thereby establishing a data foundation and analytical capability that support the full instructional cycle. This enables systematic support from data integration to instructional decision-making. At the same time, by relying on a self-developed platform architecture, the university is able to accumulate educational data assets, effectively protect teachers' instructional resources and intellectual outputs, and lay a solid foundation for future resource reuse, knowledge modeling, and teaching innovation. Figure 1 illustrates the layered architecture of the platform and its end-to-end closed-loop empowerment logic.

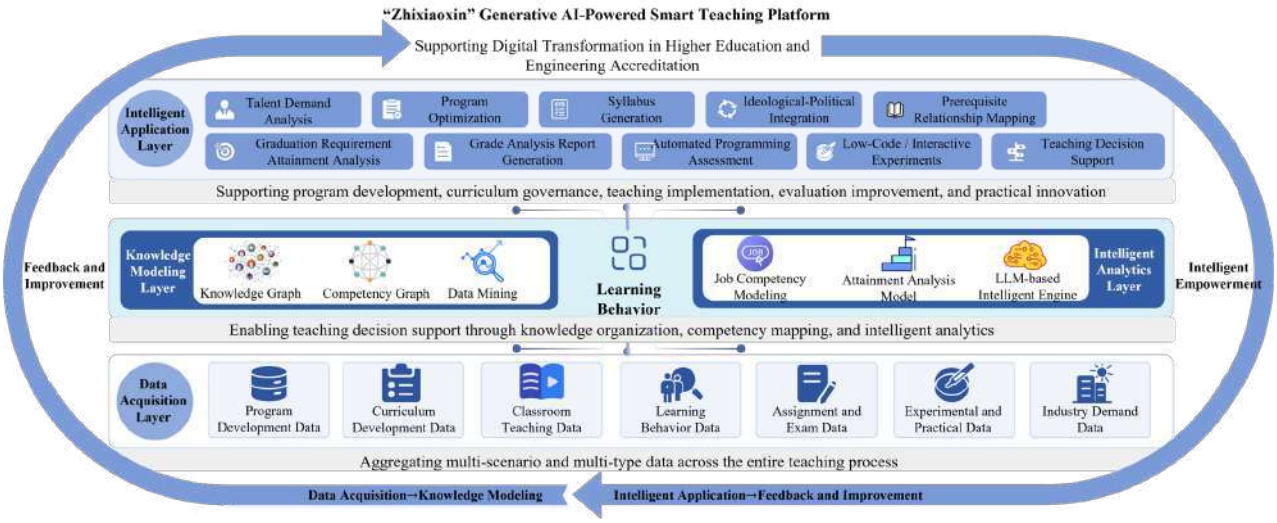

Figure 1. Layered Architecture and End-to-End Closed-Loop Empowerment Framework of the “Zhixiaoxin” Platform

(2) Supporting Engineering Education Evaluation and Accreditation by Reshaping Program Development and Curriculum Governance Mechanisms

Guided by the outcome-based philosophy of engineering education accreditation, the platform focuses on key processes including program setup, program plan optimization, curriculum system design, attainment evaluation, and continuous improvement. In program development, the platform collects multi-source data such as industry demand, job competency requirements, and graduate employment trends. Based on large language models, it constructs job competency models and has automatically generated talent demand reports for 115 academic programs, providing evidence for revising program objectives and optimizing training schemes. In curriculum construction, the platform supports the

intelligent generation of training schemes and course syllabi, while also enabling the systematic construction of course objectives, graduation requirement indicators, prerequisite relationships, and curriculum mappings, thereby strengthening the alignment between curriculum systems and talent cultivation objectives. In evaluation and improvement, the platform automatically collects learning data from classroom interaction, assignments, quizzes, experiments, and practical training; calculates course objective attainment and graduation requirement attainment; and generates course performance analysis reports. This provides process-oriented and traceable evidence for course improvement, teaching reflection, and accreditation support materials. Figure 2 presents the business workflow through which the platform supports the closed loop of objectives, implementation, evaluation, and improvement in engineering education evaluation and accreditation.

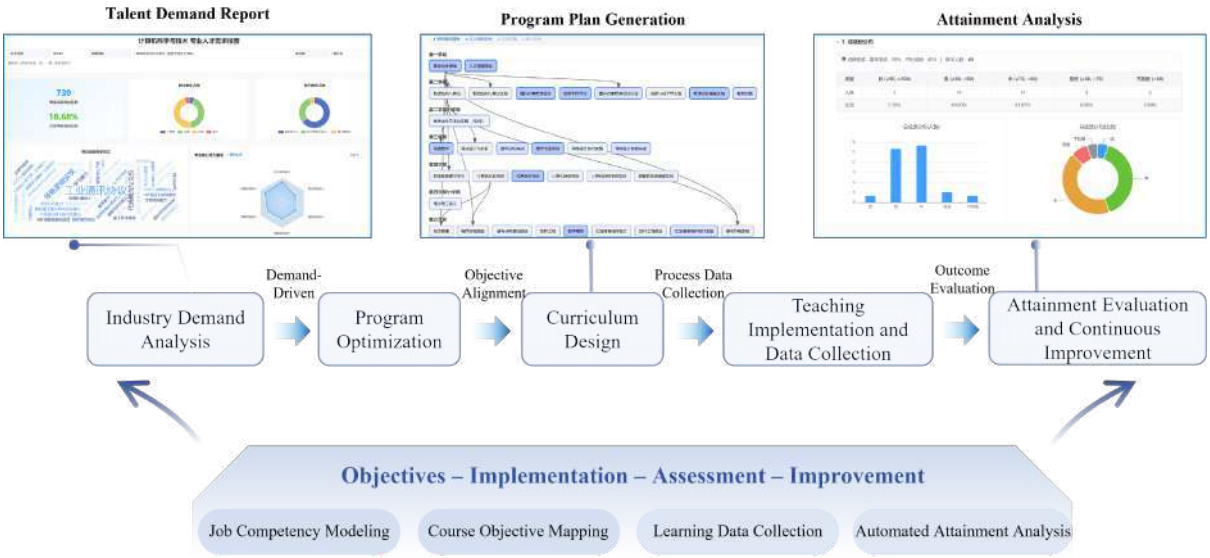

Figure 2. Business Workflow of “Zhixiaoxin” for Supporting Engineering Education Evaluation and Accreditation

(3) Empowering Practice-Oriented Teaching in Emerging Engineering Education by Expanding Experimental and Practical Training Scenarios

To address the highly practical and organizationally complex nature of courses such as Introduction to Artificial Intelligence and programming-related courses, the university developed an experimental and practical training module based on the “Zhixiaoxin” platform, exploring a new practice-oriented teaching model suited to emerging engineering education. As shown in Figure 3, the platform is designed around the learning characteristics of programming and AI-related courses. It integrates automated programming assessment to provide instant evaluation and feedback on students' code submissions, thereby improving teaching efficiency and the precision of process-based assessment. In addition, it offers low-code, interactive, and drag-and-drop experimental environments, enabling students to complete knowledge acquisition and skills training in visualized and progressively structured learning settings, thus enhancing participation and practical learning experience. By effectively integrating theoretical instruction, experimental training, and process-oriented evaluation, the platform has improved both the quality and effectiveness of practical teaching.

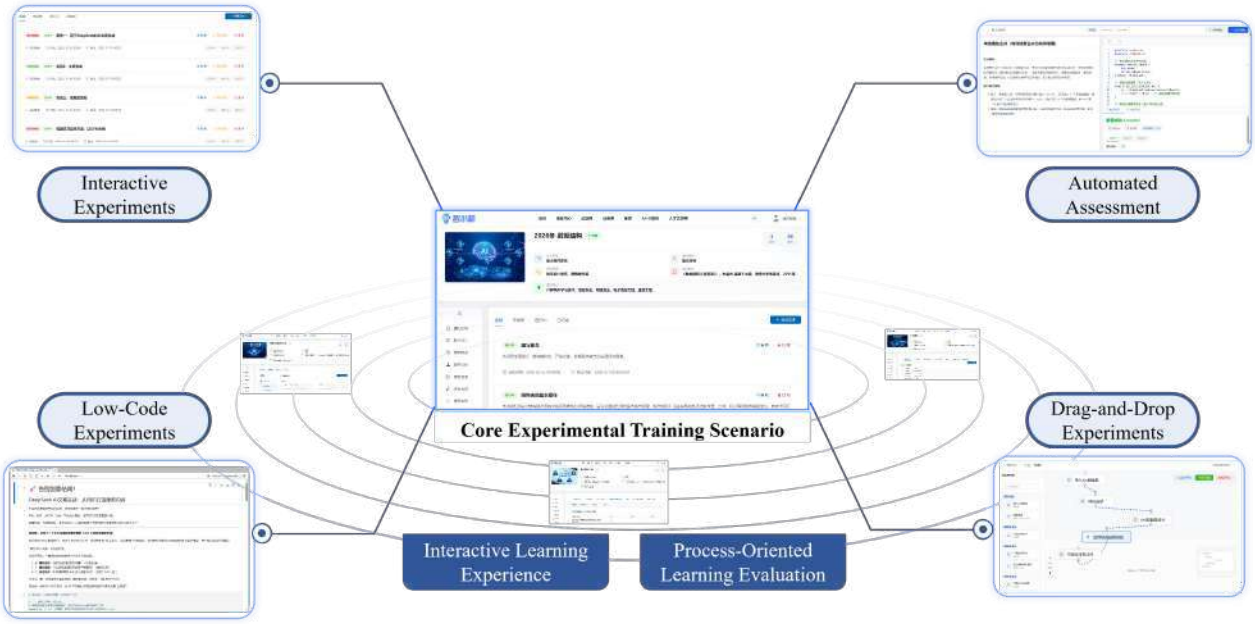

Figure 3. Experimental and Practical Training Scenarios for Introduction to Artificial Intelligence and Programming Courses

Case Innovation and Breakthroughs

(1) Main Innovations

The primary innovation of this case lies in its teaching model and governance approach. Guided by engineering education accreditation, the university deeply integrates the Outcome-Based Education (OBE) philosophy into the entire talent cultivation process, promoting a shift in teaching reform from emphasizing results display to emphasizing process support, evidence-based evaluation, and continuous improvement. Focusing on program development, course implementation, practical teaching, learning evaluation, and quality enhancement, the case reconstructs the alignment among program objectives, graduation requirements, course objectives, teaching activities, and evaluation outcomes, thereby forming a closed loop of objectives, implementation, evaluation, and improvement. Its innovation does not lie in the replacement of a single technical tool, but in the use of digital and intelligent technologies to transform the governance model of teaching and learning, reflecting modern higher education principles that are student-centered, competency-oriented, and evidence-informed in educational decision-making.

In addition, this case innovatively establishes a discipline-industry dual-driven support mechanism for talent cultivation. Starting from industry demand, the platform integrates job analysis, competency modeling, program optimization, curriculum system design, and learning evaluation into a unified process. This makes program development more responsive to regional industrial needs and the development trends of emerging engineering education, thereby improving the alignment between talent cultivation and societal demand.

(2) Technological Breakthroughs

At the technical level, this case has developed an independent technological pathway tailored to the complex scenarios of higher education. The system is designed and deployed based on a microservices

architecture, with strong modular scalability, business decoupling capability, and continuous iteration capacity, enabling it to adapt flexibly to different disciplines, courses, and application scenarios. In terms of core technologies, the team integrates large language models, learning behavior modeling, data mining, knowledge graphs, and competency graphs. Based on multi-source heterogeneous educational data, it constructs course- and program-level knowledge graphs and further evolves them into competency graphs. Breakthroughs have been achieved in areas such as industry demand analysis, job competency modeling, program design, syllabus generation, and automated attainment analysis.

The significance of these technological breakthroughs lies not only in improving the efficiency of teaching management and accreditation-related work, but also in advancing educational digitalization from business support to instructional empowerment, and from result statistics to process analysis and quality improvement. The case provides a replicable technological pathway for the digital implementation of engineering education evaluation and accreditation.

(3) Breakthroughs in Application Practice

At the application level, this case goes beyond the limitations of digitalization that remain confined to resource management and administrative affairs, enabling digital technology to address the core questions of what to teach, how to teach, how students learn, and how improvement can be made. In the context of engineering education accreditation, the platform automatically generates talent demand reports for academic programs, providing evidence for dynamic program adjustment and revision of training schemes. In course teaching, it establishes automated linkages among course objectives, graduation requirement indicators, and learning evaluation data, thus providing evidence-based support for course attainment evaluation and continuous improvement. For emerging engineering courses such as artificial intelligence and programming, it builds an experimental and practical training environment integrating automated assessment, low-code experiments, interactive operation, and drag-and-drop practice, thereby improving both the organization of practical teaching and the effectiveness of students' competency development.

This practice has promoted coordinated changes in teaching, learning, and educational management. It helps shift quality improvement from experience-based adjustment to evidence-based improvement, and from fragmented digitalization to end-to-end digital transformation. For universities in frontier regions, it also provides a practical model with regional characteristics and strong potential for wider dissemination.

(4) Intellectual Property Status

All core technologies and system achievements involved in this case were independently developed by the university. The intellectual property rights are clearly defined, fully owned, and well positioned for future dissemination and application. At present, the project has obtained 11 software copyrights, and 2 invention patents are under substantive examination. All related intellectual property rights are fully owned by the university. This provides strong support for subsequent platform iteration, technology transfer, and large-scale promotion, and also demonstrates the case's strengths in technological originality, self-reliance, and sustainable development.

Promotion Value and Risks

This case addresses the practical needs of higher education digital transformation and engineering education accreditation, and therefore shows strong potential for wider dissemination and application. At present, the “Zhixiaoxin” platform has achieved systematic application in program development, curriculum construction, teaching implementation, experimental and practical training, and quality evaluation. It has supported 115 academic programs in industry demand analysis and program plan optimization, and has also been applied in artificial intelligence- and programming-related courses, enabling vertical integration from the program level, to the course level, and further to the instructional process level. Developed and operated independently by the university, the platform is based on a microservices architecture with strong scalability and replicability, providing a solid foundation for large-scale promotion.

In terms of social value, the platform helps shift higher education from experience-based management to data-driven governance, from outcome-focused evaluation to process-oriented evaluation, and from fragmented improvement to continuous improvement. It also enhances the alignment between talent cultivation and industry demand, and has strong demonstration value for engineering education accreditation, emerging engineering education reform, and smart teaching platform development.

In terms of economic value, the platform has significantly reduced the high costs caused by fragmented procurement through integrated deployment and continuous iteration. Under traditional approaches, commercial teaching platforms typically require RMB 50,000-80,000 per course for course development, about RMB 500,000 per program for program development, around RMB 2 million for an experimental platform for general AI courses, and approximately RMB 1 million for engineering accreditation modules. In contrast, the university's independent development of the “Zhixiaoxin” platform has reduced redundant construction and repeated investment, improved service efficiency, and enabled unified collection, storage, and governance of teaching and learning data throughout the entire instructional process. It has also effectively protected teachers' instructional resources and intellectual outputs, while gradually forming the university's own knowledge base and educational data resources to support future upgrading, transformation, and long-term operation.

During implementation, attention must be paid to the potential risk of LLM hallucination. To address this issue, the university has adopted measures such as human review, validation at key stages, and iterative optimization of generated results to ensure the reliability and safety of platform outputs.

Other Relevant Information

(1) Awards and Honors

Award Date	Award Title
January 2026	First Prize of the Xinjiang Uygur Autonomous Region Teaching Achievement Award
December 2025	First Prize, Western Region, 2nd National Smart Teaching Case Competition for University Teachers in Electronic Information Disciplines (Haopu Cup), 2025
December 2025	Second Prize, National Finals, 2nd National Smart Teaching Case Competition for University Teachers in Electronic Information Disciplines (Haopu Cup), 2025
August 2025	Excellent Case of Smart Education

(2) Mainstream Media Coverage

Coverage Title	Source
From Classroom to Industry: Xinjiang University's "Barrier-Breaking" Practice in Computer Education	Shiliuyun
Empowered by Platforms and Guided by Industry: Xinjiang University Creates a New Educational Model for Computer-Related Courses	Shiliuyun
From Classroom to Industry: Xinjiang University's "Barrier-Breaking" Practice in Computer Education	Tianshan Net

(3) Other Supporting Materials

Supporting materials include the access link to the “Zhixiaoxin” platform (http://zhixiaoxin.cn), a talent demand report for academic programs (Computer Science and Technology as an example) as Attachment 1, a course performance analysis report (Computer Networks as an example) as Attachment 2, and Attachment 3, which contains the software copyright and patent supporting documents of the “Zhixiaoxin” platform together with photos documenting its promotion and application process.

Case 73

AI Empowerment + Industry-Education Integration Creates a Digital Education Ecosystem for 'Education Silicon Valley'

Binjiang District Education Bureau, Hangzhou City, Zhejiang, China

Background

As Zhejiang Province's "Digital Economy Pioneer Zone", Binjiang District of Hangzhou faces four core challenges in digital education transformation: insufficient motivation for educational innovation mechanisms, shallow integration of AI technologies with teaching applications, incomplete AI literacy development systems for teachers and students, and limited effectiveness of data-driven governance in educational operations. Leveraging its unique advantage of high-tech enterprise clustering, promoting deep AI integration with education has become an inevitable choice for Binjiang's high-quality educational development. Guided by the vision of building an "Education Silicon Valley", this initiative regularly releases the "Artificial Intelligence + Education White Paper", using AI as the core engine. Through a dual-driven approach of "top-level design + grassroots innovation", it constructs a digital education ecosystem characterized by AI empowerment, data-driven strategies, and industry-education collaboration. These efforts aim to address aforementioned challenges, achieve comprehensive digital upgrades across teaching methodologies, teacher training systems, and governance services, and establish a regional model for basic education digital transformation.

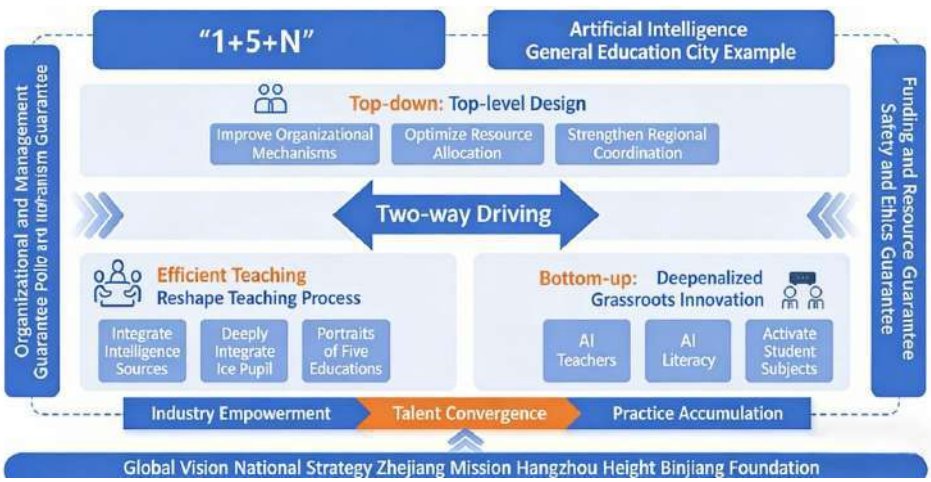

Figure 1 Content Framework of Binjiang District's "2025 Artificial Intelligence + Education White Paper"

Case Implementation Status

This case study focuses on the core requirements of educational digitalization and implements systematic practices across four key dimensions:

1. Mechanism Innovation as Foundation: Implementing the "One School, One Digital Task Force" system to ensure full coverage of CIO/CTO roles across all primary and secondary schools (including kindergartens) in the district, while establishing a project roadmap featuring "pilot cultivation → regional rollout → benchmark creation." Strategic partnerships with 10 high-tech enterprises have been forged to develop an industry-education collaboration model where "enterprises provide technology, schools deliver application scenarios, and regions cultivate ecosystems," jointly developing customized digital intelligence systems for education.

2. Competency Enhancement Empowerment: Establish a tripartite training system integrating teachers, students, and professional teams, forming a 50-member digital education lecturer team and leveraging 460 classroom terminals to build a digital professional development platform. Develop district-level AI education digital platforms and general education courses, collaborate with 28 high-tech enterprises for AI project-based learning initiatives, establish Hangzhou Artificial Intelligence Innovation Practice School, and create a pilot zone for large-scale AI curriculum application at the Central Electric Education Museum.

3. Classroom Innovation and Quality Enhancement: Integrating AI technology throughout the teaching process, implementing intelligent homework grading across all domains, and utilizing the "Learning Ability Map" to precisely deliver tiered and varied exercises; Establishing a comprehensive digital-intelligent sports system to customize personalized exercise regimens; Generating student growth profiles through the primary school comprehensive evaluation system to achieve data-driven differentiated instruction.

4. Enhanced Efficiency through Digital and Intelligent Governance: Developed two digital and intelligent supervision platforms for campus food safety and school commute safety, establishing a cross-departmental collaboration mechanism and an intelligent early warning closed-loop system; created the "Educational Personnel Manager" platform to achieve comprehensive lifecycle management of teachers and precise faculty allocation, thereby forming a safe and efficient educational governance system.

Through a two-way mechanism combining 'top-down coordination + bottom-up innovation,' practical implementation facilitates deep integration of technology, resources, and application scenarios, enabling AI education applications to evolve from isolated explorations to comprehensive coverage across all domains.

Case Innovation and Breakthrough

1. Main innovative content

We pioneered a regional digital education development model integrating industry-education collaboration with AI empowerment, achieving three major innovations: First, establishing a collaborative mechanism where enterprises provide technologies, schools create learning scenarios, and regions develop ecosystems to directly apply high-tech resources to educational contexts;

Second, creating a dual-driven promotion pathway combining top-level design with grassroots innovation to balance regional coordination and school-specific explorations; Third, building an integrated digital system encompassing teaching, competency development, and governance to enable comprehensive AI applications across all basic education scenarios; Fourth, developing data-driven precision education models that leverage learning profiles and competency mapping for large-scale personalized instruction.

2. Content of Technological Breakthroughs

We have achieved breakthroughs in implementing multi-source data integration and intelligent analysis technologies for education, collaborating with enterprises to develop digital intelligence systems tailored for basic education. This initiative has successfully broken down data barriers across multiple scenarios including classroom instruction, homework management, assessment systems, and governance frameworks. By establishing intelligent systems powered by large-scale models for automated Q&A, essay grading, and oral practice support, we have enabled large-scale application of natural language processing technologies in basic education. Furthermore, we have constructed an intelligent governance framework encompassing monitoring, analysis, early warning, and corrective measures to enhance educational management efficiency. The technological applications in this case study rank among the leading levels of regional basic education informatization in China, earning recognition as a Zhejiang Province Pilot Zone for Technology-Enabled Smart Education.

3. Breakthroughs in Application Practice Content

The region has achieved comprehensive digital coverage and deep implementation in basic education, with 100% completion rate of smart campus construction. Intelligent homework grading and digital teacher training programs now cover all schools, establishing replicable regional digital education models. It pioneered AI-based general education for 21,000 students, achieving a 200% year-on-year increase in digital literacy practice participation rates. The regional academic equity index has consistently ranked first in the province for consecutive years, providing a practical model for China's basic education digital transformation characterized by "comprehensive advancement, industry-education integration, and data-driven approaches." These initiatives are driving the transition from "balanced development" to "high-quality balanced development" in basic education.

4. Intellectual Property Status

Jointly developed educational digital intelligence systems and intelligent supervision platforms by industry-academia collaborations are jointly owned by both parties, with the Binjiang District Education Bureau retaining exclusive usage rights in the education sector. The region independently established "Xue Zai Binjiang" integrated educational resource platform and primary school student comprehensive evaluation system enjoy independent operation and upgrade rights. Core AI technologies are licensed by partner high-tech enterprises under patent agreements, restricted to educational applications in Binjiang District without involving intellectual property transfers.

Promotional Value

1. Application Prospects

This initiative has achieved comprehensive coverage across Binjiang District. By 2025,39 digital education projects were launched with a total investment of 15 million yuan, 73% of which focused on AI applications, establishing a mature "two-way drive" operational model. The approach can be

replicated nationwide in digital economy high-tech zones and science-education integration demonstration areas through a three-step strategy: top-level design output, school-enterprise collaborative replication, and technology-scenario adaptation for large-scale implementation. It particularly serves as a model for regions with abundant high-tech enterprise resources.

2. Social and Economic Value

In terms of social benefits, it enhances the quality and equity of basic education, cultivates students' AI thinking and digital literacy, and strengthens the foundation for regional digital talent development. Economically, intelligent governance reduces administrative costs such as educational supervision and teacher allocation. Through industry-education integration, it enables low-cost co-construction and sharing of educational technology resources while facilitating the transformation of high-tech enterprise technologies into educational applications, achieving mutual empowerment between industry and education.

3. Demonstrative and Leading Role

This initiative was recognized as one of China's first National Model Zones for High-Quality and Balanced Development in Compulsory Education and a Central Electric Education Pavilion Pilot Zone for Large-Scale AI Curriculum Implementation. In 2025,14 exemplary cases were selected as National Outstanding Smart Education Cases (ranking first in the province). Its development model featuring "industry-education integration, comprehensive regional advancement, and data-driven approaches" provides actionable regional experience for digital transformation in basic education nationwide, demonstrating innovative pathways for high-quality development in foundational education within the digital economy context.

Other Relevant Information

1. Case Reward Status

• 2024: Designated as one of the first National High-Quality and Balanced Development Zones for Compulsory Education (Ministry of Education), a Pilot Zone for Large-Scale Application of Artificial Intelligence Courses by the Central Electric Education Pavilion (Central Electric Education Pavilion), and a Zhejiang Provincial Pilot Zone for Technology-Enabled Smart Education (Zhejiang Provincial Department of Education).

• 2025:14 cases were selected as National Outstanding Cases of Smart Education (Organizing Committee of Global Smart Education Conference), ranking first in the province in terms of selection quantity

• 2023-2025: The Regional Education Modernization Development Level Monitoring Index ranked among the top three in Zhejiang Province for three consecutive years (Zhejiang Provincial Department of Education)

2. Third-party Evaluation

This case was designated as a benchmark example of digital transformation in basic education in Zhejiang Province and exhibited as a district-level characteristic case at the 11th Asian Education Equipment Expo. At the public level, the achievements in high-quality and balanced regional education development have gained widespread social recognition, establishing it as a hallmark of Hangzhou's digital transformation in basic education.

Case 74

Artificial Intelligence Technology Empowers the Cultivation of Scientific and Innovative Talents

China United Network Communications Group Co., Ltd. Shanghai Branch, China

Shanghai Luwan Senior High School, Shanghai, China

Background

At present, the cultivation of scientific and innovative talents in basic education faces several pain points, such as monotonous teaching models, insufficient practical scenarios, extensive quality evaluation, and inadequate interdisciplinary integration. The development of students' innovative thinking and practical abilities is restricted, while teachers' capabilities in science and innovation teaching and the application of digital tools urgently need improvement. To address these issues, China Unicom Shanghai has partnered with Shanghai Luwan Senior High School, guided by the philosophy of "Nurturing people through science education and establishing character with humanistic spirit". Relying on artificial intelligence technology, the two parties promote the reform of the scientific and innovative talent cultivation system, build an intelligent teaching environment, develop distinctive science and innovation courses, and establish a data-driven quality evaluation system. The project aims to innovate teaching models, efficiently integrate resources, and cultivate a new generation of scientific and innovative talents with AI literacy, interdisciplinary thinking and innovative practical capabilities, providing a replicable practical paradigm for the cultivation of scientific and innovative talents in basic education.

Case Implementation Status

In line with the objectives of cultivating scientific and innovative talents in senior high schools, the teaching needs of teachers and students, and the trend of digital transformation in basic education, this case focuses on exploring innovative applications of artificial intelligence technology in driving educational reform. It carries out full-scenario construction in four dimensions: "digital teaching environment and facilities, digital education and comprehensive evaluation system, digital curriculum and teaching resources, and digital perception and management processes", fully empowering the cultivation of scientific and innovative talents.

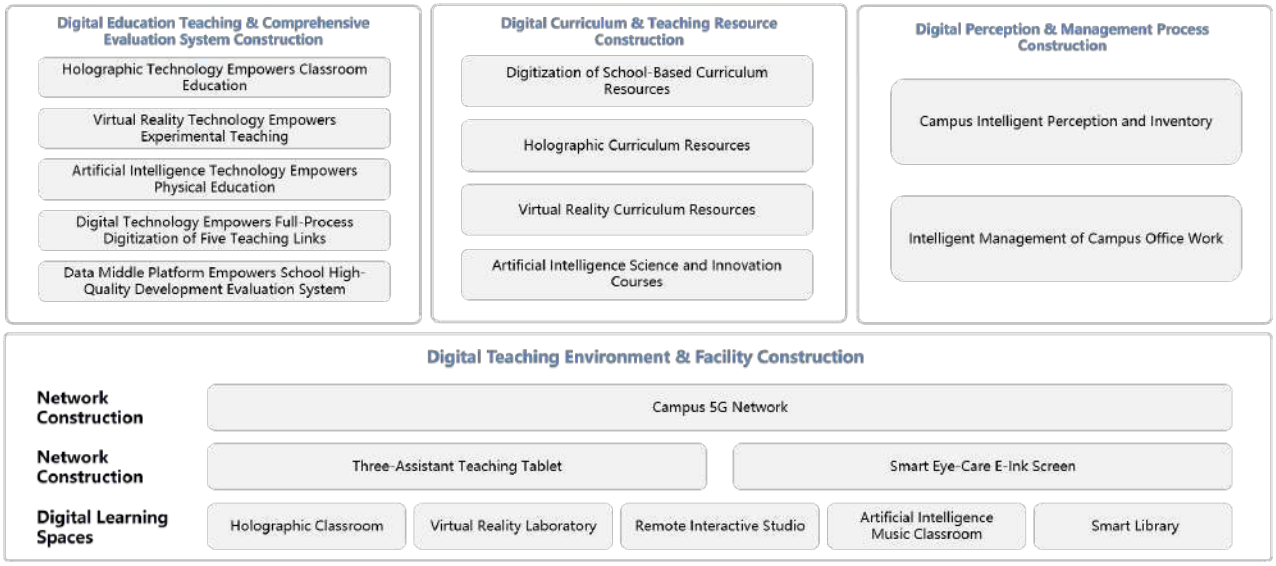

Figure 1

First, in the construction of digital teaching environment and facilities, the case has achieved full 5G coverage on campus, including indoor full coverage in key areas such as the school's comprehensive building and teaching buildings, serving as infrastructure support for information-based scenarios. The whole Grade 10 is equipped with three sets of teaching assistant tablet terminals, and four classes are provided with intelligent eye-friendly e-ink screen terminals, supporting teaching links including lesson preparation, teaching, assessment and homework. Meanwhile, digital learning venues such as holographic classrooms, virtual reality laboratories, remote interactive studios, AI music classrooms and AI smart libraries have been built to meet the requirements of digital classrooms and inter-school interactive courses.

Figure 2 Digital Teaching Space (Exemplified by Holographic Classroom)

Second, in the construction of digital education, teaching and comprehensive evaluation system, the case has built a holographic classroom management system and teaching resources for key subjects including geography, chemistry and biology to support daily classroom teaching. For chemistry experiment teaching, XR virtual reality experiment resources have been developed to empower chemistry experiment classes. A smart physical education teaching scenario has been established to meet the needs of physical fitness monitoring and training, realizing non-perceptual data collection and evaluation in PE classes and improving teaching quality and efficiency. Based on information technology, with intelligent teaching terminals and digital teaching spaces as carriers, a cloud-real integrated teaching system has been constructed, covering online lesson preparation, teaching, homework, assessment and evaluation to digitalize the entire five key teaching processes and realize routine application of classroom management. A high-quality connotative development platform driven by educational model reform and data governance has been built, promoting the school's high-quality development and transformation from three levels: "school-running objective evaluation, curriculum quality evaluation and teacher development evaluation".

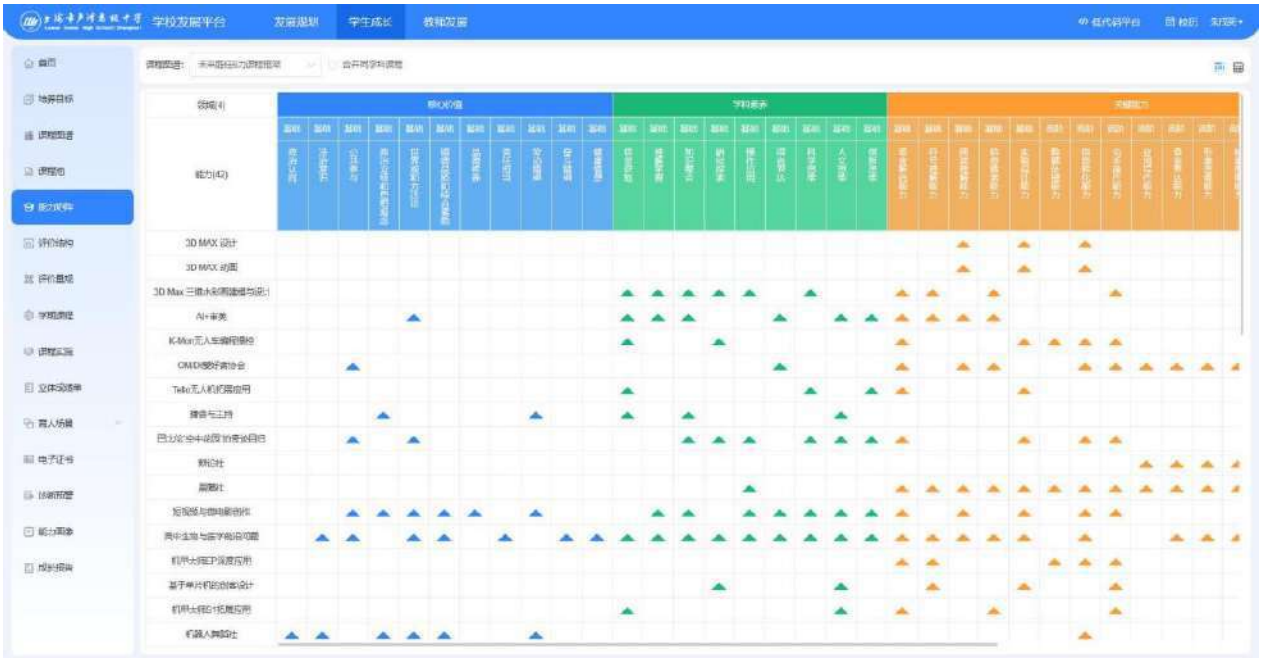

Figure 3 Artificial Intelligence Technology Empowers Curriculum Quality Evaluation

Third, in the construction of digital curriculum and teaching resources, the case has completed the digitalization of teaching auxiliary resources across all subjects, as well as the development of holographic curriculum resources and XR virtual experiment curriculum resources. In total, more than 120,000 school-based resources, over 20 sets of holographic curriculum resources and more than 30 sets of virtual reality curriculum resources have been accumulated.

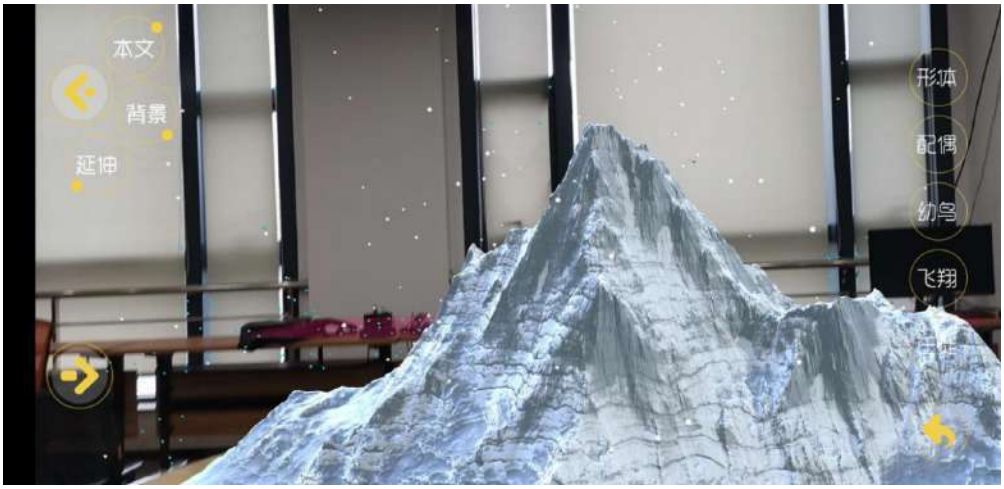

Figure 4 Digital Curriculum Resources

Finally, in the construction of digital perception and management processes, the case has completed the establishment of campus intelligent perception and inventory processes as well as intelligent office management processes, enabling the school to intelligently perceive and manage the campus environment and administrative workflows, improving management efficiency and standards.

Figure 5 Campus Intelligent Perception and Inventory Equipment

Case Innovation and Breakthroughs

1. Main Innovation Content:

(1) In teaching model: innovate the “AI immersive + interdisciplinary” science and innovation teaching model, deeply integrating holography, VR/AR and artificial intelligence technology with science and innovation courses, breaking the time and space constraints of traditional classrooms and realizing the transformation from “knowledge instillation” to “inquiry-based learning”.

(2) In technology application: build a cloud-real integrated science and innovation teaching system to digitalize the entire process of the five teaching links (lesson preparation, teaching, homework, assessment and evaluation). Meanwhile, AI technology is used to achieve accurate evaluation of

scientific and innovative literacy and personalized guidance.

(3) In curriculum construction: build a hierarchical and systematic AI science and innovation curriculum group, connecting basic subjects with scientific and innovative practice to realize the integrated application of interdisciplinary knowledge.

2. Application Practice Breakthrough Content:

The case has overcome the industry-wide pain points in basic education talent cultivation: "lack of practical scenarios, rough evaluation systems and difficult resource integration". For the first time at the senior high school level, it has realized the full-process empowerment of scientific and innovative talent cultivation by artificial intelligence, forming a complete system covering environment construction, resource development and evaluation system establishment.

This practice provides an operable and replicable implementation path for basic education in Shanghai and even China, helping to improve the overall quality of science and innovation education at the basic education stage nationwide and laying a foundation for cultivating high-quality reserve talents for the country.

3. Intellectual Property Status:

This project focuses on the application of artificial intelligence technology in basic education science and innovation teaching. Relevant technical application solutions and teaching resources are jointly developed by Shanghai Luwan Senior High School and China Unicom Shanghai. The intellectual property rights of digital teaching resources, science and innovation curriculum system and literacy evaluation system belong to Shanghai Luwan Senior High School, while the software copyrights related to the technical support platform belong to the cooperative enterprise. Both parties are co-construction and co-sharing entities of the project, with no intellectual property disputes.

Promotion Value and Risks

1. Application Effect and Prospects

The project has been fully implemented in Shanghai Luwan Senior High School, covering all students. The school has offered more than 100 AI science and innovation courses, and students have won over 20 world-class awards, 3 international awards and 9 national awards in science and innovation competitions, strongly supporting the cultivation of scientific and innovative talents.

The case has been exhibited at the Shanghai Education Fair for three consecutive years and has been promoted to many schools in Huangpu District and Shanghai. Since July 2021, it has received education delegations from Singapore, the Belt and Road countries, the Department of Education of Guangdong Province, Inner Mongolia, Hunan, Anhui, and the education bureaus of Tianjin, Shenzhen and Jinan, making it capable of large-scale promotion in basic education nationwide.

2. Social and Economic Value

Socially, it promotes the digital and intelligent development of science and innovation education in basic education, cultivates students' innovative thinking and practical abilities, and contributes to educational equity and the sharing of high-quality educational resources. Economically, resource integration and sharing reduce repeated investment in science and innovation education and lower teaching costs, while providing a low-cost and high-efficiency implementation plan for regional digital transformation in education.

3. Demonstration and Leading Role

As a National AI Education Base for Primary and Secondary Schools (approved by the Ministry of Education) and a benchmark school for digital transformation of education in Shanghai, Shanghai Luwan Senior High School has set a benchmark for AI-empowered cultivation of scientific and innovative talents in basic education. The case provides practical references for primary and secondary schools across the country and promotes the overall upgrading of science and innovation education.

4. Potential Risks

Technical risks include failures of AI teaching equipment, interrupted data transmission and untimely update of teaching resources. Ethical risks involve possible student privacy leakage in AI data collection, and over-reliance on AI may weaken students' independent thinking and hands-on abilities.

Other Relevant Information

1. Case Award Status:

2021: Third Prize in the Smart Education Track of the MEC Edge Computing Special Competition, 4th "Bloom Cup" 5G Application Collection Contest, awarded by China Unicom 5G Application Innovation Alliance.

2022: Featured Case Award at the 1st Exhibition and Evaluation of Excellent Original Cases of China Basic Education, East China Normal University.

2024: Third Prize for Excellent Cases of Digital Transformation Application, 3rd "Dingxin Cup", awarded by the "Dingxin Cup" Digital Transformation Application Collection Organizing Committee.

2024: Selected as a National AI Education Base for Primary and Secondary Schools by the Ministry of Education.

2025: Third Prize in the Digital Education Special Competition of the 2nd "Golden Spirit Cup" China Internet Innovation Contest, awarded by the Internet Society of China.

2. Third-Party Evaluation:

Mainstream media including CCTV, The Paper, Wen Wei Po, Eastday and Jiefang Daily have repeatedly reported the school's AI-enabled science and innovation teaching practice, praising that it "has built Shanghai's first H·AI high school, realized the deep integration of artificial intelligence and science and innovation education, and provided a Shanghai model for the cultivation of scientific and innovative talents in basic education".

Case 75

Digital Intelligence Empowerment, Scenario SymbiosiHolistic Good Governance: Innovative Practices of AI-Empowered Education Modernization

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Education Bureau of ShangchengDistrict, Hangzhou, Zhejiang,China

Background

Hangzhou Shangcheng District is home to 196 schools, serving over 160,000 students and employing more than 14,000 staff members. It ranks among the nation's first batch of High-Quality Balanced Development Zones for Compulsory Education and has been designated by the Ministry of Education as an experimental zone for "New Teaching and Learning Models Based on Teaching Reform and Integrated Information Technology." Despite its solid foundation and comprehensive framework in digital education, the district faces practical challenges in fully leveraging artificial intelligence to drive high-quality educational development. First, system integration is insufficient: business systems for student evaluation, teacher development, and school management operate in isolation, suffering from inconsistent data standards, incomplete interface interoperability, and significant data silos that hinder collaborative governance efficiency. Second, scenario intelligence lacks depth: the application of AI in core areas such as student health assessment, teacher resource sharing, precision teaching, evaluation reform, and campus management requires greater breadth and depth. Third, the effectiveness of educational services is limited: inadequate data aggregation and imprecise demand analysis have resulted in a need to optimize the supply of inclusive and personalized educational services. To address these challenges, since 2024, Shangcheng District has adopted artificial intelligence as its core driver to comprehensively integrate and upgrade the "Shangcheng Beautiful Education" comprehensive service system. By creating a regional education "Smart Brain," the district is transforming its governance model from experience-driven to data-driven, from fragmented efforts to holistic intelligent governance, and from passive response to proactive empowerment.

Figure 1 Overall Framework of "Shangcheng Quality Education"

Case Implementation Status

Adhering to the principle of "Health First," the district focuses on three dimensions—platform integration, scenario empowerment, and service innovation—to deeply fuse artificial intelligence with education, ensuring technology serves every teacher, every student, every school, and every family.

(1) Supporting System Integration with an Intelligent Foundation.

By aggregating applications such as "Tao Curriculum," "Tao Teacher," and "Tao Activity" under a "1+4+N+X" architecture, the "Shangcheng Beautiful Education" comprehensive service system has been established. The one intelligent foundation connects data hubs across the "National-Provincial-Municipal-District-School" levels, aggregating 4,900 fields and over 20 million data entries regarding students, teachers, and school development. This enables a seamless end-to-end process of "collection-entry-processing-usage-analysis" for the "one file per student, one file per teacher, one file per school" model. The four core domains focus on building scenarios and specialized databases for student growth, teacher development, intelligent school governance, and education services, making education visible and perceptible. The N district-level applications cover key scenarios like intelligent school governance; for instance, by integrating data from 12 specialized libraries including "Qing Shan e-Home" (Smart Cafeteria) and school evaluations, an AI assessment model for school development has been constructed to achieve "one-screen overview" of campus governance. The X campus-specific scenarios empower schools to innovate independently; for example, the "Love Little Dingdang" system non-intrusively collects multi-modal data such as micro-expressions, voice, and behavior to intelligently track student health status,providing robust support for regional education governance.

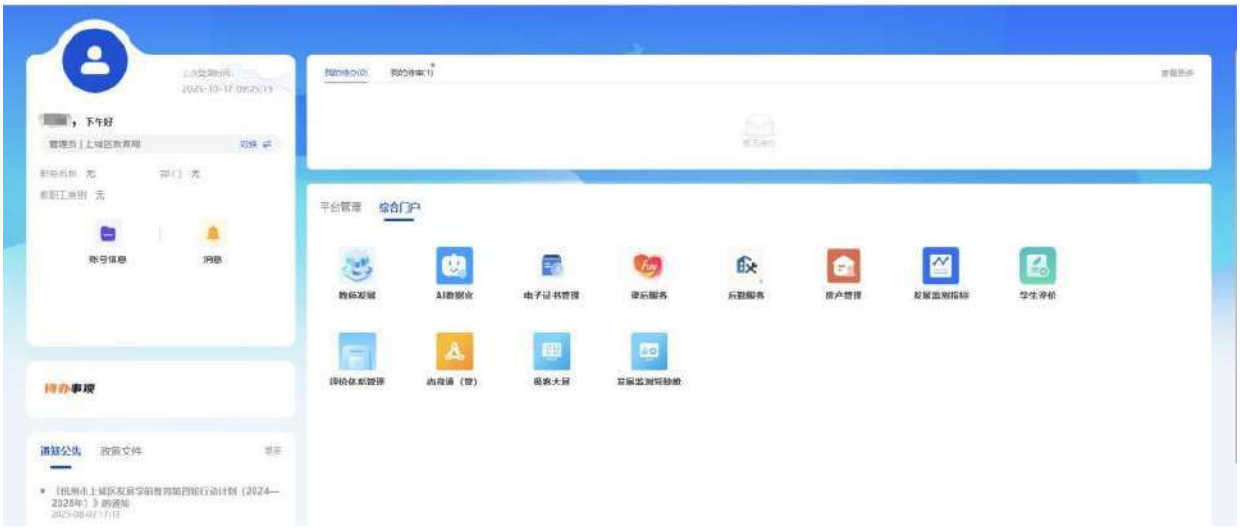

Figure 2 Overview of "Shangcheng Quality Education" Applications

(2) Empowering Teacher and Student Growth with AI+ Scenarios.

Leveraging "AI+" technology to empower core education teaching scenarios makes "Seeing Every Child" a reality. On the "Tao Curriculum" platform, the "Smart Growth" evaluation module has been iterated, and an AI monitoring toolchain established. Aggregating 103 indicators and over 800,000 pieces of multi-modal data on moral literacy and physical/mental health, the system dynamically generates "Student Health Profiles," school big health index chains, and regional health school maps. Additionally, AI+ smart spaces for sports, psychology, and intelligent learning have been created based on needs, delivering "thousand faces for thousand people" personalized growth curriculum support. On the "Tao Teacher" platform, a four-level development monitoring system ("District-Group School-Single School-Teacher") has been built. Focusing on 5 dimensions, 32 key indicators, and 128 observation points, the district developed algorithms for monitoring teacher equity and an "AI Data Officer" intelligent agent. Over three years, this facilitated a two-way precise "selection" process for over 1,600 teachers and schools via the "Tao Teacher" mechanism. Furthermore, 135 AI observation classrooms have been established, non-intrusively collecting and analyzing over 18,000 lesson cases. By developing "Master Teacher Intelligent Agents," the model of "one person refining a lesson, AI conducting intelligent research, accessible to all" has been realized, ensuring every child can access excellent teachers.

Figure 3 AI+ Scenarios for Teacher and Student Development

(3) Enhancing Service Quality with "One-Click Tao".

AI technology empowers off-campus education, deepening collaborative nurturing among schools, families, and society. The "After-School Paradise" platform was launched, where an AI assistant pushes multiple care service proposals based on student interests and club activities, supporting students in autonomously choosing their after-school destinations. The "Tao Activity" platform was integrated, accumulating resources from 430 social venues, listing over 200 types of resources, and launching more than 10,000 activities. The system intelligently recommends study tours and sports events to families, allowing parents and children to "select online with one click and experience offline," enjoying the fun of parent-child holiday activities. The "Star Parent License" platform was iterated to offer over 18,000 "Online University" resources, including parenting courses, psychological counseling, and study tour routes. This delivers high-quality family education resources directly to 340,000 registered parents with one click, enabling on-demand learning and the automatic generation of "Qualified" certificates, effectively consolidating the synergy of nurturing efforts.

Figure 4 AI+ Education Service Scenarios

Case Innovation and Breakthroughs

(1) Upholding the Educational Value of "AI for Good"

We remain steadfast in our original mission of "Education for Every Child," deeply integrating AI technology with the essence of education to highlight humanistic care and warmth.

Our goal is to truly realize "AI for Good" with student development at the core. In student evaluation, we prioritize health, integrate moral, intellectual, physical, aesthetic, and labor education (the "Five Domains"), and emphasize process-oriented assessment. Leveraging digital profiling, we provide adaptive educational support for every student. For instance, Penghui Primary School integrates multi-dimensional data—including physical activity, vision, behavior, and learning experiences—to precisely safeguard students' physical and mental health. In classroom transformation, we adhere to a "Human-Machine Collaboration, Human-Led" principle, innovatively promoting an "AI for Preliminary Diagnosis, Humans for Final Review" model. AI observation classrooms are positioned as teaching assistants rather than evaluative judges, achieving an organic unity of technological rationality and educational warmth. For example, the "Hongxiang Ideological & Political Intelligent Agent" can intelligently analyze the logic and emotional attitudes in student speeches, while value guidance and ideological education remain led by teachers, thereby upholding the original intention and true color of education.

(2) Constructing a "Five-Dimensional Fusion" Governance Mechanism Shangcheng District has established a dedicated "AI + Education" Leadership Group to coordinate and integrate resources from administration, enterprises, universities, research institutions, and social venues.

This creates a "Government-Society-Industry-Academia-Research"five-in-one collaborative governance system, driving AI educational applications to be more inclusive, balanced, and efficient. Education Administration: Responsible for overall planning, standard setting, and path guidance. Social Units (Museums, Science Centers): Provide off-campus practical learning scenarios. Tech Enterprises: Handle R&D and scenario implementation. Universities & Research Institutes: Offer theoretical support and teacher training. Schools: Focus on practical application and personalized innovation. This framework ensures full coverage of AI technology across all scenarios and populations, ensuring technological dividends reach every classroom and benefit every student's personalized growth. For instance, the "Tao Activity" module, coordinated by the education department, leverages AI to precisely match supply and demand for social venue resources, guaranteeing all students fair access to high-quality off-campus educational resources.

(3) Innovating a "District-School Symbiosis" Application Ecosystem

We fully implement the "Three-Teacher Linkage" system comprising School Chief Information Officers (CIOs), Data Specialists, and Subject AI Mentors. This strengthens digital construction and application capabilities at both district and school levels, providing solid organizational and talent guarantees for "District-Wide Unified Construction, School-Based Innovation." District Level: Uniformly provides data standards, computing power, basic applications, and security safeguards to build a robust digital education foundation. School Level: Conducts school-based micro-innovations atop this unified foundation, forming a closed-loop AI+ scenario model of "Usage → Feedback → AI Analysis → Optimization Iteration." This constructs a sustainable, iterable, and growing educational digital intelligence ecosystem evolving from "unified construction" to "district-school symbiosis." For example, Jianlan Middle School developed an "AI Intelligent Learning Companion" based on AI observation classrooms to provide personalized learning support and emotional companionship. Dinglan No. 2 Primary School created a characteristic "AI + Football" scenario via smart sports to stimulate student interest in exercise. In 2026, we will comprehensively advance "AI + Education" scenario construction across the entire district, assisting 33 schools in building featured application scenarios. This fosters a new digital education ecosystem where "everyone can learn,

everywhere can learn, and anytime can learn." Related practices have been featured in special reports by Zhejiang Education News.

Promotion Value and Risks

Shangcheng District, grounded in the principle of "For Every Child," has leveraged AI to empower regional education governance, accumulating rich practical experience.

First, governance effectiveness has continuously improved.

The district has been recognized as a National Demonstration Zone for High-Quality and Balanced Development of Compulsory Education, a National Experimental Zone for Collaborative Education involving Schools, Families, and Society, a Zhejiang Pilot Zone for the National Smart Education Platform for Primary and Secondary Schools, and a participating unit in the National Pilot Program for Education Evaluation Reform (focused on basic education teacher evaluation). It has supported the creation of 56 provincial modernized schools, and in 2025, ranked first statewide in Zhejiang Province's Digital Education Development Index.

Second, the development of teachers and students has consistently enhanced quality.

AI-enabled classroom observation rooms have driven a transformation in teaching research models, with related practices earning 13 national-level and 15 provincial-level awards. The student health and comprehensive quality evaluation system has been continuously refined and selected as a typical case by the Ministry of Education for evaluation reform. Additionally, digital intelligence practices in special education have been recognized as a national model.

Third, practical outcomes have fostered continuous innovation.

Monographs such as Digital Intelligence Cube and Learning Centers have been published. The initiative "Systematically Promoting AI Education in Primary and Secondary Schools to Build a New Intelligent Ecosystem for 'Quality Education'" was selected as a typical case of AI in education by the Ministry of Education. The district's experiences were featured as an outstanding case at the 2025 World Artificial Intelligence Conference and received the Zhejiang Provincial "Data Elements ×" Excellence Award.

Fourth, radiation and promotion have continuously expanded.

The platform "Shangcheng Education Cloud Future" has been launched on the provincial service app "Zheli Ban," allowing teachers, students, and parents across the province to independently select and experience its offerings. The district's experiences have been presented multiple times at the World Artificial Intelligence Conference. Six AI+ scenarios have been included in Zhejiang Province's Key Cultivation Projects for Digital Education, and two institutions have been awarded the title of Zhejiang Provincial Excellent Pilot Schools for AI in Education. Practices such as AI classroom observation rooms have been shared with over 70 regions, and the district has been reported more than ten times by media outlets including the People's Daily, providing a replicable and scalable model for the digital transformation of regional education nationwide.

Other Relevant Information

This case study is designed to address common needs in regional education governance. Featuring a lightweight architecture, practical scenarios, and controllable costs, it possesses high universality and replicability, making it suitable for digital education transformation across all regions of China with a clear and feasible promotion path. The implementation strategy involves first unifying data standards to break down barriers, then prioritizing the deployment of four high-frequency scenarios: student growth, teacher development, public welfare services, and intelligent school governance, while simultaneously establishing district-school collaboration and security operation mechanisms. Different regions can flexibly adapt the model based on their informatization infrastructure and education scale, ensuring compatibility with existing provincial and municipal business systems to achieve low cost. rapid results,

and easy implementation. Recently, our district has hosted delegations from Quanzhou, Nanchang, Zhoushan, Wenzhou, and other cities for study visits and case sharing. These practical achievements have gained widespread recognition, demonstrating significant exemplary effects and promotion value. This model can effectively assist more regions in leveraging artificial intelligence to modernize education governance, facilitating the transition of educational development from "high-quality balance" to "high-level ease."

Case 76

Building an Inclusive Future Education for ALL in the Intelligent Age

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Background

As artificial intelligence reshapes how knowledge is produced, disseminated, and learned, K-12 education worldwide faces a fundamental transition: from knowledge transmission toward fostering innovation capacity in every learner. This shift demands more than curriculum reform at the classroom level; it requires a systemic rethinking of how schools access, share, and sustain the conditions that make innovation education possible.

In practice, three structural barriers persist across educational systems. First, the key ingredients of innovation education — advanced laboratories, research mentors, authentic projects, and frontier technologies — remain concentrated in universities, research institutes, technology firms, and a small number of elite schools. Most schools, despite genuine demand, lack reliable pathways to access these resources. Second, even where a region possesses substantial assets, the absence of coordination mechanisms means that curricula, expertise, equipment, and facilities remain fragmented and underutilized, with significant disparities across schools. Third, innovation opportunities tend to be reserved for a select few students through competition tracks or extracurricular programs, falling far short of the goal of cultivating innovation capacity in every learner.

Addressing these challenges requires repositioning AI not merely as a classroom tool, but as infrastructure for rebuilding the regional education ecosystem itself — connecting schools to external expertise, enabling efficient resource circulation, and ensuring equitable access at scale.

Futian District of Shenzhen, has undertaken this systemic approach. Leveraging its position as a national hub for technology and innovation, Futian has organized its reform around three interlocking dimensions: *flowing in* (channeling innovation assets into schools), *circulating* (building a district-wide shared service system), and *going beyond* (scaling proven models nationally and internationally). Together, these dimensions constitute a coherent ecosystem designed to make innovation education a universal public service rather than a privilege of the few.

Case Implementation Status

Futian's reform is not a sequential, phased roll-out but a simultaneous construction along three ecosystem dimensions — each reinforcing the others to ensure that every school can deliver innovation education, and every student can participate.

Dimension 1: Flowing In — Transforming Schools into Innovation Frontlines

The challenge is not simply importing resources, but embedding the full set of conditions — physical environments, authentic projects, expert mentorship, and institutional support — into schools' everyday educational practice.

Co-building New Productivity Science Labs. Innovation education requires tangible, explorable learning environments, not abstract concepts alone. Futian has partnered with technology companies, universities, and research institutes to establish 88 science labs across all district schools. Each lab translates frontier domains — artificial intelligence, marine science, digital creativity, life sciences — into hands-on scenarios where students can observe, experiment, and create. These are not exhibition halls; they function as instructional spaces integrated into daily curricula, inquiry-based learning, and project work. Cutting-edge science becomes part of students' lived school experience.

Figure 1 The Map of Innovation Education in Futian (with 88 science labs)

Co-developing Cross-Sector Innovation Projects. Access alone is insufficient without pedagogical transformation. Futian collaborates with university labs, industry partners, and government agencies to co-develop innovation projects that convert real-world scientific, technological, and social challenges into age-appropriate learning tasks. These cross-disciplinary, inquiry-driven projects ensure that external expertise does not merely supplement existing curricula but actively reshapes what and how students learn, moving innovation education from superficial activity toward deep, problem-centered learning.

Co-establishing Doctoral Workstations. Sustained mentorship is the missing link in most school-based innovation programs. Futian has established doctoral workstations within school science museums, where university researchers, scientists, and industry engineers serve on a regular, ongoing basis — co-designing curricula, mentoring student projects, and coaching teachers. This transforms external intellectual capital from episodic guest appearances into a permanent support structure, simultaneously elevating student learning and building teachers' capacity for interdisciplinary instruction and project design.

Figure 2 24 Doctoral Workstations across Futian District

Dimension 2: Circulating — Creating a District-Wide Innovation Education Service System

Even when high-quality assets flow into individual schools, systemic impact requires regional coordination. Futian's core insight is that innovation education must shift from school-level self-reliance to district-level public service provision.

The "Central Kitchen" — Kunpeng Youth College. Futian established the Kunpeng Youth College as the district's resource integration and supply hub. The College consolidates curricula, mentors, materials, and project resources scattered across universities, enterprises, research institutions, and schools, then repackages them into a menu-based service system. It has developed innovation programs spanning science, health, humanities, arts, and international exchange, and provides synchronized teacher training and implementation guidance. Through the 88 school-based science labs, these standardized offerings are shared across the entire district — converting fragmented, non-standardized innovation assets into modular, accessible public services.

The "College–College Branches–School" Three-Tier Supply Network. A single hub cannot achieve universal coverage. Futian has therefore extended the system by establishing Kunpeng college branches within each of the district's 11 education groups, with school-level innovation spaces serving as delivery endpoints. This three-tier network ensures that innovation resources circulate efficiently throughout the district: centrally developed programs flow down to schools, while school-level implementation feedback flows back to the hub for iterative improvement. Every student, regardless of which school they attend, gains access to high-caliber mentors and high-quality projects.

The Kunpeng AI Platform. To manage this circulation digitally, Futian developed the "Kunpeng AI" intelligent agent, enabling online scheduling of innovation courses, mentor matching, venue booking, and supply logistics. This extends AI's role beyond supporting individual learning into supporting district-level educational governance — making resource allocation data-driven, transparent, and responsive.

Dimension 3: Going Beyond — From Local Exploration to National Sharing and Global Dialogue

A viable education ecosystem must not only function locally but generate transferable knowledge. "Going beyond" refers not to exporting resources, but to scaling Futian's institutional design, implementation mechanisms, platform tools, and ecosystem-building model so they can be adopted, adapted, and validated elsewhere.

Scaling Nationally. Through the National Alliance for AI Education in Primary and Secondary Schools, Futian disseminates its innovation education pathways, curriculum development experience, AI application frameworks, teacher professional development models, and documented case studies to schools nationwide — with particular emphasis on under-resourced regions in central and western China. Curriculum sharing, platform connectivity, mentor deployment, and public-benefit programs transform Futian's local exploration into replicable reform infrastructure.

Engaging Globally. Futian actively collaborates with partner schools across the Guangdong-Hong Kong-Macao Greater Bay Area and international sister schools, participates in the Asia-Africa Youth AI Education Exchange Alliance, and hosts the Asia-Pacific Learning Sciences Community research base. Cases have been presented at the inaugural International Forum on Global Education Governance and School Leadership, published in the International Handbook of School Effectiveness and Improvement, and accepted for the 2026 International Congress for School Effectiveness and Improvement (ICSEI) — bringing grassroots Chinese education reform into global professional discourse.

Expanding Students' Horizons. Ultimately, "going beyond" serves student development. Through Junior Ambassador showcases, AI education exchanges, and international forum presentations, Futian students gain authentic opportunities for cross-cultural expression and collaborative innovation. Three Futian students presented at UNESCO's AI Day 2026 International Summit on AI and Education, demonstrating that this ecosystem model not only transforms institutional supply but opens real pathways for young learners to engage with the wider world.

Figure 3 Three students from Futian attended UNESCO's AI Day

Case Innovation and Breakthroughs

1. Main Innovation Content

This case advances a distinctive proposition about the nature of innovation education reform: innovation education should not remain a boutique offering of select schools but must become a core component of regional public education services; and AI should not function merely as a pedagogical add-on but as foundational infrastructure for rebuilding the education ecosystem. Three innovations operationalize this proposition:

Innovation in Teaching and Learning Models. By embedding 88 school-based science labs and co-developed cross-sector projects into everyday instruction, Futian has shifted innovation education from competition-oriented, extracurricular programming toward curriculum-integrated, inquiry-driven learning accessible to all students. Innovation is no longer an add-on activity; it is how students learn.

Innovation in Resource Supply Models. The Kunpeng Youth College "central kitchen" and the district–branch–school supply network reconstitute what were previously closed, scattered, and school-siloed assets into a regionally coordinated, dynamically allocated, universally accessible public service system. This represents a structural shift from institutional resource ownership to shared public provision.

Innovation in Open Collaboration Models. Through the National Alliance and international partnerships, Futian has constructed a multi-layered dissemination architecture — local implementation, regional sharing, national scaling, international dialogue — enabling its reform model to be continuously tested, refined, and amplified beyond its point of origin.

2. Technology Breakthroughs

Futian's technological contribution lies not in any single tool but in embedding AI across the full stack of educational infrastructure — platforms, resources, governance, and services — to create a coherent district-level digital ecosystem.

Unified AI Education Portal ("i-Fuwa"). Futian co-developed with leading technology partners an

intelligent education gateway integrating over 100 AI-powered educational agents, each vetted through a standardized evaluation and admission process. This solves a pervasive problem in educational AI adoption: platform fragmentation, inconsistent quality, and lack of governance. By providing a single entry point with unified standards and services, i-Fuwa ensures that AI tools available to every school meet consistent pedagogical and safety benchmarks.

District-Level Computing Resource Center. Futian established a shared computing infrastructure that provides foundational AI processing capacity to all schools, teachers, students, and families. This breakthrough addresses the equity dimension of AI in education — ensuring that access to AI-powered learning is not contingent on individual school budgets or technical capacity, but is universally available as a public utility.

The systemic nature of these breakthroughs — portal, computing infrastructure, and intelligent scheduling operating as an integrated whole — positions Futian's approach at the forefront of regional education digitalization, with clear implications for scalability.

3. Application Practice Breakthroughs

This case demonstrates a viable pathway for AI-supported innovation education that is simultaneously universal, systemic, and internationally connected:

From "a few schools have conditions" to "every school has capacity". Innovation education is no longer dependent on individual school endowments but has become a standard district-wide capability.

From "scattered resource accumulation" to "ecosystem-level operation". The central kitchen, supply network, and digital platform transform fragmented assets into a continuously circulating system.

From "local experimentation" to "model sharing and scaling". Futian's institutional design and implementation mechanisms are being adopted and adapted across regions, converting local practice into transferable reform architecture.

These breakthroughs matter for national basic education development because they demonstrate that equitable, high-quality innovation education does not require extraordinary investment at every school — it requires intelligent system design at the regional level.

4. Intellectual Property Status

All institutional designs, platform architectures, and curriculum resources in this case were developed under the coordination of the Futian District Government. Digital platforms, AI agent admission protocols, curriculum packages, and application standards were co-developed by government agencies, partner schools, technology service providers, and collaborating institutions under contractual agreements. For jointly developed outputs, Futian follows principles of legal compliance, clear rights allocation, authorized use, and open dissemination — balancing intellectual property protection with the public service mission of education.

Promotion Value and Risks

1. Application Prospects and Replicability

The primary scalability of this case lies in its transferable logic rather than its specific investment level. Futian's experience demonstrates that the critical factor in regional innovation education is not the volume of resources injected, but the ecosystem architecture — flowing in, circulating, going beyond — that determines how efficiently resources are configured and how equitably they reach learners.

This architecture is adaptable across contexts. Resource-constrained regions can begin with lightweight

entry points: curriculum sharing through national platforms, rotating mentor programs, and digital platform access. Better-resourced regions can simultaneously develop physical innovation spaces, district-level coordination hubs, and international collaboration networks, progressively building toward a comprehensive ecosystem.

The case is currently being disseminated through the National Alliance for AI Education in Primary and Secondary Schools, with active partnerships supporting schools in central and western China. Internationally, the model has been presented and published across multiple forums and academic venues, generating cross-border dialogue and collaborative adaptation.

2. Social and Economic Value

Social value: The ecosystem significantly expands access to innovation education for ordinary schools and ordinary students, directly advancing educational equity. Teachers' professional capacity for interdisciplinary, project-based instruction is strengthened through sustained collaboration with researchers and engineers.

Economic value: District-level coordination and intelligent scheduling eliminate redundant construction across schools, substantially improving the return on public education investment.

Demonstration and Leading Role: This case offers the field of basic education a complete, operational framework — from school-level scenario construction, through district-level governance restructuring, to open model dissemination — for integrating AI into innovation education. Its demonstration value lies not in any single initiative, but in the coherence of the system and the clarity of the underlying logic, both of which are available for adaptation by other regions.

3. Risk Identification and Mitigation

Technical risks include platform stability and data security challenges inherent in large-scale digital infrastructure. Ethical risks encompass algorithmic bias, over-reliance on AI among young learners, and concerns about data privacy. Equity risks arise from disparities in digital literacy across schools, teachers, and families.

Futian has established a District Expert Committee on AI in Education, issued the Futian District Interim Standards for AI Application in Primary and Secondary Schools, and deployed the district computing resource center to universalize access. These institutional safeguards ensure that AI adoption in education remains safe, regulated, inclusive, and fair.

Other Relevant Information

1. Case Award Status

The practice of the case was awarded the *First Prize of the 2025 Guangdong Province Teaching Achievement Award.*

2. Third-Party Evaluation

Government and industry recognition: Futian's Twenty-Five Measures for Promoting District-Wide AI Application in Education was disseminated nationally by China's Ministry of Education. The district's practices have been featured at the 2025 World Digital Education Conference and the Global Smart Education Summit.

Case 77

Industrial Hub (IT-HUB)

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Higher School of Economics, Russia

Solution Introduction

The Industrial Hub is a collaborative digital ecosystem developed by HSE University's Online Campus. It serves as an educational space where industry experts, researchers, and academics create educational content that bridges the gap between higher education institutions and industry by integrating the knowledge and skills of industry experts into academic formats.

Industrial Hub addresses a growing pain in today's higher education: the disconnect between rapidly changing industry demands and the slower pace of the traditional academic environment. Nowadays, students expect to get beyond theoretical knowledge in universities. They want to develop practical skills based on real-world case studies and formats that will allow them to apply learning in their career. At the same time, universities struggle to attract industry experts as consistent contributors to their programs. The Hub addresses both these needs within a unified framework that serves its core value of creating a space of support, learning, and shared growth where the university and industry develop in synchrony.

Industrial Hub's core functions sustain a full cycle of expert engagement and content development. It creates a structured contribution pathway for experts. They may choose several scenarios that integrate theory, practice, and digital solutions: developing online courses or modules, delivering guest lectures, mentoring students, leading research, or contributing methodological and educational materials.

The solution operates within the platform that provides a digital environment for content delivery, live sessions, case studies, and community work. It focuses on key areas of contemporary education where industry expertise and digital solutions are in demand: digital economy and finance; psychology and coaching; management and communications; and digital technologies (artificial intelligence, data analysis, and digital transformation).

Beyond individual contributions, one of the Hub's main goals is to build a professional and learning community through workshops, joint work, and collaborative research initiatives that may contribute to the broader fields.

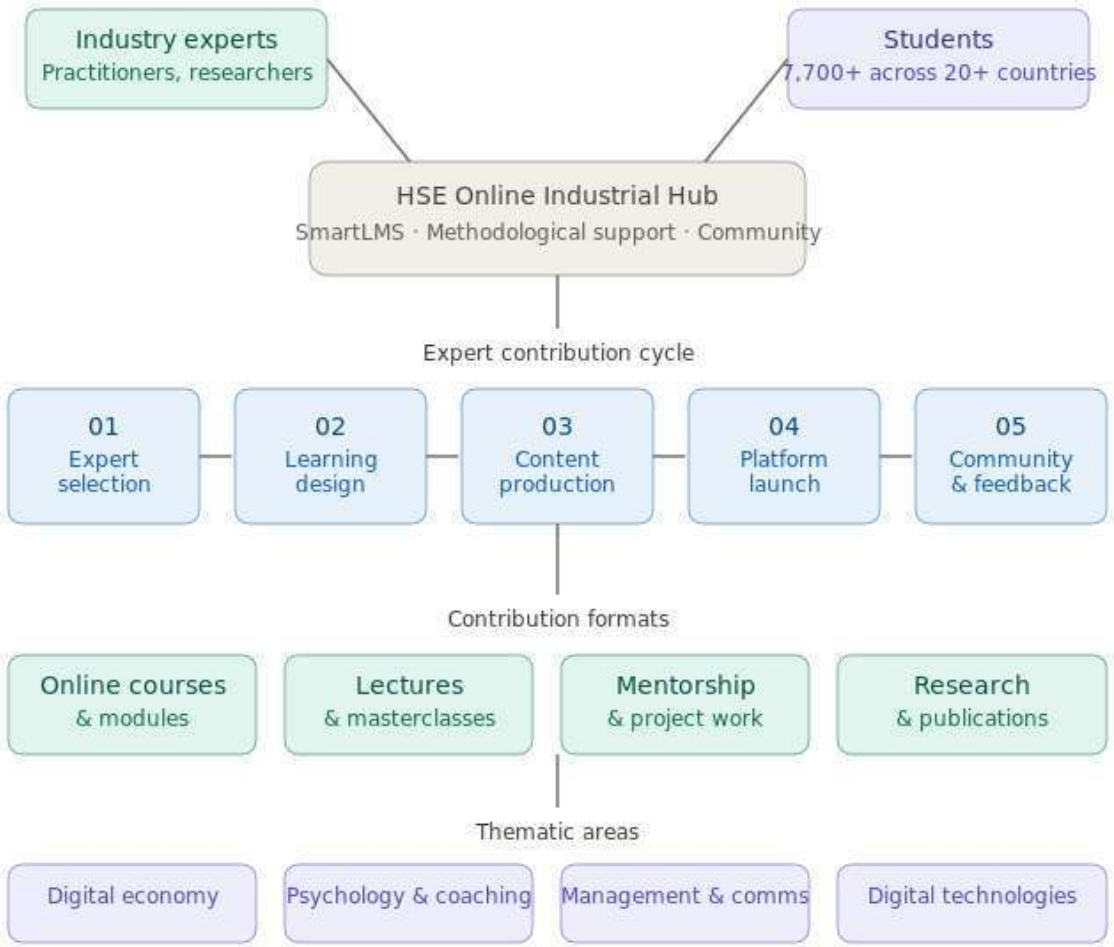

Figure 1 HSE Online Industrial Hub structure

Industrial Hub offers a holistic approach for an industry-academia collaboration and provides comprehensive production, methodological, marketing, administrative, and technological support for both experts and learners. This creates an "industry-to-academia pipeline" where industry professionals step into teaching roles and share their knowledge and experience within the university model without bureaucratic barriers. It also ensures the technological innovation of the initiative. The Hub embeds live industry expertise directly into the university's learning infrastructure. Educational modules and materials from the experts are integrated into the online programmes, illustrating key case studies and scenarios within a theoretical framework. For online programmes, such content operates within the university LMS system. Experts may also take on mentorship roles, supporting students through individual consultations and group project work. To build up an expert community, part of the learning materials is also available on open Hub's platform.

The Hub integrates several interconnected elements that make this solution scalable. At the current stage, The Hub's team is implementing an algorithmic matching approach that helps to align experts with programmes based on their profile, subject area, and level of the student cohort. This ensures that each contribution addresses an actual knowledge gap in the curriculum rather than duplicating what is

already covered academically. The same approach is used for the community analytics. One of the recent goals is to collect information on which topics generate the strongest student response, where expertise is underrepresented across the programme portfolio, and which contributors are most effective, so it could be a base for further learning design enhancement.

The project's roadmap includes a content quality analytics dashboard. This tool will track expert contributions via engagement and completion metrics and will establish an additional quality management layer for the Hub's environment.

The whole cycle operates through the following stages:

I. Expert Selection and Onboarding Process. The stage begins with reviewing the candidate's application based on the stated real-life experience. We suggest providing a short preview lecture: a 15-20 minute session, recorded or live, in which the expert presents a topic of their choosing. The Hub methodist and production teams share feedback on both content and format, after which they decide on a possible format and thematic direction, and resources for further collaboration

II. Learning design. Educational methodologists co-develop content structures, teaching materials, and assessments (if necessary), enabling experts to focus exclusively on knowledge transfer.

III. Content Production. The Hub provides all the necessary infrastructure: professional studios, post-production support, and technical assistance.

IV. Content launch and integration. Final materials are published within the inner or open platform environment, where they become an embedded component of the educational programs, becoming accessible to students as part of their learning pathway.

V. Community work and feedback. Contributing experts and students become part of a professional community where they can exchange experience, collaborate on research, participate in joint events, and develop materials together. Ongoing feedback from students and methodologists supports ongoing improvements and helps experts stay engaged with the Hub over time.

Application Scenarios

The Industrial Hub is designed for online and blended learning environments. It runs on an inner university platform (Moodle-based) and open platforms accessible to everyone.
The initiative provides low entry barriers for experts as they can share their knowledge in any convenient format (text, recorded video, or feedback) that can be adapted easily by any other institution using its own resources. Other additional software is not required.
Live sessions are delivered via video conferencing tools such as Zoom, Telemost, MTS Link, MS Teams, or any other preferred tool. As for pre-recorded lectures, they are recorded in a professional studio or remotely with a basic home setup. Post-production is handled by Hub's production team.
Hardware requirements for contributing experts are minimal: a stable internet connection, a laptop,

and a webcam. HSE Online provides professional studio access for higher-production content at no cost to the expert.

The Hub is created for a wider audience, but the target ones are senior professionals across relevant fields who would like to contribute to the academic experience and students enrolled in HSE Online programs who are looking for education that could contribute to their careers.

The Hub is also open to institutional partners (universities or businesses) and to the broader learning community that forms around the Hub's open content and events. Because the model is fully remote, it works equally well across different regions and international contexts, with no geographic barriers to participation. However, we are developing a series of offline events that could stimulate the expansion of networking activity among students and collaborators. The first one is scheduled on April 21st, 2026.

Scenario 1: Mentor Seminars within educational programs

One of the Hub's recurring formats is the mentor seminar. It is a live online session in which a working professional interacts directly with students on topics relevant to their programme.

The experts are not lecturers in the traditional sense. They bring a professional perspective, analyse and discuss real cases from their own work, and engage with student projects in real time. A session might focus on how to evaluate a business hypothesis, how to approach investor communication, how to build effective cross-functional collaboration, and so on. Such topics are difficult to teach from a textbook but come naturally from someone actively working in the field. Students ask questions, share their own work, and receive feedback grounded in what's going on in the industry at the moment.

This format fits into the online master's programmes where the majority of students are working professionals from all over Russia and other parts of the world, combining full-time employment with their studies. The sessions are conducted fully online, making it easy for experts and students to participate regardless of location.

Before each session, the Hub coordinator and the expert discuss what students have already covered in the programme and what would be useful to address, ensuring the session is relevant within the curriculum.

Scenario 2. Practice-Oriented Online Courses

The Hub produces standalone online courses developed by practitioners from technology companies, creative industries, and the digital economy. The courses are built around real-world application: their pathway and assignments are designed so that students complete the course with applicable outcomes they can add to their portfolio.

Among the contributors are product managers, AI specialists, marketing strategists, program directors, and many other experienced practitioners. Each course is developed in collaboration with the Hub's methodological team using instructional design principles and existing EdTech tools. This ensures that the practical knowledge is well-structured and useful in practice.

The courses run on both open and inner platforms and are open to students enrolled from across Russia and internationally, with course materials accessible from anywhere making participation independent of time zone or location.

Impact and Case Evidence

Since HSE Online was established as a digital campus, we observe a growing demand for how the classic academic content could be designed so it could correspond to the real-life demands in professions. 1 in 5 students at HSE University study fully online, so the Industry Hub provides up-to-date knowledge and skills.

HSE Online has over 7500 students and hosts 46 degree programmes across bachelor's and master's levels, with 96% of graduates finding employment in their field during or immediately after completing their studies (https://online.hse.ru/en#about) .

More than 50 industry experts actively contribute across the Hub's thematic directions, integrated into more than 20 programs. Since its launch in early 2026, the Hub has accumulated over 250 applications, showing the strong interest in building a widespread professional-academic community. Each applicant underwent an interview, and some were given test assignments, making sure their contribution would be relevant and useful within chosen programs.

Currently, HSE Online holds Gold Status in the Times Higher Education Online Learning Rankings 2024, placing it in the global top 10. HSE University ranks first among Russian universities in the HeadHunter employer ranking and is recognised by Forbes Education as having the best graduate reputation among employers. It confirms that industry-integrated models, such as IT-Hub, produce effective outcomes (https://www.hse.ru/en/news/edu/1142200069.html).

Replicability, Sustainability and Promotion Potential:

The Hub's model could be easily adopted by any other institution. Moreover, one of the core values of the initiative is to build a diverse professional community, and HSE Online's hub is open to any interested regional or international expert. Its architecture does not depend on physical infrastructure or location.

Any university or educational organisation with basic online infrastructure and a methodological team can adopt a similar "Industry Hub" approach.

Sustainability is ensured through a mixed funding model (paid programmes and corporate partnerships) and the self-reinforcing community that continuously generates new content. Promotion potential is strong via university networks and partners, marketing or professional channels.

A Typical Case:

Implementation Case 1. Mentor's Seminar "How to Choose a Strong Business Hypothesis and Package a Project for Growth and Investment"

In March 2026, within the framework of the Industrial Hub's "Mentor's Seminar" series, industry expert Zhembe Mikhailov (graduate of HSE University's "Digital Product Management" programme and practising entrepreneur) delivered an online session for students of HSE Online programmes.

Format and scale: The seminar was conducted online via Zoom and lasted 2 hours. It attracted more than 80 participants, primarily bachelor's and master's students from business, management, and digital programmes. The session combined a structured lecture with interactive case analysis and a live Q&A.

Content and activities:

- How to select a strong business hypothesis and assess its growth potential
- Why most startups fail, and common mistakes teams make at the early stage
- Quick and effective ways to test a hypothesis
- What investors actually look for when evaluating early-stage projects
- Key pitfalls in investor search and communication

The most valuable part of the seminar was the live dissection of a real student project, **AI Soulmate**, an AI companion bot designed to help young women discuss their anxieties and emotional challenges 24/7 when they do not want to burden friends or family. Zhembe Mikhailov analysed the project together with the author, helped refine the core hypothesis, suggested improvements to the business model, and outlined practical next steps for development and monetisation.

Students asked questions about finding investors, building long-term communication with them, and avoiding typical mistakes during the fundraising process. The expert shared real-life examples from his own experience.

Key outcomes:

High student engagement: the session received very positive feedback, with many participants noting that the practical analysis of a live project was particularly useful.

High value for students: one participant received direct recommendations on how to restructure her project hypothesis and business model.

Strengthened the connection between academic learning and real business practice.

The recording of the seminar was later uploaded to the Hub's platform and made available to all HSE Online students.

This case demonstrates how the Industrial Hub brings current industry expertise directly into the educational process through live, interactive formats.

Exhibition Materials (if available)

If the solution is suitable for exhibition, applicants may provide conceptual renderings or design visuals for the exhibition display, along with details on hardware and software configuration, exhibition environment requirements, and spatial layout.

The exhibition materials should authentically demonstrate how the solution is implemented in real educational settings, highlighting its technological advancement, practical effectiveness, and demonstrative value.

1. One example of the Hub's content is the "After the Prompt" documentary film produced by HSE Online in collaboration with industry practitioners and researchers, exploring how artificial intelligence is reshaping professional work and career development: https://youtu.be/KJMDyut1Co8

2. +/- 10 minutes is a video format adapted by the Hub's experts. They offer practice-oriented insights on specific professional challenges. Each video addresses a single concrete question or scenario. The videos form part of a broader content contribution by industry experts within the framework of HSE Online's degree programmes.

a. +/- 10 minutes. How to communicate with manipulators:
https://vkvideo.ru/video-160066144_456240295
https://www.youtube.com/watch?v=G9MiZAkEVU8
b. +/- 10 minutes / IT & AI / How Deepseek works:
https://vk.com/video-160066144_456240073
https://www.youtube.com/watch?v=gm-kh58Has0
c. +/-10 minutes / How to create a marketing strategy that works:
https://vkvideo.ru/video-160066144_456240648
https://www.youtube.com/watch?v=J-JR8VHoSUs
3. Articles and analytical materials from contributing experts
a. How to learn to make choices without the struggle
https://vc.ru/life/2250627-kak-nauchitsya-delat-vybor-bez-boli-i-straha
b. What IT professionals are most in demand right now
https://iz.ru/1832580/2025-02-09/ekspert-rasskazal-o-vostrebovannyh-specialistah-v-it
c. How to protect your digital data
https://russian.rt.com/russia/news/1516046-golosovaya-zapis-riski

Basic Information of the Institution

HSE University (National Research University Higher School of Economics) was established in 1992 in Moscow, the Russian Federation. It is one of Russia's leading and most internationally recognised research universities. The university operates five campuses in Moscow, Saint Petersburg, Nizhny Novgorod, Perm, and the online campus serving over 60,000 students. Its faculty, researchers, and students represent more than 100 countries (https://www.hse.ru/en/info/) .

The university consistently ranks among the top institutions in Russia, Eastern Europe, and Eurasia. It holds the highest rating for AI education quality in Russia, ranks first among Russian universities in the Forbes Employer Reputation ranking, and leads national standings in economics and econometrics, psychology, business and management, and political sciences across both QS World University Rankings by Subject and the Shanghai Global Ranking of Academic Subjects. Globally, HSE is ranked among the top 100 institutions worldwide in economics, linguistics, mathematics, psychology, and the humanities. According to the latest Forbes Russia ranking, HSE University ranked as the №1 university among Russian higher education institutions, further confirming its leading position and high employer reputation (https://tass.ru/obschestvo/26933951).

HSE maintains active partnerships with over 400 universities worldwide through bilateral agreements and multilateral projects.

Experience or Qualifications in the Field of Digital Education: Please describe the institution's professional experience in digital education, core strengths, relevant qualifications, and past successful projects.

HSE Online is the first fully digital campus in Russia. Its mission is to make a world-class Russian education accessible globally, anytime and anywhere. It has quickly gained recognition, earning Gold

status in the Times Higher Education (THE) Online Learning Rankings in 2024. It has also received the Online University of the Year award and leads national rankings for the quality of AI specialist training.

HSE Online offers a comprehensive digital learning ecosystem. This includes 46 state-accredited online bachelor's and master's programs (5 of which are in English) in such fields as AI, data science, and business. Today, 1 in 5 HSE students study online, and we partner with more than 40 universities worldwide through the course exchange network.

Beyond full degrees, we provide over 470 Massive Open Online Courses (MOOCs), including over 10 courses on the XuetangX platform, 12 Specializations, lectures, and educational materials from top academic and industry contributors.

Case 78

The Climate Alliance: Leveraging Generative AI for Cross-Continental Environmental Advocacy

Claudia MUELLAUER [1], Thi Diem Hang NGO [2], Sea Fong LIANG [3]

[1] International High School Herzogberg, Austria / Central European University

[2] Mount Carmel College, Australia

[3] Thang Long University, Vietnam / St Andrew's Secondary School, Singapore

Case Background

The Pedagogical Disconnect

Traditional climate education often suffers from a "psychological distance" where students perceive environmental crises as geographically or temporally remote. In the regions of Austria, Singapore, and Australia, educators observed that while teenagers demonstrate high digital adaptability, they often experience "eco-anxiety" coupled with a sense of helplessness.

The Necessity of AI Integration

The Climate Alliance was established to bridge this gap by transforming abstract global data into localized, actionable narratives. AI technology is not merely a supplementary tool in this case but a functional necessity to:

- **Synthesize Complex Data:** Translate regional climate impacts (e.g., Alpine flooding vs. Outback air quality) into creative media.
- **Facilitate "Agile Advocacy":** Enable students to pivot their communication strategies in real-time based on cross-continental peer feedback.
- **Foster Critical AI Literacy:** Move beyond functional use to address the "Environmental Paradox"—evaluating the carbon footprint of AI models against their advocacy utility.

Implementation Process

The project was executed over a four-week intensive curriculum involving 53 students across three continents.

Table1 Technical Architecture and Timeline

Phase	Focus	AI Tools & Technical Application
Week 1: Ethical Foundations	Literacy & Ethics	Baseline assessment of AI familiarity; introduction to **LLM mechanics** and the context of "hallucinations".
Week 2: Creative Prototyping	Local Research	Utilization of **ChatGPT, DALL·E, and Canva Magic Write** to transform raw environmental data into poetry, songs, and digital art.
Week 3: Virtual Exchange	Collaboration	Synchronous (Zoom) and asynchronous (Padlet) sessions where students engaged in "Agile Advocacy," adjusting content based on global perspectives.
Week 4: The 3A Framework	Reflection	Evaluation of outcomes via the **3A Framework**: Advocacy, Agency, and Activism.

Operational Constraints

Coordinating across disparate time zones and navigating varied data privacy legislation—particularly the stringent requirements of Australia—required a "tailored compliance strategy" and flexible digital scheduling.

Innovation Highlights

The Climate Alliance distinguishes itself from standard digital literacy programs through three core innovations:

1.Pedagogical Pivot via Real-Time AI: Traditional projects follow a linear path; this case uses AI to allow "Real-Time Pivoting". Students can regenerate advocacy materials instantly to better resonate with an international audience.
2.Narrative as Data: By converting firsthand accounts of climate events—such as Sumatran squalls in Singapore or Alpine snow melt—into creative artifacts, the project humanizes climate science.
3.Critical Ethical Reasoning: The curriculum explicitly tackles the Environmental Paradox, forcing students to weigh the energy costs of generative AI against the social value of the climate awareness they produce.

Effectiveness Proof

The project's success is validated by high-level institutional recognition and measurable student output:

- **Gold Award Recognition:** The initiative received the Gold Award at the ASEF ClassNet Conference 2024, signaling excellence in international digital cooperation.
- **Student Agency:** 100% of participants transitioned from passive observers to "active digital advocates," producing community-facing awareness campaigns.
- **Professional Scalability:** The project has already influenced 4 EmpowerED teachers from Croatia, Bangladesh, Malaysia, Mongolia, and was therefore multiplied in these respective countries.
- **Published Content:** A live repository of student-led advocacy is maintained on the project's shared digital workspace, serving as a permanent record of achievement.

Promotion Plan

To ensure the global sustainability of the Climate Alliance, the following promotion architecture has been implemented:

Promotion Paths and Feasibility

- **Open Educational Resources (OER):** The entire curriculum—including AI guides and assessment rubrics—is hosted on the Open Education for a Better World (OE4BW) platform for worldwide adaptation.
- **Low-Bandwidth Adaptation:** Recognizing the digital divide, all OER materials are provided in downloadable, low-data formats, ensuring that schools in developing regions can implement the 3A framework.
- **Expected Impact:** By leveraging the ASEF ClassNet and EmpowerED networks, the project aims to reach 100+ educators by the end of 2026, establishing a standardized "Climate Alliance" model for AI-enhanced global citizenship.

References

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Muellauer, C., Ngo, T. D. H., & Liang, S. F. (2024). The Climate Alliance: From Alps to Singapore to Outback. Case study presented for the EmpowerED initiative.

Open Education for a Better World (OE4BW). (2025). OER Repository: Climate Alliance 3A Framework for AI and advocacy.

UNESCO. (2023). Guidance for generative AI in education and research. (Used here to contextualize the SAMR model and ethical frameworks applied in the case).

Case 79

"Minzhi Xinyu" AI-Powered Mental Health Support System: A Scenario-Driven Approach to Adolescent Psychological Well-being

Minhang District Institute of Education, Shanghai, China

Background

Adolescent mental health has emerged as a critical global concern. In China, the detection rate of depression among teenagers reaches 14.8%, with overall psychological issue prevalence at 17.3%. Minhang District, serving approximately 208,000 K-12 students across 147 schools, faces a significant resource gap: only 213 full-time and 806 part-time mental health teachers, with nearly half dedicating less than 50% of their work time to psychological services. Traditional counseling models struggle with limited coverage, slow response times, and insufficient professional depth. Students often hesitate to seek help due to stigma, privacy concerns, or lack of accessible channels, while teachers face challenges in early identification and timely intervention.

The "Minzhi Xinyu" initiative was launched to address these pain points through digital transformation. Implementation objectives include:

(1) expanding accessible, low-threshold psychological support to break help-seeking barriers;
(2) enhancing screening accuracy and early warning capabilities through data-driven approaches;
(3) empowering teachers with intelligent tools to improve intervention efficiency;
(4) fostering a collaborative ecosystem involving schools, families, and medical institutions. By integrating AI large model technology with professional psychological expertise, the project aims to shift from reactive crisis management to proactive, development-oriented mental health promotion, ensuring every student receives timely, personalized support.

Case Implementation Status

1. Demand Analysis and Co-Design

In 2025, Minhang District conducted a comprehensive survey among 122 full-time mental health teachers to inform system design. Key findings revealed three priority needs: (1) 92.62% of teachers requested intelligent assessment support to integrate multimodal behavioral data for dynamic psychological profiling; (2) 79.51% emphasized the need for machine learning-based crisis recognition models with tiered early warning mechanisms; (3) 77.87% advocated for AI psychological assistants with natural language interaction capabilities to provide 24/7 emotional support while respecting student privacy. These insights directly shaped the functional architecture of "Minzhi Xinyu".

2. Technology Development and Personalized Customization

Collaborating with iFLYTEK and East China Normal University (ECNU), the project developed three core technological components:

• Adolescent Mental Health Vertical Large Model: Built upon the Spark Large Model, fine-tuned with 1B+ professional psychological data, including 400K+ journal articles, 1,500+ specialized books, and 1M+ anonymized counseling dialogues. The model can identify over 100 typical adolescent psychological issues (e.g., depression, academic anxiety, social anxiety) and provide evidence-based intervention strategies.

• AI Multimodal Screening Digital Avatar: Co-developed with depression experts from Beijing Anding Hospital, this tool integrates 18 data modalities (speech, language, facial expressions, heart rate) to conduct interactive psychological assessments. Validation studies showed 95.5% consistency with specialist diagnoses in clinical settings and 89.4% accuracy in school-based screening, outperforming traditional scales by 25.6%.

• "AI Psychological Partner" Chatbot: Designed with input from ECNU's psychology faculty, this 24/7 accessible virtual companion supports students through voice, text, and video interactions, offering empathetic listening, cognitive reframing, and stress management techniques.

3. Application Optimization and Pilot Implementation

The system was first piloted in 40+ schools, with iterative optimization based on user feedback:

• Screening Workflow: 21 schools conducted 34,017 student screenings, with 791 flagged for follow-up. AI-generated preliminary reports reduced manual analysis time, enabling teachers to focus on high-risk cases. Schools like Qibao Xindu established a three-tier assessment mechanism: universal screening, individual assessment, and developmental evaluation.

• Counseling Integration: The "AI Psychological Partner" was introduced as a supplementary channel alongside traditional counseling. In pilot schools, weekly counseling sessions increased from 3-5 to 9-15 per school, with coverage expanding from <10% to 30%. The system's "online appointment + offline follow-up" model reduced help-seeking barriers.

• Multi-Endpoint Accessibility: Students access self-help resources via web, tablet, mini-program, and physical "psychological corners", completing 6,440 self-assessments, 4,996 stress-relief exercises, and 3,365 course modules independently.

• Early Warning System: A multi-source integration framework combines scale results, teacher/parent reports, AI monitoring, and hotline data to trigger automated risk alerts and intervention workflows, improving closed-loop intervention rates.

校名称	覆盖学生数	学生使用次数（通数）	与小星对话（问答）次数	用户会话总时长（分）
上海市闵行区田园外国语中学	553	554	2549	755
华东理工大学附属科技高中	131	555	2244	856
上海市七宝中学附属鑫都实验中学	2732	255	1082	280
上海市闵行区七宝文来学校	1230	83	339	91
上海市闵行区马桥复旦万科实验中学	1300	42	249	215
华东师范大学第二附属中学紫竹校区	1391	39	133	26
上海市七宝中学附属闵行金都实验中学	942	18	130	48
上海市闵行区七宝第三中学	1672	12	129	141
闵行中学附属实验中学	1	34	125	27
华东师范大学第二附属中学附属初级中学	1605	17	101	28
七宝中学	2542	7	51	19
上海市罗阳中学	1021	19	40	5
上海市闵行区君莲学校	20	8	39	34
上海市闵行区教育学院	20	6	22	4
上海市航华中学	1190	6	22	5
华东师范大学附属闵行永德学校	1027	4	16	5
上海中医药大学附属闵行晶城中学	1336	3	5	0
上海市闵行区浦江第一中学	302	2	4	0

Figure 1 Pilot schools

4. Teacher Capacity Building

Recognizing that technology alone cannot replace human expertise, the project implemented a tiered training program: specialized workshops on AI tools and crisis intervention for mental health teachers; general literacy training for homeroom and subject teachers; and regular case-sharing sessions to promote best practices. By 2026, the plan includes launching an "AI Psychological Consultant" module to further support all teaching staff.

Figure 2 "AI Psychological Consultant" module

Case Innovation and Breakthroughs

1. Main Innovation Content

- Paradigm Shift in Service Delivery: Transitioning from passive problem identification to proactive developmental guidance, from experience-based judgment to data-driven decision-making, and from school psychologist-centric to whole-school mental health promotion.
- Scenario-Based AI Integration: Rather than deploying generic chatbots, the system embeds AI into specific educational scenarios (e.g., post-screening follow-up, break-time counseling, exam stress management), ensuring contextual relevance and pedagogical alignment.
- Human-AI Collaborative Workflow: Establishing clear role boundaries where AI handles initial engagement, routine support, and data aggregation, while human psychology teachers focus on complex cases, ethical oversight, and relationship-building.

2. Technology Breakthrough Content

- Multimodal Emotion Recognition: Students using self-reported scales may have a sense of avoidance, with an average accuracy rate of only 63.8%. And AI multimodal screening, through real-time face-to-face interaction between digital humans and students, comprehensively evaluates and analyzes 18 types of information generated, including text, speech, and facial expressions. The accuracy of AI enabled psychological screening has increased by 25.6% compared to traditional scales.
- Domain-Specific Large Model Fine-Tuning: Personalized psychological companionship is achieved through fine-tuning and engineering iteration training of multi personality MBTI virtual characters. The coverage rate of personalized psychological counseling for students has increased from 10% to over 70%.
- AI Psychological Crisis Warning and Intervention: The "Minzhi Xinyu" system integrates a dynamic early warning algorithm capable of real-time detection of psychological crisis signals in students. It enables proactive prevention and continuous risk monitoring, significantly reducing the likelihood of psychological crises. The system automatically triggers alerts and intervention workflows, promptly notifying school psychological counselors to provide timely emotional support and psychological intervention.

These technological innovations contribute to educational digital transformation by demonstrating how AI can augment—not replace—professional judgment, while providing scalable solutions to resource-constrained environments.

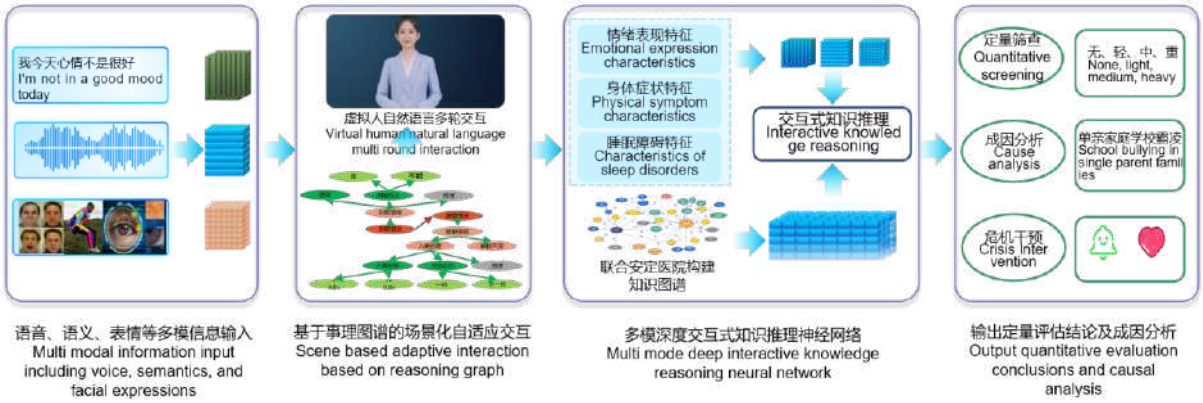

Figure 3 Technology Roadmap of "Minzhi Xinyu" system

3. Application Practice Breakthrough Content

- Breaking Help-Seeking Barriers: By offering non-judgmental AI interactions with imperceptible student assessments, the system addresses adolescents' reluctance to disclose struggles to adults, particularly for stigma-sensitive issues.
- Data-Informed Resource Allocation: Aggregated, anonymized usage data helps administrators identify school-level trends (e.g., exam-period anxiety spikes) and allocate counseling resources proactively.

Figure 4 Psychological Resource Recommendation

- Family-School-Medical Collaboration: The platform's shared data framework (with appropriate privacy safeguards) enables coordinated care, reducing fragmentation in student support services.

These practices offer valuable insights for basic education development in China and beyond, particularly in scaling personalized support within large, diverse school systems.

4. Intellectual Property Status

The "Minzhi Xinyu" system is developed through a public-private partnership between Minhang District Education Commission and iFLYTEK Co., Ltd. Core intellectual property rights are distributed as follows:

(1) The underlying Spark Large Model and related AI technologies are owned by iFLYTEK;

(2) The adolescent mental health vertical model and application-specific adaptations are jointly developed, with usage rights granted to Minhang District for educational purposes;

(3) All student data collected through the system remains under the governance of Minhang District Education Commission, in compliance with China's Personal Information Protection Law and educational data security regulations. No third-party intellectual property is used without proper licensing.

Promotion Value and Risks

1. Application Prospects and Achievements

As of October 2025, "Minzhi Xinyu" has been deployed in 21 pilot schools, serving 19,000 students. The operational model features: (1) District-level coordination for standardization and quality control; (2) School-level flexibility for contextual adaptation; (3) Iterative improvement cycles based on usage analytics and teacher feedback. The 2026 expansion plan aims to cover 100+ schools in Minhang District, with potential for replication in other regions through the "Minhang Model" framework.

2. Social and Economic Value

Socially, the project enhances adolescent mental well-being, a foundational element for academic success and lifelong development. By enabling earlier intervention, it may reduce long-term healthcare

costs associated with untreated psychological conditions. Economically, the AI-augmented approach improves counselor productivity (30% efficiency gain reported), allowing limited human resources to focus on high-need cases. The initiative also contributes to China's strategic goals in educational digitalization and AI innovation. From an equity perspective, the project demonstrates how technology can help bridge the mental health service gap between schools with varying resource levels, advancing the goal of "high-quality balanced development" in Shanghai's basic education system.

3. Demonstration and Leading Role

The project offers a replicable blueprint for scenario-driven AI integration in basic education, emphasizing: (1) Needs-based co-design with end-users; (2) Ethical-by-design principles; (3) Balanced human-AI collaboration. Its presentation at the 2025 Global Smart Education Conference has sparked international interest in China's approach to "AI for social good" in education. Domestically, the "Minhang Model" serves as a reference case for Shanghai's 16 districts exploring AI-enabled mental health services. The modular architecture, standardized protocols, and capacity-building framework developed in Minhang provide actionable pathways for other regions to adapt and scale similar initiatives, accelerating city-wide adoption of evidence-based, technology-enhanced mental health support.

4. Potential Risks and Mitigation Strategies

- Technical Risks: Model bias or inaccurate assessments could lead to false positives/negatives. Mitigation: Regular model auditing, human-in-the-loop validation, and transparent uncertainty reporting.
- Ethical Risks: Privacy concerns, over-reliance on AI, or reduced human connection. Mitigation: Strict data encryption, clear disclosure of AI's auxiliary role, and mandatory training on ethical AI use.
- Implementation Risks: Uneven adoption or misuse across schools. Mitigation: Standardized protocols, ongoing technical support, and performance monitoring.

Other Relevant Information

1. Case Award Status

- October 2024: "Top 10 Projects Award" at the 10th China (Shanghai) International Technology Import and Export Fair for the "AI Psychological Partner" product.
- August 2025: Featured as a best practice case at the 2025 Global Smart Education Conference, organized by Beijing Normal University and UNESCO IITE (United Nations Educational, Scientific and Cultural Organization Institute for Information Technologies in Education).

2. Third-Party Evaluation

- User Feedback: In a pilot school survey, 67.0% of students reported reduced feelings of loneliness, 36.5% noted decreased anxiety, and 55.3% expressed increased willingness to seek help after using the AI Psychological Partner.
- Expert Review: The system's multimodal screening approach was validated in collaboration with Beijing Anding Hospital, showing 95.5% consistency with specialist diagnoses.
- Public Recognition: The initiative has been covered by authoritative media including Xinhua News Agency and the CCTV Focus Interview, highlighting its innovative approach to educational equity.

3. Case-related Materials

央视《焦点访谈》：闵行AI赋能心理健康教育着力"四个突破"

12月16日，中央电视台《焦点访谈》节目报道了闵行区人工智能赋能心理健康教育的创新实践。闵行区积极构建智慧心育新范式，以"闵智心语"大模型为核心引擎，着力实现"四个突破"：一是目标升级，从提升效率转向优化品质，借助AI全面提升育人质量与服务内涵。二是区校协同，从个体探索转向区域统筹，将各校实践经验整合，转化为区域层面有序、可持续的协同行动体系。三是场景突破，从有限服务转向全面覆盖，通过AI心理伙伴、多模态筛查等，拓展服务边界，惠及更多学生。四是理念引领，从技术驱动转向人本融合，始终坚持技术应用与人文关怀深度融合，让AI成为教师的得力助手而非替代。

星海

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6 57 2 写留言

Figure 5 Press release

Figure 6 Public Recognition of the initiative

Case 80

Bridging the Intelligence Divide: AI-Driven Networked Innovation for Inclusive and Equitable Basic Education in a Populous Province

Sichuan Provincial Education Informatization and Big Data Center, Sichuan, China

Beijing Normal University, Beijing, China

Background

Global education is transitioning from content digitalization to AI-driven transformation. Smart education should not only expand access to resources, but also promote equity, inclusiveness, and high-quality learning, while strengthening teachers' technological empowerment and ensuring that AI enhances educational transformation without undermining human agency.

In China, Sichuan Province covers approximately 486,000 square kilometers, with jurisdiction over 21 prefecture-level cities and 183 counties/districts, and a resident population of 83.18 million by the end of 2025. As a large province with significant regional disparities, notable gaps remain between underdeveloped counties and developed urban areas in terms of educational environment, resource allocation, and application capabilities. These disparities continue to challenge the equitable distribution of high-quality education across the province.

In addition, digital education development faces a persistent issue: increased resource supply does not automatically lead to meaningful teaching transformation. Earlier initiatives such as "Sichuan Cloud Education" have enabled cross-regional sharing of high-quality resources. However, the mere availability of static resources has not been sufficient to drive classroom improvement. There remains a lack of effective environmental support, interaction mechanisms, and implementation pathways to bridge the gap between resource connectivity and deep pedagogical application. With the emergence of generative AI and related technologies, educational disparities are evolving from a "digital divide" into an "intelligence divide". Differences across regions in AI tool usage, data-driven feedback, and teacher digital literacy may further widen regional, urban-rural, and inter-school gaps.

In response, this case builds upon the existing foundation of large-scale remote sharing of high-quality educational resources in Sichuan. Centered on the **"Network-Linked Sharing Initiative"**. It integrates smart learning environments, scenario-based interactive pedagogy, data-driven precision evaluation,

and collective teacher development mechanisms. The initiative aims to upgrade basic education from resource sharing to intelligent empowerment, forming a sustainable pathway for high-quality development that balances equity, quality, and long-term impact.

Case Implementation Status

Building on the foundation of "Sichuan Cloud Education", Sichuan Province has advanced the **"Network-Linked Sharing Initiative"**, shifting high-quality resource sharing from isolated distribution to networked collaboration, and from simple remote transmission to intelligent support. This has led to a systematic implementation pathway supported by smart learning environments, centered on scenario-based interactive teaching, connected through data-driven evaluation, and sustained by collaborative teacher development. Rather than relying on isolated technological tools, the initiative integrates resource sharing, classroom teaching, pedagogical research, and provincial-level governance into a unified system that promotes high-quality and balanced development of basic education across the province.

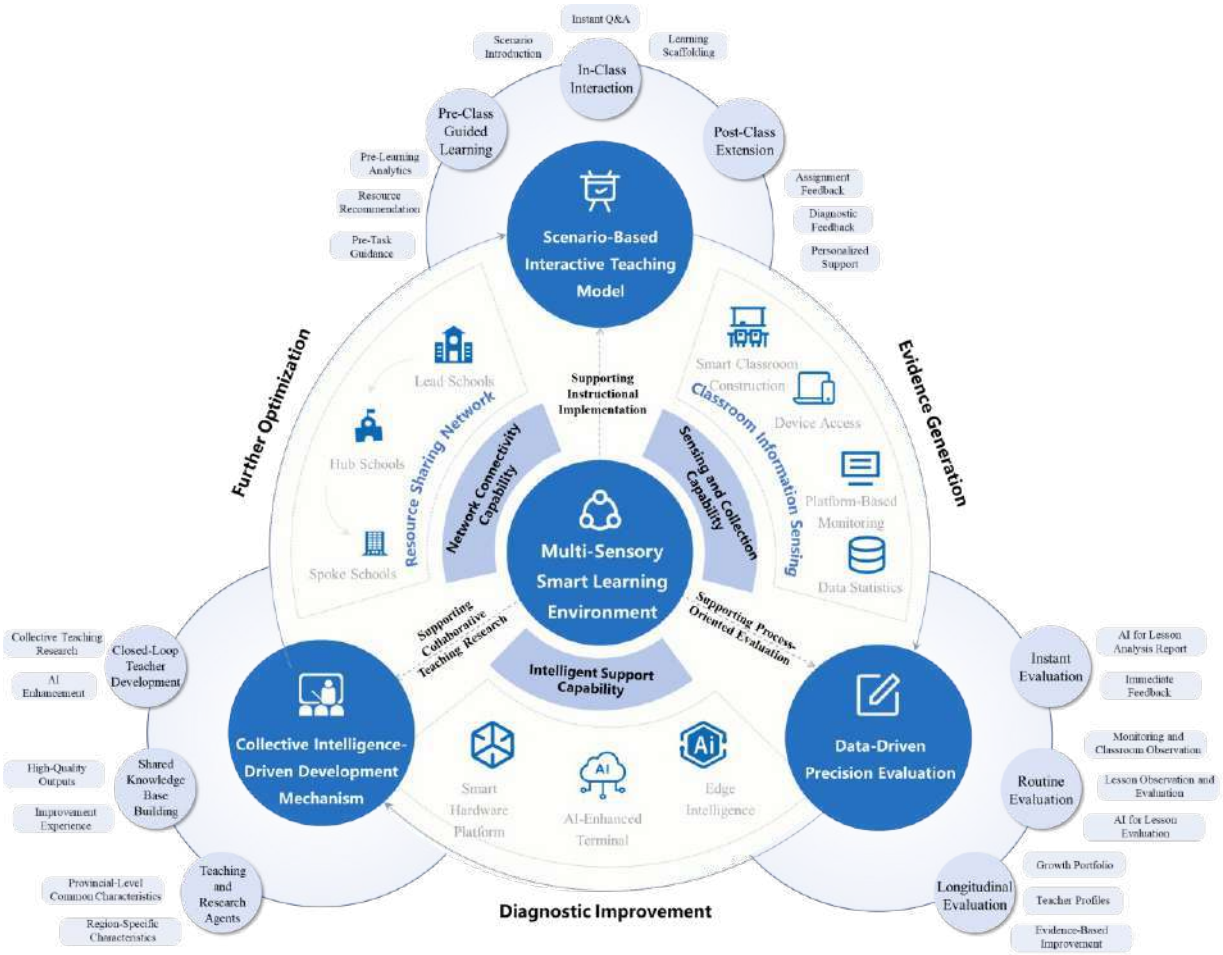

Figure 1 Unified System of High-quality and Balanced Development of basic education across the province

1. Developing a Multi-Sensory Smart Learning Environment

To address the practical needs of large-scale remote sharing of high-quality educational resources, Sichuan has continuously strengthened the construction of intelligent learning environments under the Network-Linked Sharing Initiative, forming a province-wide foundational infrastructure covering primary and secondary schools. This development progresses along two dimensions: resource-sharing network construction and classroom information sensing.

At the network level, following the principle of "improving quality while expanding coverage", 35 teaching alliances have been established to connect Lead Schools, Bridge Schools, Hub Schools, and Spoke Schools into a networked system. This structure enables the regularized distribution of high-quality educational resources across all primary and secondary schools in the province. Supporting facilities, including direct broadcast classrooms, local channels, interactive classrooms, and resource platforms, enable the production and sharing of integrated resource packages such as high-quality lessons, teaching plans, courseware, exercises, thematic activities, and micro-lecture videos. This forms a dynamic resource supply network characterized by "on-chain circulation" and "on-demand access".

At the classroom level, intelligent sensing is enabled through live classroom upgrades, integration of interactive devices, platform-based monitoring, data analytics, and AI Teaching Assistants. These technologies enable real-time tracking of resource usage, participation, and instructional processes, transforming the learning environment from "simple connectivity and accessibility" to a more advanced state where "resources are perceivable", "classrooms are interactive", and "processes are continuously supported".

2. Constructing a Scenario-Based Interactive Teaching Model

To address the critical issue of how shared resources can effectively enter classrooms and promote meaningful learning, Sichuan has leveraged the collaborative classroom scenarios within teaching alliances to transform teaching from one-way transmission to multi-stage interaction, and from passive reception to active knowledge construction:

In the pre-class phase, teachers utilize the network-linked platform and resource packages, together with AI Teaching Assistants and subject-specific intelligent agents, to conduct learning analytics, resource recommendation, and task-oriented guidance. This supports optimized instructional design and enables students to engage in structured pre-learning. **In the in-class phase,** diverse application modes, such as observation, embedded instruction, recorded lessons, and live broadcasting, are integrated to strengthen coordination and real-time interaction between delivering and receiving classrooms. Technologies such as digital humans and intelligent agents support scenario introduction, real-time questioning, interactive discussion, and scaffolding, enabling students to engage in inquiry, communication, and knowledge construction within authentic problem contexts. **In the post-class phase,** mechanisms such as lesson replay, assignment feedback, diagnostic analysis, and personalized support help consolidate learning outcomes and support continuous instructional improvement.

Through this integrated "pre-class guidance – in-class interaction – post-class extension" chain, resource sharing is transformed into actual learning processes, promoting the development of higher-order thinking, problem-solving abilities, and self-directed learning.

3. Establishing a Data-Driven Precision Evaluation Model

To enhance the effectiveness of resource sharing and classroom application, Sichuan has continuously strengthened teaching quality evaluation, process monitoring, and feedback analysis within the

Network-Linked Sharing Initiative, forming a data-driven precision evaluation model integrating instant evaluation, routine evaluation, and longitudinal tracking.

Instant evaluation relies on classroom data collection and AI-powered lesson analysis tools to rapidly assess classroom interaction, resource usage, and instructional processes. This enables teachers to receive timely feedback after each lesson, improving responsiveness. **Routine evaluation** combines mechanisms such as live monitoring, classroom observation, lesson review, and AI-supported evaluation tools to conduct ongoing, process-oriented assessments of resource quality, classroom application, and instructional effectiveness. This establishes a regional teaching quality monitoring and feedback system. **Longitudinal evaluation** utilizes accumulated teaching behavior data to build teacher development profiles and professional portraits. These support teachers in tracking instructional changes over time and engaging in evidence-based reflection and improvement.

Through the integration of these three evaluation types, a closed-loop model of "teaching – evaluation – feedback – optimization" has been established, providing sustained support for instructional improvement and teacher development.

4. Building a Collective Intelligence-Driven Teacher Development Mechanism

Teacher professional development and the construction of collaborative teaching communities are essential for sustaining high-quality and balanced basic education at the provincial level. Accordingly, Sichuan has developed a "chain-based collaborative research" model supported by teaching alliances, collective pedagogical research, and AI-enabled tools.

This model is demand-driven and integrates multiple activities, including online collaborative research, joint lesson planning, job-shadowing, training for key teachers, and digitally supported professional development. It forms a complete cycle of: "needs analysis – thematic collaboration – lesson demonstration – interactive evaluation – practical immersion – reflective improvement". The resulting outputs, such as high-quality instructional designs, lesson cases, research products, and improvement strategies, are incorporated into a regional knowledge base, supporting the development and iteration of a provincial AI-powered teaching research model. Through this approach, research products can be rapidly disseminated and reused within alliances. Teachers gradually transition from resource recipients to co-designers, co-researchers, and co-innovators, forming a new paradigm of AI-supported collaborative teaching research.

Through the coordinated advancement of the four components above, Sichuan has established an implementation framework characterized by provincial-level coordination, municipal-county collaboration, school-level responsibility, and alliance-based linkage. The Network-Linked Sharing Initiative has thus evolved beyond a mechanism for expanding access to high-quality resources, becoming a key pathway for transforming basic education from digital connectivity to intelligent empowerment, and from resource sharing to quality enhancement.

Case Innovation and Breakthroughs

1. Bridging the Technology "Access Divide": Leveraging Technological Breakthroughs in the Streamlined Deployment of Large Models and Edge Computing to Create a Low-Cost, Multi-Sensory Smart Learning Environment

This case breaks away from the limitations of traditional remote education characterized by one-way transmission and fragmented resource silos. By leveraging large models as the digital foundation, it

constructs a province-wide interconnected, multi-sensory intelligent learning environment.

Through streamlined deployment of large models and edge computing optimization, the system enables remote schools with limited bandwidth and computing capacity to operate intelligent interactive systems smoothly. This facilitates real-time interconnection not only between classrooms, but also across schools and regions, forming an intelligent connected learning environment.

The intelligent sensing system continuously captures multimodal classroom data, including speech, behavior, and facial expressions, and dynamically adapts instructional strategies accordingly. As a result, each learner's status can be effectively "perceived" and "responded to" in real time. This technological approach fundamentally bridges the "access divide" in remote areas and provides robust infrastructural support for inclusive education.

2. Bridging the Resource "Acquisition Divide": Achieving Cross-Chain Flow and On-Demand Allocation Through a Provincial-Level Mechanism for High-Quality Resources Sharing Based on an innovative "Multi-to-Multi, Node-Linked" Model

This case pioneers a "multi-to-multi, node-linked" network-sharing mechanism, establishing a large-scale, structured system for high-quality resource distribution across the province.

Through 35 teaching alliances, Lead Schools, Bridge Schools, Hub Schools, and Spoke Schools are interconnected into a networked community, effectively breaking the traditional "resource island" model. High-quality resources—including lessons, teaching plans, and courseware—are enabled to flow across networks and be dynamically allocated based on local needs.

This mechanism directly addresses the "resource access divide" in remote and underdeveloped regions, ensuring that all learners—regardless of their physical, cognitive, social, emotional, or linguistic conditions—can access educational resources suited to their developmental needs.

Beyond resource connectivity, the initiative further integrates these resources into pedagogical processes, forming a scenario-based interactive teaching model ("pre-class guidance – in-class interaction – post-class extension") and a data-driven closed-loop evaluation model ("teaching – evaluation – feedback – optimization"). This enables deep interconnection among teachers and students across time and space, transforming resource sharing into effective learning engagement.

3. Bridging the Teacher "Usage Divide": Establishing a New Paradigm of Teachers' Professional Development Based on Collective Teacher Diagnosis and Driven by Human-AI Collaborative Intelligence

Using teaching alliances as the organizational carrier, this case innovatively develops a collective intelligence-driven "chain-based co-research" paradigm, powered by the synergy between AI and teachers. Under this "AI Teaching Assistant + teacher collective intelligence" model: AI is responsible for data mining, resource recommendation, and learning analytics; Teachers focus on professional judgment, emotional support, and collaborative diagnosis. This complementary relationship transforms teachers from isolated practitioners into members of an interconnected professional learning community.

The model effectively addresses the long-standing "usage divide" faced by teachers in remote areas, namely, difficulties in using technology, limited support, and lack of sustainability. Teachers progressively shift from passive recipients of resources to co-designers, co-researchers, and co-innovators, achieving continuous professional growth through networked collaboration.

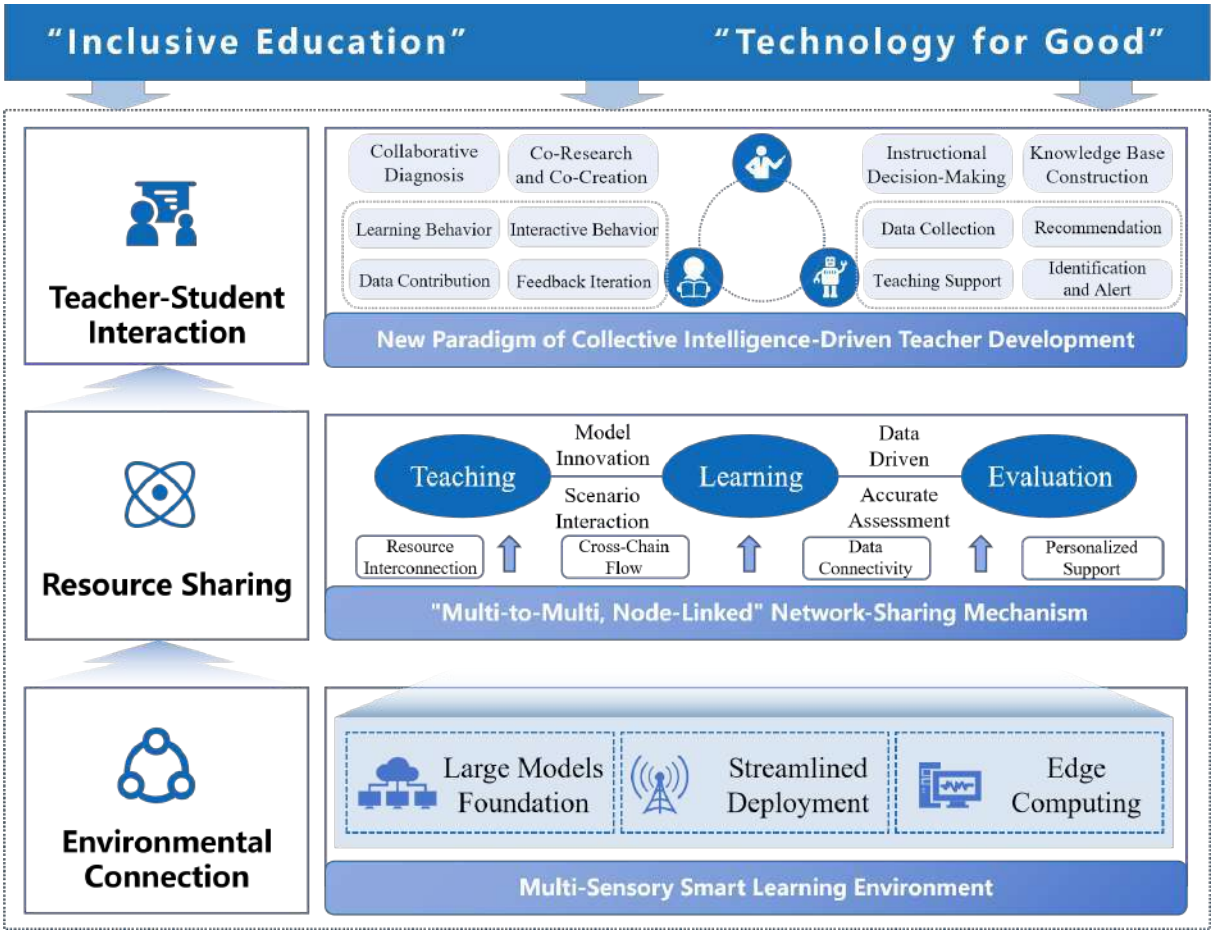

Figure 2 An AI-Empowered New Ecosystem for Provincial Inclusive Education

This case strictly adheres to international ethical standards, including the United Nations Convention on the Rights of the Child and the EU Ethics Guidelines for Trustworthy AI. It adopts privacy-preserving technologies such as federated learning to ensure data security and responsible AI use. Rather than positioning AI as a purely technical tool, the initiative frames it as a socio-technical system that promotes co-creation, inclusiveness, and relational transformation in education.

The case has received multiple national-level recognitions, including being selected among the Top 50 Digital China Exemplary Cases and as a National "5G + Smart Education" Benchmark Project, demonstrating its strong innovation value and policy relevance.

Promotion Value and Risks

1. Scalability and Overall Impact

The initiative has been implemented through 25 compulsory education alliances and 10 senior secondary alliances, covering all 21 prefectures and 100% of counties, reaching nearly 12,000 schools and benefiting over 11 million students. More than 460,000 high-quality curriculum resources across all subjects and grade levels have been developed and shared. During the COVID-19 pandemic, the platform supported home-based learning for over 9 million students, with 770 million cumulative views across internet and television platforms, demonstrating strong emergency support capacity.

Through the establishment of a provincially-led and non-profit live-streaming platform, the initiative has achieved strong regional impact and is increasingly recognized at the national level, and it has been reported by major media outlets more than 20 times. The case was presented at the World Digital Education Conference, and recognized as the only provincial-level representative case in the first batch of Digital China Exemplary Cases. It has also been selected as a National "5G + Smart Education" Benchmark Project. In September 2025, the Minister of Education emphasized that the initiative should be institutionalized as a scalable national model, noting that the "Sichuan approach" effectively addresses the dynamic allocation of educational resources and has strong potential for nationwide replication.

2. Educational, Social, and Institutional Value

2.1 Student achievement

Leibo Middle School increased undergraduate admissions from 7 (2015) to 272 (2025) (~38× growth). Beichuan Middle School achieved a 100% undergraduate admission rate (2023-2025), with over 78% admitted to first-tier universities, including Tsinghua and Peking University.

2.2 Teacher development

By 2025, the number of national awards won by teachers from Sichuan Province had risen to the top of the national rankings. Alliance-based collaboration and job-shadowing programs have fostered a practice-oriented professional community, supporting teacher co-development and leadership growth (e.g., a teacher advanced from homeroom teacher to acting vice principal and led curriculum innovation).

2.3 School management

Previously under-resourced schools (e.g., Beichuan, Leibo School) have significantly improved performance and local reputation, retaining more top-tier students and achieving "low-entry, high-outcome" transformation.

3. Demonstration and Leadership Value

At the management level, alliance-based governance supports weak schools through leadership collaboration and shared management practices.

At the teacher level, joint lesson planning, interactive teaching, and post-class reflection create a continuous professional support system.

At the student level, learners in remote areas gain access to the same classrooms as urban peers, broadening horizons and strengthening motivation.

4. Potential Risks and Mitigation

4.1 Technical Risks

- System performance risks due to large-scale data accumulation (e.g., lag, instability)
- Storage and architecture risks (capacity overload, data security concerns)
- Device compatibility risks due to heterogeneous equipment standards

4.2 Ethical Risks

- Intellectual property risks related to unauthorized reuse of teaching resources
- Privacy risks involving sensitive biometric data (e.g., facial expressions, voice data)
- Psychological risks arising from perceived surveillance in live classroom settings

4.3 Mitigation Measures

These risks are addressed through provincial-level governance, data security protocols, and role-based

access control mechanisms, ensuring that all AI applications operate within legal, compliant, and ethical frameworks.

Other Relevant Information

1. Case Award Status

(1)Award Time: January 2022

Award Name: *China Digital Transformation Success Case ("Technology for Pandemic Response")*

Issued by: *People's Daily (China)*

(2)Award Time: July 2024

Award Name: *National Typical Project of "5G + Smart Education" Pilot Applications*

Issued by: *Ministry of Industry and Information Technology & Ministry of Education (China)*

(3)Award Time: November 2024

Award Name: *Digital China Exemplary Case*

Issued by: *National Data Administration (China)*

2. Third-Party Evaluation

2.1 Third-Party Certification

Software copyright obtained for the *Sichuan Cloud Education Live Classroom Platform V1.0*

2.2 International Endorsement

In April 2025, at the 3rd Global Symposium on "Smart Learning Environments in the Age of AI", organized by the Global Smart Education Network (GSENet) with participation from international authoritative organizations including UNESCO, Professor Yanyan Li from Beijing Normal University presented this case on behalf of China, titled "Smart Learning Environment in AI Era: Conception, Practical Exploration, and Future Evolution."

During the symposium, participating international experts unanimously recognized that this practice demonstrates significant global value in promoting educational equity, empowering teacher development, and ensuring ethical AI application, and holds strong potential as a model for international reference.

2.3 Media Coverage (Selected)

- *Sichuan Science and Technology Daily.* November 27, 2019.
  "Sichuan Cloud Education" Officially Launched, Benefiting Students Across the Province.
  (http://kjb.sckjw.com.cn/c7bfab1a2283456c8716b7394202d12c)
- *Sichuan Observer News.* September 3, 2020.
  Phase II of the "Sichuan Cloud Education" Platform Launched, Benefiting Over 200,000 Teachers and Students Province-wide. (https://cbgc.scol.com.cn/custom/358057)
- Official Website of Sichuan Provincial Department of Education. June 17, 2021.
  Sichuan Promotes High-Quality and Balanced Education Development through "Sichuan Cloud Education".
  (http://edu.sc.gov.cn/scedu/c100494/2021/6/17/2bcc96778079442b87c6d5e19cd0f188.shtml)
- *Sichuan Online.* September 27, 2021.
  Establishing a Multi-Level Cloud Education Alliance System to Promote High-Quality Development of "Sichuan Cloud Education". (https://sichuan.scol.com.cn/ggxw/202109/58294612.html)

- General Office of the Sichuan Provincial Government. September 27, 2021. Then Vice Governor Luo Qiang Emphasized Enhancing Informatization and Sharing High-Quality Educational Resources at the "Sichuan Cloud Education" Conference. (https://www.sc.gov.cn/10462/lqyghd/2021/9/27/173e1f1509a342859a3524bbc847d5f5.shtml)
- Official Website of Sichuan Provincial Department of Education. November 28, 2022. After-School Services of "Sichuan Cloud Education" Support Student Development. (https://www.sc.gov.cn/10462/c109797/2022/11/28/f34d9dac2c3b40929d02ef5ddf33133e.shtml)
- Official Website of Sichuan Provincial Department of Education. February 15, 2023. "Sichuan Cloud Education" Gains Wide Recognition: Introduction by the Director of the Sichuan Provincial Department of Education at a World-Class Conference. (http://edu.sc.gov.cn/scedu/c100494/2023/2/15/680e9dd1454a46888dc515f0ea4386cc.shtml)
- Sichuan Educational Informatization and Big Data Center Website. November 22, 2023. "Developing Sichuan Cloud Education to Promote High-Quality and Balanced Development: A Sichuan Practice of Large-Scale Sharing of High-Quality Educational Resources" Selected and Exhibited at the 6th China Educational Innovation Expo. (https://www.scbdc.edu.cn/p/8/?StId=st_app_news_i_x638374727627178950)
- Official Website of Sichuan Provincial Department of Education. March 20, 2025. Launch of the "Network-Linked Sharing Initiative" for Basic Education in Sichuan Province. (https://edu.sc.gov.cn/scedu/c100494/2025/3/20/3de25cc5e60042c1bd3a2815c43f240e.shtml)
- *Sichuan Daily.* March 20, 2025. Sichuan Launches the "Network-Linked Sharing Initiative" for Basic Education, Breaking Regional Barriers and Enabling Resource Sharing Across All Primary and Secondary Schools. (https://www.sc.gov.cn/10462/10464/10465/10574/2025/3/20/ba75ea071bc349139333e6158f1b8216.shtml)
- *Guangming Online.* March 24, 2025. Sichuan Launches the "Network-Linked Sharing Initiative" for Basic Education. (https://difang.gmw.cn/2025-03/24/content_37929363.htm)
- *Guangming Daily.* April 3, 2025. How to Share Educational Resources in the Era of Digital Intelligence. (https://epaper.gmw.cn/gmrb/html/2025-04/03/nw.D110000gmrb_20250403_5-02.htm)
- Sichuan Provincial Government Portal. November 30, 2025. Expanding the Supply of High-Quality and Equitable Public Education Services through "Network-Linked" Master Teacher Classes. (https://www.sc.gov.cn/10462/c111481vvh/2026/2/5/d2fc0644e16f4cdeaa8423e4ca5538af.shtml)
- Sichuan Provincial Government Portal. February 4, 2026. Sichuan Provincial Department of Education: Safeguarding Basic Livelihood Needs and Empowering the Development of a Strong Education Province. (https://www.sc.gov.cn/10462/10464/10465/10574/2026/2/4/7026e9c3d46943d6a0d97522d2e49296.shtml)

- Sichuan Provincial Government Portal. February 5, 2026.
  Deepening the Implementation of the “Network-Linked Sharing Initiative” to Enable the Sustainable Growth of High-Quality Education.
  (https://www.sc.gov.cn/10462/c111481vvh/2026/2/5/d2fc0644e16f4cdeaa8423e4ca5538af.shtml)
- Sichuan Provincial Government Portal. April 6, 2026.
  Sichuan’s “Network-Linked Sharing Initiative” Further Expands, with Provincial Alliances to Cover All Primary and Secondary Schools.
  (https://www.sc.gov.cn/10462/10464/10465/10574/2026/4/6/5ad4b597f7dd40668c202a94d70b13ed.shtml)

3. Case-related images, videos, and other materials

3.1 Promotional video (Sichuan Cloud Education)

https://pan.baidu.com/s/1AgzE_nykoZHAFMOqBmubYA (Extraction code: scyj)

3.2 Promotional video (Network-Linked Sharing Initiative)

https://pan.baidu.com/s/12GAdQ0rB9Zx2pgWWQiFi-w (Extraction code: wljh)

.3 Software copyright (Sichuan Cloud Education Live Classroom Platform V1.0)

https://pan.baidu.com/s/1ydNRryp_XNoMuUiph6iriA (Extraction code: 5hie)

Case 81

Leading the Construction of Future Teacher, Future Classroom and Future School with Future Learning Center: The Reconstruction and Practice of the Smart Teaching System of West China School of Stomatology

Sichuan University, Sichuan, China

Background

In the context of the digital transformation of education, stomatological education confronts three critical challenges: firstly, the disciplinary knowledge system is highly complex and interdisciplinary, **hindering students from constructing a systematic knowledge network**; secondly, traditional skills training models are disconnected from authentic clinical scenarios, **resulting in a lag in the development of students' practical competencies and clinical reasoning**; thirdly, standardized educational models lack intelligent, real-time precise feedback and dynamic guidance, **rendering personalized training difficult to implement**. Deepening the exploration and practice of “Artificial Intelligence (AI) + Higher Education” and building a “Four Futures”-oriented new ecosystem for stomatological education have become the inevitable path to empowering excellent talent cultivation and leading educational innovation.

Following the strategic direction of digital education transition from “3C” to “3I”, West China School of Stomatology Sichuan University, leverages its A+ discipline and national first-class undergraduate majors to establish **the West China School of Stomatology(WCSS) IDEA Future Learning Center at** Sichuan University. The center utilizes the independently developed the West China School of Stomatology(WCSS) Cloud Academy with the "Digital Dental Student Identity (DDS-ID)" as a unified

access credential, guided by the personalized training objective of "One Student, One Strategy", promotes intelligent interaction between teaching resources and learning scenarios, opens up "dynamic navigation" adaptive learning pathways, creates **a new ecosystem of smart stomatological education featuring a three-stage integrated progression of "Strengthen Knowledge, Sharpen Capabilities, and Refine Expertise"**, achieves scaled personalized education (All-to-One), and provides the "WCSS Solution" for cultivating top-notch innovative stomatology talents capable of solving complex clinical problems in the future.

Case Implementation Status

Including but not limited to the exploratory practices carried out in aspects such as demand analysis, technology research and development or personalized customization, and application optimization. Text and pictures can be used together for better illustration.

The West China School of Stomatology is guided by the vision of being Intelligent, Data-Driven, Experiential, and Adaptive. Leveraging its status as a National Demonstration Center for Experimental Teaching and a Virtual Simulation Experimental Teaching Center, **it has independently developed China's first multimodal large model in the field of stomatology: the "WCSS Zhilian Large Model".** Using this model as its technological foundation, and employing both physical teaching spaces and the cloud-based teaching system **"i-Portfolio WCSS Cloud Academy"** as its dual core carriers, the school has innovatively created the **"WCSS IDEA Future Learning Center".** This initiative establishes a boundary-less smart education ecosystem that integrates online and offline learning and covers the entire teaching lifecycle.

Figure 1 WCSS IDEA Future Learning Center

The physical teaching space covers approximately 8,000 square meters and is equipped with over 500 sets of digital and intelligent teaching facilities. Through Internet of Things (Iot) -enabled sensing and intelligent scheduling, the center achieves full-process smart management, including equipment reservation, environmental control, and consumables management. **The "i-Portfolio WCSS Cloud Academy" uses the "Digital Dental Student Identity (DDS-ID)" as a unified access credential.** It connects with physical teaching equipment to establish a comprehensive digital growth portfolio for each student, integrates core functional modules covering "Teaching, Learning, Practice, Assessment, Management, and Research". It precisely records learning trajectories, intelligently generates competency profiles, connects the entire training chain from "theoretical learning" to "simulation training" and "clinical practice", and accurately adapts to the competency trajectories and personalized needs of stomatology students at different stages, the center drives the deep evolution of stomatological education toward greater intelligence.

Scene 1: "Strengthen Knowledge" - Building an Immersive Cognitive Environment for "Autonomous Exploration"

Deeply integrating artificial intelligence with cutting-edge teaching concepts, AI is upgraded from an auxiliary tool to a smart engine that runs through all teaching links. Based on the WCSS Zhilian Large Model, specialized AI agents such as intelligent diagnosis, clinical reasoning, and simulation surgery are developed, and the smart course cluster of 17 courses are constructed, covering all core courses in stomatology. This is complemented by AI teaching assistants, video analysis, and practice functions, guiding students to shift from passive knowledge absorption to active construction of knowledge systems through intelligent interaction. For instance, the SMILE smart course in Orthodontics uses AI to provide personalized learning paths, allowing students to independently mark anatomical points and receive immediate feedback, helping them establish an integrated thinking of "images - anatomy - pathology - risks", with the core knowledge point mastery rate increasing by 32% and the average course score rising by 9.4 points. It has been efficiently promoted and shared in many universities across the country and has been used to train dentists in 7 countries along the "Belt and Road", achieving a new breakthrough in international teaching. **The "Orthodontics" course won the Special Prize and the "Digital Intelligence Education" Special Award in the Seventh National University Blended Teaching Innovation Design Competition.**

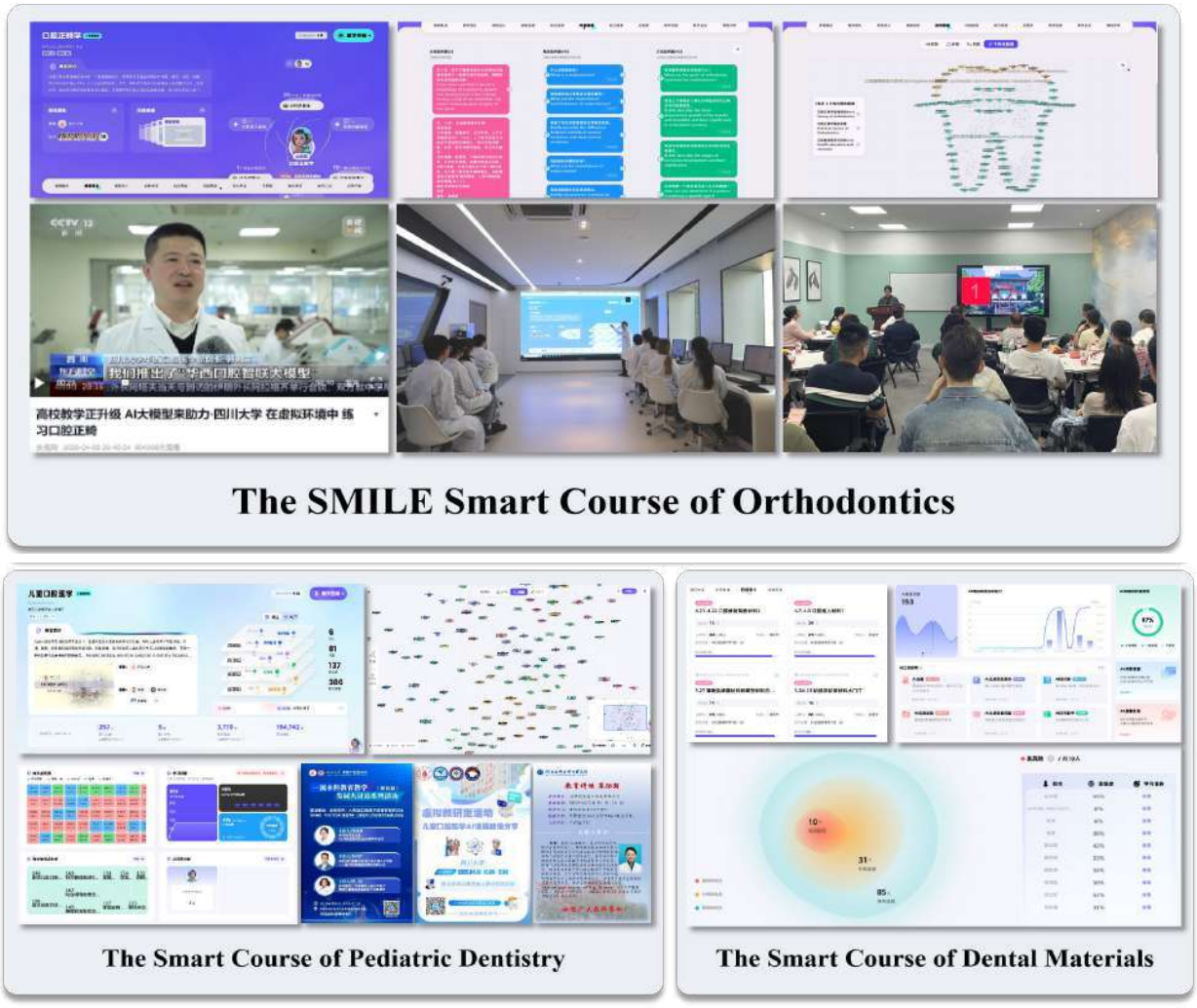

Figure 2 The Smart Stomatology Course Cluster

Scene 2: "Sharpen Capabilities" - Creating a highly realistic skill refinement system of "Self-driven Advancement"

Based on the practical teaching characteristics of stomatology, which include "repeated training, precise clinical operation, and aesthetic cultivation", and relying on technologies such as machine learning and computer vision, the **AI virtual simulation experimental teaching system 2.0** has been constructed. It integrates online virtual simulation experiments, virtual reality/mixed reality virtual simulation training systems, and intelligent diagnosis assistance functions, breaking the time and space limitations of practical training and creating a clinical skills training scenario that infinitely close to reality. The online virtual simulation experiment teaching system has over 1,000 registered units, with the highest course click rate reaching 30,000 times. Through industry-university collaboration, 8 categories of extended reality teaching equipment have been developed, including the world's first mixed reality-based implantology training system and the dental virtual-actual fusion simulation training console system powered by spatial computing. Achieving full coverage of core stomatology disciplines, these innovations establish a tripartite interactive teaching model involving teachers, students, and intelligent systems, thereby facilitating the cultivation and advancement of students'

clinical practical skills. The faculty team was selected for **the first and second batches of "Project Universities and Case Teams for the Virtual Simulation Teaching Innovation Laboratory Project in Higher Education Institutions" approved by the Ministry of Education of the People's Republic of China.** Furthermore, the platform's construction was recognized as **a benchmark work in the "Management Cases of Virtual Simulation Teaching Laboratories in Universities" category of the 2025 National Teacher-Student Information Literacy Improvement Practical Activity(Higher Education Special Project).** The project also secured First Prize in both **the "Virtual Simulation Teaching Application" and "Simulation Innovation Design" tracks at the 2025 Simulation Innovation and Application Competition (SIAC).**

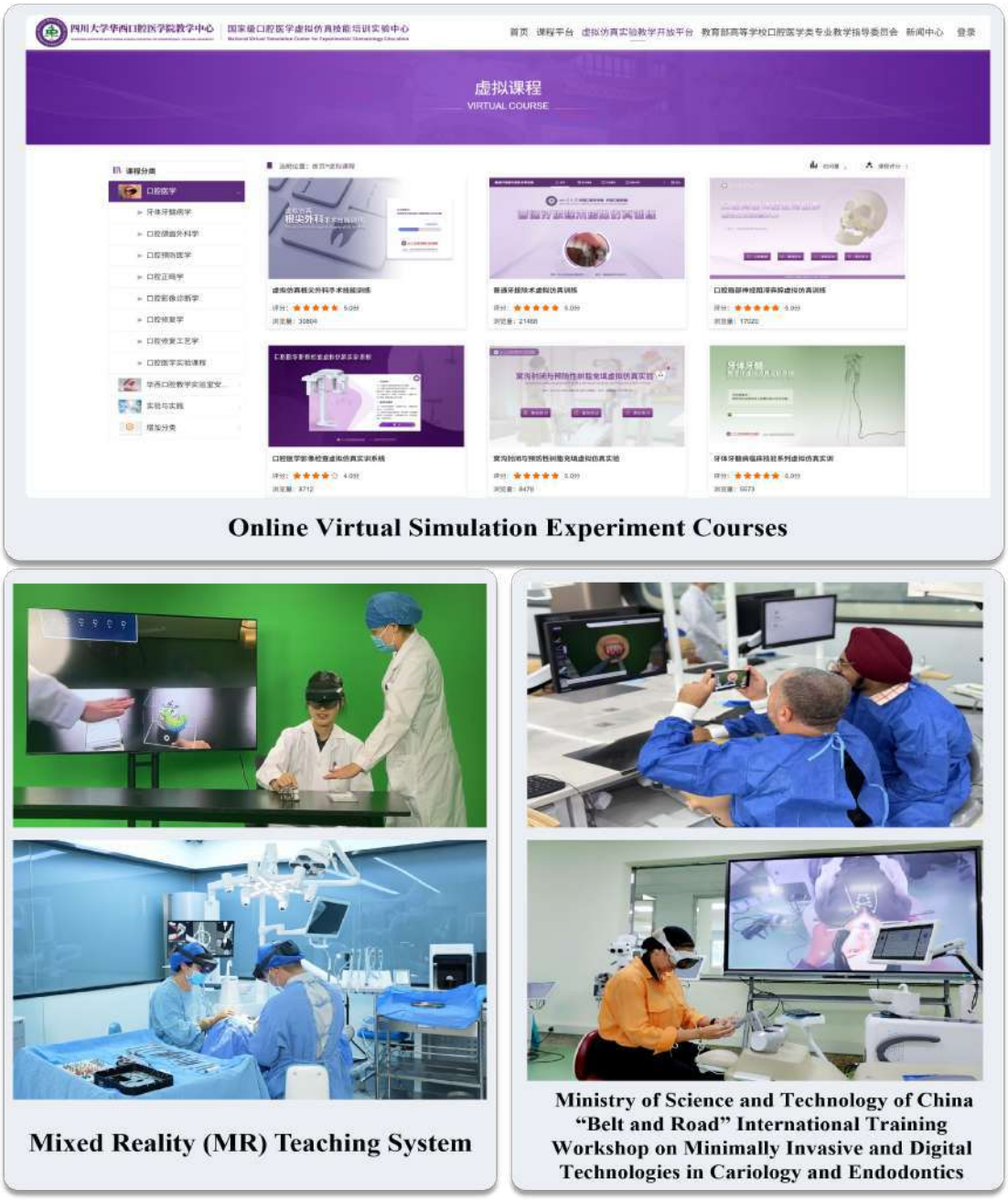

Figure 3 AI virtual simulation experimental teaching system 2.0

Scene 3: "Refine Expertise" - Creating a Practical Clinical Application Scenario of "Self-Driven Improvement"

Empowered by the WCSS Zhilian Large Model, the entire clinical diagnosis and treatment process is deeply enhanced, and an AI-driven clinical internship decision-making training system is constructed. The system intelligently integrates three core clinical scenarios: image diagnosis, pathological analysis, and specialized treatment, precisely supporting the step-by-step growth of students' clinical competence. Independently developed oral imaging AI matrix covers real-time image quality control, multi-disease intelligent recognition, and visual diagnostic assistance modules, and is deeply integrated with the Picture Archiving and Communication System (PACS). AI diagnostic results can be retrieved within 2 seconds, and intelligent reports can be generated within 5 seconds, efficiently assisting in the cultivation of students' clinical diagnostic abilities. By deeply exploring the correlation between oral pathology and clinical practice, **the world's first multi-modal oral pathology AI analysis system** is built, supporting intelligent diagnosis of over 30 oral diseases and interactive teaching. The first-of-its-kind active navigation training system for oral and maxillofacial surgery, after five years and 450 cases of validation, significantly shortens the operation time, increases the speed of designing surgical plans for students by 62.5%, and improves the accuracy rate by one-third. Independently developed "OrthoGPT" AI-assisted decision-making system and mixed reality (MR) navigation orthodontic bracket bonding system are precisely integrated into clinical training through MR virtual-real interaction teaching training mode and navigation bracket bonding automatic registration device, with students' bracket bonding distance accuracy reaching 92.3%. It has won **the Gold Award of the 2025 China International College Students Innovation Competition, the First Prize of the 2024 Simulation Innovation and Application Competition (SIAC) in the track of "Virtual Simulation Teaching Application", the Gold Award of the 14th Challenge Cup China College Students Entrepreneurship Plan Competition,** and other national awards. It has been selected as **a typical case of the second and third batches of "AI + Higher Education" Application Scenarios** by the Ministry of Education of the People's Republic of China.

Figure 4 AI-powered Clinical Internship Decision-Making System

Case Innovation and Breakthroughs

Addressing the urgent imperative of cultivating high-caliber stomatological talents for the new era, this initiative targets critical bottlenecks plaguing traditional education models. These bottlenecks include the misalignment between teaching environments and real-world clinical scenarios, overly fragmented knowledge systems that impede systematic learning, the absence of high-fidelity practical skill training, and lagged feedback mechanisms in clinical decision-making.

Rooted in the core philosophy of scaled personalized education (All-to-One), this project pioneered the launch of China's first multimodal vertical large language model dedicated to stomatology—the WCSS Zhilian Large Model. In parallel, it independently developed the i-Portfolio WCSS Cloud Academy, which integrates three core modules: the Smart Stomatology Course Cluster, the AI Virtual Simulation Experimental Teaching System 2.0, and the Clinical Internship Decision-Making System.

These advancements led to the establishment of the WCSS IDEA Future Learning Center and the innovative design of a three-stage integrated teaching framework: Strengthen Knowledge, Sharpen Capabilities, and Refine Expertise. As a result, the initiative has achieved a transformative leap in intelligent teaching models—spanning from the groundbreaking development of the vertical large model to the full coverage of smart curricula across core stomatological disciplines.

By comprehensively breaking down multi-dimensional teaching barriers and enabling precise profiling of individual learners, it has fulfilled the personalized talent development goal of "One Student, One Strategy". Ultimately, this effort has forged a new paradigm of digital-intelligence integration for the future of "AI + Stomatology" education.

Building on general-language models such as Qwen and DeepSeek, and leveraging the extensive multimodal clinical data from the West China School of Stomatology, the institution has launched China's first specialized multimodal large model dedicated to stomatology: the WCSS Zhilian Large Model.

Equipped with advanced domain-specific capabilities, this model supports a wide range of applications, from encyclopedic Q&A in oral medicine to training in clinical reasoning. It spans the entire educational continuum, covering both foundational professional training for dental students and hands-on clinical practice.

The system is now fully deployed within the West China School of Stomatology, serving over 20,000 faculty members and students. It has significantly enhanced teaching efficiency and strengthened students' clinical reasoning skills. The model has been recognized by the Ministry of Education of the People's Republic of China as a typical case of "AI + Higher Education" application scenarios, a typical case of Innovation and Practice in Medical Artificial Intelligence by the National Health Commission of the People's Republic of China, the first batch of Typical Cases of "AI + Healthcare" by the Sichuan Provincial Health Commission. Furthermore, the project secured the Second Prize nationwide and the First Prize in Sichuan Province at the 7th National Finals of Smart Healthcare Innovation Competition. It also contributed to winning the First Prize for Innovation Achievement awarded by the China Industry-University-Research Institute Collaboration Association (CIUR), as well as the Gold Medal at the 2nd "Innovation for Youth" National Health Industry Youth Innovation Competition organized by the National Health Commission of People's Republic of China. 5 invention patents and 2 software copyrights has been generated

Figure 5 WCSS Zhilian Large Model

Case 1: Digital-intelligent integration drives innovation in orthodontic education

This project establishes a smart course and multimodal diagnostic tools built on an orthodontic knowledge graph, facilitating a paradigm shift from knowledge dissemination to personalized competency development. It features an AI-guided system for precise measurement and digital virtual tooth arrangement, transforming traditional reliance on manual experience into high-precision quantitative analysis. Leveraging a vast repository of clinical cases, the "OrthoGPT" auxiliary decision-support system, combined with integrated virtual-real operational training pathways, systematically cultivates students' "holistic thinking"—spanning from radiographic analysis to clinical reasoning. Within a highly intelligent simulated environment, the program also refines students' skills in doctor-patient communication and humanistic care.

The initiative has been successfully scaled and adopted across numerous universities nationwide. In addition, it has contributed to transnational educational innovation by training 28 dentists from 7 countries participating in the Belt and Road Initiative. These achievements have been featured in prominent national media, including China Central Television (CCTV) and China Education News. The project was awarded as a benchmark work in the 2024 National Teacher-Student Information Literacy Improvement Practical Activity (Higher Education Special Project).

Figure 6 AI-Empowered Innovations in Orthodontic Medical Experiments

Case 2: Digitally-Empowered Pedagogy in Oral and Maxillofacial Surgery Education

Leveraging the clinical and academic expertise of our Oral and Maxillofacial Surgery Department, we have pioneered a highly realistic, robot-assisted virtual system for minimally invasive surgical training. This system integrates AI, virtual simulation, and robotic technologies to overcome the limitations of traditional observation-based apprenticeship models, providing students with real-time, intelligent assessment and feedback throughout the entire surgical process. For authentic clinical training, we have developed the first-of-its-kind active navigation system for craniomaxillofacial surgery, utilizing big data and augmented reality. This innovation establishes a digitally-integrated workflow for craniomaxillofacial surgery, characterized by "intelligent planning, precision navigation, and personalized reconstruction". This project has been honored with multiple national accolades, including the Gold Award at the 14th Challenge Cup China College Students Entrepreneurship Plan Competition, the National Gold Prize at the China International College Students' Innovation Competition, and the Grand Prize at the National College Student Robotics Innovation and Entrepreneurship Camp and Competition.

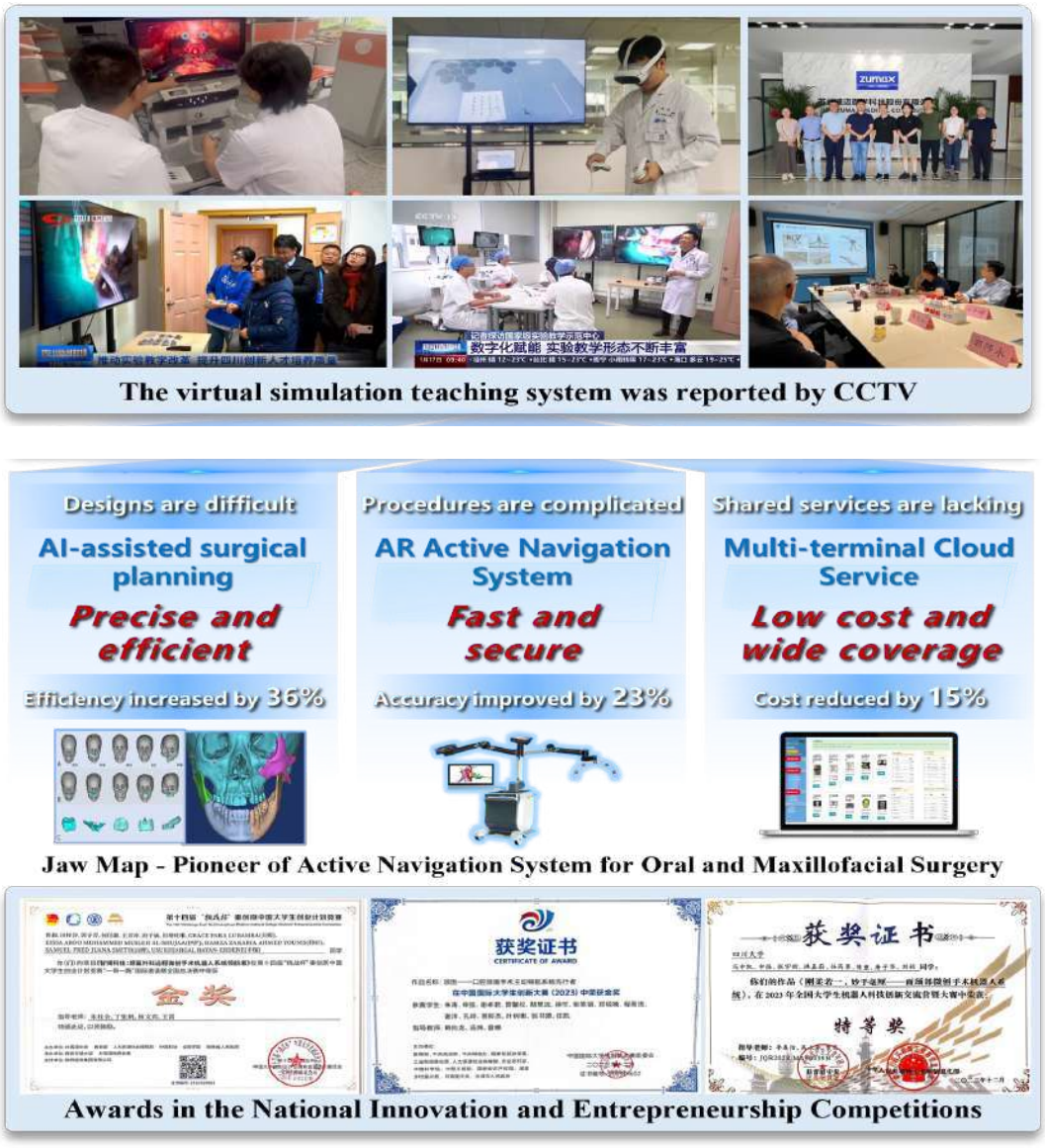

Figure 7 AI-Empowered Instruction in Oral and Maxillofacial Surgery

Case 3: Digital-intelligent integration leads innovation in dental diagnostic teaching

Addressing key challenges in oral pathology education—including limited specimen resources, complex disease classifications, and students' limited proficiency in microscopic interpretation, we pioneered the development of the world's first clinical-grade multimodal oral pathology large model, HXDental-PathAI. Based on this model, an immersive and intelligent teaching ecosystem featuring "one-click image acquisition and text-image interaction" has been established. Leveraging massive pathological and clinical data, the platform enables intelligent interpretation and quantitative analysis within 10 seconds, transforming abstract pathological knowledge into intuitive AI-driven insights. This significantly enhances students' autonomous image-reading abilities and clinical reasoning skills.

To overcome the efficiency bottlenecks and accuracy limitations of traditional imaging diagnosis teaching, we independently developed an oral imaging AI matrix. This system integrates real-time image quality control, multi-disease intelligent recognition, and visual diagnosis assistance modules. It achieves immediate quality control upon image acquisition, retrieves AI diagnosis results within 2

seconds, and generates intelligent reports within 5 seconds—a substantial efficiency improvement compared to traditional manual processes. Functioning as an "intelligent coach", the system empowers students with instant and precise AI diagnostic feedback, guiding them to independently develop imaging diagnostic thinking ability. This project was awarded the Outstanding Case and Best Individual Performance Award at the 2025 National Competition of CN-Healthcare.

Figure 8 AI-Empowered Instruction in Oral Diagnosis

All core technologies underpinning this project are protected by patents. Intellectual property rights, encompassing both software copyrights and patents, are equitably allocated commensurate with each party's specific contributions. The project maintains full compliance with all applicable laws and regulations. Furthermore, rigorous safeguards have been implemented to protect teaching and clinical data generated during operations, thereby ensuring robust information security.

Promotion Value and Risks

In the past three years, this program has been featured nearly 200 times by CCTV, People's Daily, Guangming Daily, Xinhua News Agency, and the official website of Ministry of Education of the People's Republic of China. The WCSS Zhilian Large Model has served over 20,000 faculty members and students, while the Smart Stomatology Course Cluster has recorded nearly 2.7 million page views and more than 20,000 teacher-student interactions. The AI Virtual Simulation Experiment Teaching System has been adopted by over 1,000 institutions, with a single course receiving up to 30,000 clicks. The digital orthodontic teaching project has amassed over 150,000 views and 600 interactions, and has provided training to 28 dentists from 7 countries along the Belt and Road, marking a breakthrough in international teaching. The minimally invasive virtual system for oral and maxillofacial head and neck oncology has been successfully piloted in three medical schools, training more than 1,500 medical students. Furthermore, through the 14 consecutive years of the international course week "University Immersion Program(UIP)" and 4 consecutive years of hosting the "Campus Asia" joint academic conference, the case has established partnerships with over 30 dental schools across 15 countries and regions. It has invited nearly 100 international experts for academic exchanges, benefiting thousands of stomatology students.

2.Illustrate the social and economic value it brings.

This case has achieved positive social benefits in enhancing the quality of talent cultivation, promoting the universal accessibility of high-quality educational resources, and serving the national health strategy. It has effectively reduced expenditures on experimental consumables and equipment maintenance, as well as the labor costs associated with repetitive teaching, thereby significantly reducing costs and enhancing efficiency.

3.Elaborate on its demonstration and leading role in the entire basic education field.

Remarkable outcomes have been achieved in talent development. Over the past five years, undergraduate students have received 364 awards at the national and provincial levels. An average of 114 students present their research at top notch international conferences annually, and 31 international academic awards have been secured. Graduates have been honored with accolades such as Forbes 30 Under 30 Asia. Nearly 100 graduates have been recruited by top universities around the world, including Oxford and the University of Michigan.

Remarkable leadership and demonstrative impact have been achieved in pioneering innovation. In terms of demonstration construction, 9 National First-Class Undergraduate Courses has been approved, ranking first among all stomatological universities nationwide. Lead the breakthrough pilot project in the discipline of bionic intelligent stomatology initiated by the Ministry of Education of People's Republic of China—the only such initiative in the field of stomatology. The case has been recognized the first batch of Virtual Teaching and Research Platforms, and selected as a typical case of "AI + Higher Education" application scenarios by the Ministry of Education of the People's Republic of China, a typical case of Innovation and Practice in Medical Artificial Intelligence by the National Health Commission of the People's Republic of China. It received a benchmark work in the National Teacher-Student Information Literacy Improvement Practical Activity and invited for a national presentation as the only one in the field of medicine. In terms of international cooperation, partnership agreements have been established with over 30 leading institutions, including Harvard University. Invited by the Ministry of Education of the People's Republic of China as the sole medical representative, we jointly established a Chinese-UK digital course cluster with King's College London, and jointly built an oral virtual experiment center with Beijing University of Aeronautics and Astronautics and the Dental College of Belgrade University. Faculty members have held 124 international academic appointments and led or participated in the development of 39 international guidelines and consensus statements.

4. Identify potential risks such as technical risks and ethical risks that may arise during the application of the case.

The case faces potential technical challenges, including hardware compatibility and data security vulnerabilities, as well as ethical concerns regarding the boundaries of virtual simulation, patient data authorization, and algorithmic bias. To mitigate these risks, we propose establishing a comprehensive lifecycle governance framework. This framework integrates system security, data governance, and algorithmic ethics to ensure effective risk management and strictly compliant operations.

Other Relevant Information

This case closely aligns with the trend of digital transformation in education, leveraging artificial intelligence to reshape the talent cultivation model in stomatology. Based on the West China School of

Stomatology IDEA Future Learning Center, the case has accumulated a total of 28 national-level awards and 10 provincial-level awards in the field of "AI + Stomatology". Its achievements encompass the development of smart courses, the establishment of intelligent teaching platforms, and the construction of virtual simulation experimental teaching systems, fully demonstrating the project's exemplary leadership value and core competitiveness. The awarded projects are listed in the following table:

Number	Project Name	Award Name	Grade	Awarding Department	Award Year
1	The "Three-Stage Leap" Intelligent Management Model: Innovative Exploration and Practice in a Stomatological Virtual Simulation Training Center	A benchmark work in the National Teacher-Student Information Literacy Improvement Practical Activity (Higher Education Special Project)	National	the Ministry of Education of the People's Republic of China	2026
2	SmartMirror Future: Intelligent Minimally Invasive Diagnosis and Treatment System for Oral and Maxillofacial Surgery—Innovation and Application	"Innovation for Youth" National Health Industry Youth Innovation Competition	National Gold Award	the National Health Commission of the People's Republic of China, Central Committee of the Communist Youth League of China	2026
3	AI Orthodontics: Multi-Source Data-Driven Intelligent System for Interpretable Orthodontic Treatment Planning	"Innovation for Youth" National Health Industry Youth Innovation Competition	National Gold Award	the National Health Commission of the People's Republic of China, Central Committee of the Communist Youth League of China	2026
4	SmileWin: World's First Intelligent Minimally Invasive Robotic System for Maxillofacial Surgery	China International College Students' Innovation Competition	National Gold Award	the Ministry of Education of the People's Republic of China	2026
5	Building an Intelligent Teaching Platform Powered by the "WCSS Intelligent Connectivity" Large Model	Typical Cases of "AI + Higher Education" Application Scenarios	National	the Ministry of Education of the People's Republic of China	2025
6	Digital-Intelligent Integration-Driven Innovation in Virtual Simulation Experiments for Orthodontics	A benchmark work in the National Teacher-Student Information Literacy Improvement Practical Activity (Higher Education Special Project)	National	the Ministry of Education of the People's Republic of China	2025
7	Stomatological Technology Virtual Simulation Teaching Laboratory	Project Schools and Case Study Teams for Virtual Simulation Teaching Innovation Laboratories in Higher Education Institutions	National	the Ministry of Education of the People's Republic of China	2025

Number	Project Name	Award Name	Grade	Awarding Department	Award Year
8	SHIFT-Centric Teaching Reform and Practice in Oral and Maxillofacial Surgery	National College Teachers' Teaching Innovation Competition	National Second Prize	the Ministry of Education of the People's Republic of China	2025
9	Intelligent Triage and Clinical Decision-Making System Powered by the WCSS Zhilian Large Model	Typical Cases of Innovation and Practice in Medical Artificial Intelligence	National	the National Health Commission of the People's Republic of China	2025
10	Mixed Reality-Based "PISEM" Innovative Simulation Training System for Jaw Reconstruction	Simulation Innovation and Application Competition（SIAC)	National First Prize	Talent Exchange Center of the Ministry of Industry and Information Technology	2025
11	The interactive virtual simulation consultation model empowers clinical reasoning in maxillofacial surgery	Simulation Innovation and Application Competition（SIAC)	National First Prize	Talent Exchange Center of the Ministry of Industry and Information Technology	2025
12	Innovation and Practice of Smart Teaching Mode in Orthodontics	Typical Cases of Teaching Reform in National University Teacher Teaching Development Work	National	National network training center for University Teachers	2025
13	AI Empowerment: Building a New Smart Teaching Ecosystem Based on the WCSS Zhilian Large Model	The 7th National Finals of Smart Healthcare Innovation Competition	National Second Prize	Mobile Health Ministry of Education - China Mobile Joint Laboratory	2025
14	Virtual Simulation Skills Training Center of WCSS	Project Schools and Case Study Teams for Virtual Simulation Teaching Innovation Laboratories in Higher Education Institutions	National	the Ministry of Education of the People's Republic of China	2024
15	Sophybot: Pioneering Leader in Remote Minimally Invasive Maxillofacial Surgery Robot Systems	The Challenge Cup China College Students Entrepreneurship Plan Competition	National Gold Award	Ministry of Industry and Information Technology of the People's Republic of China	2024

Number	Project Name	Award Name	Grade	Awarding Department	Award Year
16	Development and Application of a Mixed Reality-Based Orthodontic Bracket Navigation Bonding System	Simulation Innovation and Application Competition（SIAC）	National First Prize	Ministry of Industry and Information Technology of the People's Republic of China	2024
17	Development and Application of a Progressive Virtual Simulation Pre-clinical Experimental Teaching System for Minimally Invasive Endoscopy and Surgical Robotics in Head and Neck Oncologic Surgery	Simulation Innovation and Application Competition（SIAC）	National First Prize	Ministry of Industry and Information Technology of the People's Republic of China	2024
18	Research and development of the standardized implementation process of virtual patients based on artificial intelligence	Simulation Innovation and Application Competition（SIAC）	National Third Prize	Ministry of Industry and Information Technology of the People's Republic of China	2024
19	Clinical Skills in Stomatology	National College Student Innovation and Invention Competition	National First Prize	China Association of Information	2024
20	Innovation and Practice of the "Dental Medicine+" Excellence Talent Cultivation Model Led by New Medical Sciences	National Teaching Achievement Award	National Second Prize	the Ministry of Education of the People's Republic of China	2023
21	Exploration and Practice of a Diversified and Precise Cultivation System for Enhancing College Students' Innovation and Entrepreneurship Abilities	National Teaching Achievement Award	National Second Prize	the Ministry of Education of the People's Republic of China	2023
22	Jaw Map - Pioneer of Active Navigation System for Oral and Maxillofacial Surgery	China International College Students' Innovation Competition	National Gold Award	the Ministry of Education of the People's Republic of China	2023

Number	Project Name	Award Name	Grade	Awarding Department	Award Year
23	"Harmony of Strength and Gentleness · Precise and Skillful 'Hands'" - Minimally Invasive Surgical Robot System for Oral and Maxillofacial Surgery	the National College Student Robotics Innovation and Entrepreneurship Camp and Competition	National Special Award	Central Committee of the Communist Youth League of China,Ministry of Industry and Information Technology of the People's Republic of China	2023
24	Creation of virtual dental patients and its application in complex oral and maxillofacial system reconstruction	Simulation Innovation and Application Competition	National First Prize	Ministry of Industry and Information Technology of the People's Republic of China	2023
25	Virtual Simulation Experiment of Open Reduction and Internal Fixation for Jaw Fractures	Simulation Innovation and Application Competition	National Second Prize	Ministry of Industry and Information Technology of the People's Republic of China	2023
26	Ai Smile for Youth - Orthodontics for Teenagers Enlightens Rural Smiles	China International College Students' Innovation Competition	National Gold Award	the Ministry of Education of the People's Republic of China	2022
27	RD-designer: Expert System for Simulation Design of Removable Partial Dentures	Simulation Innovation and Application Competition	National First Prize	Ministry of Industry and Information Technology of the People's Republic of China	2022
28	Biyou Dental - Smart Invisible Orthodontic Solution Provider	China International College Students' Innovation Competition	National Bronze Award	the Ministry of Education of the People's Republic of China	2019
29	Innovation and Practice of the Excellent Talent Cultivation System in Stomatology in the New Era	Sichuan Provincial Teaching Achievement Award	Provincial Special Award	The People's Government of Sichuan Province	2026
30	Application of the WCSS Zhilian Large Model	First Batch of Typical Cases of "AI + Healthcare"	Provincial	Sichuan Provincial Health Commission	2026

Number	Project Name	Award Name	Grade	Awarding Department	Award Year
31	Applying Artificial Intelligence to Oral and Maxillofacial Surgery: A Case Study of the "Oral Local Anesthesia" Lesson	Sichuan Provincial First Teacher Artificial Intelligence Application Ability Competition	Provincial Special Award	Sichuan Provincial Department of Education	2025
32	"Dental Connect": SCU Smart Teaching Platform for Stomatological Education	Representative scenario for "AI + Higher Education" of Sichuan Province in 2025	Provincial	Sichuan Provincial Department of Education	2025
33	AI-Powered Three-Dimensional Leap: Empowering Young Stomatology Technology Faculty in Medicine, Education, and Research through Digital-Intelligent Integration	First Prize of the First Sichuan Teachers' AI Application Skills Competition	Provincial First Award	Sichuan Provincial Department of Education	2025
34	AI-Enabled Construction of the WCSS IDEA Future Learning Center	Sichuan Provincial Exemplary Cases of University Digital Resource Development in 2025	Provincial Second Award	Sichuan Provincial Education Informatization and Big Data Center (Sichuan Provincial Audio-Visual Education Center)	2025
35	Orthodontic Digital-Intelligent Innovation Platform for Experimental Teaching	Top Ten Typical Cases of Digital Campus Application Scenarios in Higher Education in 2024	Provincial	Sichuan Provincial Department of Education	2024

36	GPT Large Model-Based Intelligent Triage and Clinical Decision Support System for Stomatology	The 7th Intelligent Medical Innovation Competition - Sichuan Regional Competition	Provincial First Award	Sichuan Provincial Health Information Society	2024
37	Virtual Simulation Experiment for Root Canal Therapy	First-Class Undergraduate Course in Virtual Simulation Experimental Teaching	Provincial	Sichuan Provincial Department of Education	2022
38	Virtual Simulation Training for Porcelain Buildup Skills in Stomatological Technology	First-Class Undergraduate Course in Virtual Simulation Experimental Teaching	Provincial	Sichuan Provincial Department of Education	2022

2. Third-Party Evaluation: Present evaluations received by the case regarding its application effects, innovative practices, etc., such as user evaluations, expert review opinions, third-party testing and certification, positive public opinions, etc. (If available, the evaluation subject, information source, and other relevant supporting documents should be specified).

Social and media reviews

(1) In April 2025, CCTV's Oriental Horizon program reported on our institution's active efforts to deepen the integration of AI technology with medical education. The report highlighted the application of the "WCSS Zhilian Large Model" in advancing teaching upgrades, demonstrating our commitment to independently cultivating a greater number of interdisciplinary top-notch innovative talents adapted to technological development.

News link: https://www.hxkq.org/Html/News/Articles/15828.html

(2) In June 2025, China Global Television Network (CGTN) reported on the International Training Workshop on Minimally Invasive and Digital Technologies in Cariology and Endodontics hosted by our institution. The event brought together 20 professionals from 13 countries along the Belt and Road. Focusing on AI-assisted diagnosis and treatment, CAD/CAM restoration, and pulp regeneration, offering hands-on experience with the latest in minimally invasive dental technologies. The program not only showcased cutting-edge techniques but also fostered global collaboration in the field of oral health.

News link: https://news.cgtn.com/news/2025-06-24/International-workshop-on-cutting-edge-dentistry-held-in-Chengdu-1EsC2rltZv2/p.html

(3) In December 2025, Health News reported on the development and application of the world's first clinical-grade multimodal large model for oral pathology — HXDental-PathAI, marking a new advancement in intelligent stomatology. Jointly developed by the Department of Pathology at our institution and Westlake University, this model integrates specialized oral pathology knowledge with frontier artificial intelligence technologies. It supports interactive intelligent diagnosis of common oral tumor subtypes and oral diseases, signifying a paradigm shift toward a "human-AI co-intelligence" model in oral pathology diagnosis.

News link: https://hxkq.org/Html/News/Articles/17318.html

【专题】引领“人机共智” 华西口腔医院研发应用多模态口腔病理大模型

健康报 2025年12月9日 17:47 北京

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近期，临床级多模态口腔病理大模型HXDental-PathAI正式在四川大学华西口腔医院病理科应用。该模型由华西口腔医院病理科与西湖大学共同研发，深度融合口腔病理专业知识与前沿人工智能技术，支持常见口腔肿瘤亚型及口腔疾病的互动式智能诊断，该模型的应用标志着医院口腔病理诊断向“人机共智”新范式转型。

(4) In June 2024, Sichuan Satellite TV reported on the event titled "28 Dentists from 7 Countries along the 'Belt and Road' Gather at West China School/Hospital of Stomatology, Sichuan University:

The Era of Precision Digital Orthodontic Diagnosis and Treatment Begins with the 'Teeth'." This training workshop brought together 28 participants from 7 countries, namely Russia, Thailand, Laos, Vietnam, Syria, Malaysia, and Singapore. The training workshop focused on key theoretical knowledge and practical operational skills in precision digital orthodontic diagnosis and treatment. It aimed to promote the application and development of products with independent intellectual property rights in countries along the 'Belt and Road' and beyond, thereby enhancing China's technological influence in the field of orthodontics within these partner nation.

News link: https://www.163.com/v/video/VT2S19PQC.html

(5) In January 2024, Sichuan News reported on a summary and promotion conference convened by our institution regarding the National Demonstration Center for Experimental Teaching. During the conference, Professor Han Xianglong shared experiences, introducing the virtual simulation experimental teaching projects at the National Demonstration Center for Experimental Teaching and elaborating on strategies to enhance students' clinical operational skills and cultivate their clinical reasoning.

News link: https://www.scu.edu.cn/info/1202/27371.htm

(6) In April 2025, the National Teacher-Student Information Literacy Improvement Practical Activity(Higher Education Special Project) organized by the Center for Educational Technology and Resource Development, Ministry of Education, P.R.China (National Center for Educational Technology, NCET) was held in Guangzhou. Professor Han Xianglong was invited to deliver a presentation titled "Constructing a New Paradigm of Experimental Stomatology Teaching through Digital-Intelligent Integration: A Case Study of Innovations in Orthodontic Virtual Simulation Experiments." The presentation shared the "West China Stomatology experience" in the digital transformation of stomatology education.

News link: https://www.hxkq.org/Html/News/Articles/15906.html

Case 82

St. Clair College using AI-Assisted Robots to Help Students Gain Independence

Bassem Shehata

St. Clair College, Windsor, Canada

Background

In the field of post-secondary education, a significant challenge is ensuring equitable access and successful integration for students with developmental disabilities or significant learning challenges. Traditional educational environments can be socially and academically intimidating, creating barriers that hinder these students' ability to develop crucial life skills and achieve their academic goals. In Canada, the Community Integration Through Cooperative Education (CICE) program addresses this need by providing a supportive pathway for these students to earn a post-secondary education. However, there remains a necessity for innovative tools that can foster independence, reduce anxiety, and facilitate both academic participation and social integration.

To address these challenges, St. Clair College implemented a project with the objective of using technology to dismantle these barriers. The initiative aims to provide CICE students with a sense of security and autonomy within the college environment. By integrating Temi Robots into the program, the institution seeks to create a more inclusive learning landscape. The implementation objective is to leverage this technology to assist students in navigating the campus, completing academic tasks like presentations, and enhancing their social interactions, thereby supporting their journey toward greater independence and successful post-secondary outcomes.

Case Implementation Status

The implementation of the Temi Robots at St. Clair College is a structured initiative involving multiple phases, from initial needs analysis to collaborative development and ongoing application optimization.

1. Demand Analysis:

The primary need was identified by faculty within the CICE program, who observed that the college environment could be "very intimidating" for students with developmental disabilities or significant learning challenges. The goal was to find a solution that could provide a "sense of security" and actively help in removing both academic and social barriers. The core requirements were a tool that could assist with:

- **Academic Tasks:** Helping with assignments and delivering presentations.
- **Socialization:** Serving as a non-judgmental companion to ease social interactions.
- **Navigation:** Guiding students to their classes across the campus.
- **Independence:** Allowing students to perform tasks they might have never done before on their own.

2. Technology Research and Development or Personalized Customization:

Rather than using the Temi Robots as off-the-shelf devices, St. Clair College fostered a unique cross-program partnership for customization. Students from the ENACTUS program, specifically robotics and mobile app development students, are actively involved in preparing and enhancing the robots. This collaboration allows for a high degree of personalization.

- **Robotics Students:** They are responsible for the "sequencing" of the robots. For a presentation, this involves programming the robot to deliver the student's content in a structured, step-by-step manner. For navigation, they create and save digital maps of the campus routes.
- **Mobile App Students:** They develop custom mobile applications tailored to help CICE students. This approach allows the college to create bespoke solutions that fit the exact needs of their student population, rather than relying on a generic, existing platform.

3. Application Optimization:

The application of the robots has been optimized for two key environments: inside the classroom and outside the classroom.

- **Inside the Classroom (Academic Barrier Removal):** The robots were used to help students complete assignments. A notable optimization is for presentations. Faculty members can sequence a student's entire presentation onto the robot. The robot then acts as the presenter, effectively removing the significant barrier of public speaking anxiety. This allows the student to participate in the assignment without the stress of standing in front of the class.
- **Outside the Classroom (Physical & Social Navigation):** The robots were used as autonomous guides. The process involves faculty or students from ENACTUS first mapping and "teaching" the robot a specific route across campus. This map is saved. A CICE student can then select that map, and the robot will lead them to their next class, reducing the anxiety of getting lost in a large institution. This feature also provides a "sense of security," as the robot serves as a familiar and supportive presence during transitions.

Case Innovation and Breakthroughs

1. Main Innovation Content:

The primary innovation lies in the novel educational and teaching model created through

through cross-program collaboration. Instead of simply purchasing and deploying assistive technology, St. Clair College has integrated the technology into the curriculum itself. The ENACTUS (robotics and mobile app) students are not just building tools for the CICE students; they are actively participating in a service-learning model where their academic projects have a direct, tangible, and immediate impact on fellow students. This creates a symbiotic relationship:

- **For CICE students:** They receive personalized, high-tech support that empowers them to overcome specific barriers.
- **For ENACTUS students:** They gain invaluable, real-world experience in user-centered design, problem-solving, and application development, seeing their work "make change" in the community. This transforms technology from a passive tool into an active bridge between different academic disciplines and student populations.

2. Technology Breakthrough Content:

The case does not describe the development of new technology or a breakthrough in the robot's core AI. Instead, the innovation is in the application and integration of existing technology (Temi Robots) within a specific educational context. The technical level of the case in the industry is significant due to its successful, multi-departmental implementation model, which could serve as a blueprint for other institutions looking to maximize the impact of educational technology.

3. Application Practice Breakthrough Content:

The key breakthrough in application practice is the democratization of technology development. By having students (from ENACTUS) create the apps and prepare the robots, the college ensures the solutions are highly relevant and user-centered. This is a departure from top-down technology implementation, where institutions purchase a solution and force it into the classroom. Here, the end-users (CICE students) are supported by peer-developers who understand their needs. This model achieves:

- **Personalization:** Apps and robot functions are built from the ground up for the specific needs of St. Clair's CICE students.
- **Scalability of Expertise:** The ENACTUS program becomes a sustainable source of technical support and innovation for the CICE program.
- **Empowerment:** It empowers not only the CICE students who use the robots but also the ENACTUS students who become agents of change, directly contributing to a more inclusive campus.

Promotion Value and Risks

1. Application Prospects and Achievements:

Until November 2021, the application scale was focused on the CICE program at St. Clair College, which is one of 13 such programs in the province. Of the 24 colleges in the province, St. Clair was the only one using this specific Temi Robot model.

2. Social and Economic Value:

- **Social Value:** The initiative has profound social value. It promotes equity and inclusion by actively removing barriers for students with disabilities. It fosters a campus culture of empathy and collaboration, as students from different programs work together. It empowers students to achieve independence and succeed in post-secondary education, which can have a lasting impact on their life trajectory.
- **Economic Value:** The model creates economic value by utilizing existing student talent (ENACTUS) to develop and maintain solutions, reducing the need for expensive external consultants. It enhances the reputation of St. Clair College as an innovative and inclusive institution, which can be a factor in attracting students and funding.

3. Demonstration and Leading Role:

This case serves as a leading example of how educational institutions can leverage technology to create a truly integrated and supportive learning environment. Its demonstration role is significant because it moves beyond viewing technology as a mere tool. It showcases a holistic model where:

- Technology supports students with specific learning challenges.
- The development of that technology is embedded into the curriculum of other programs.
- Students become active participants in the solution, driving both their own learning and the success of their peers.
- This model is replicable and scalable in various educational contexts, from K-12 to other post-secondary institutions.

4. Potential Risks:

- **Technical Risks:** The robots are dependent on battery life, Wi-Fi connectivity, and software stability. A robot failing mid-route or during a presentation could cause distress to the student. Over-reliance on the technology could also be a risk if the robots are unavailable.
- **Ethical Risks:** There is a potential for stigma if the use of the robots is seen by other students as "othering" the CICE participants. Data privacy is another ethical consideration, as the robots map routes and may record interactions. It is crucial to have clear policies on data collection, storage, and usage to protect student privacy.

The case has been reported in the media:
https://www.ctvnews.ca/windsor/article/st-clair-college-using-technology-to-help-students-gain-independence/

Case 83

AI-Driven Embodied and Situated Pedagogy: Reconfiguring Higher-Order Innovative Thinking in Higher Education Students

Ying GUO

Tianjin University

Background

In the era of digital intelligence, higher education systems are confronted with a structural misalignment between approaches to cultivating students' thinking and their learning behavior patterns. While the unprecedented accessibility of information has improved learning efficiency, it has, to some extent, weakened students' capacity for deep thinking and proactive inquiry, resulting in a growing tendency toward dependency and "surface-level depth" in learning. Students increasingly rely on AI-assisted tools to obtain direct answers, neglecting the underlying causes and intrinsic logic of problems, which in turn induces cognitive inertia.

Moreover, traditional classroom models remain largely centered on knowledge transmission and standardized assessment, lacking contextualized and multidimensional exploration of problems. As a result, students struggle to develop embodied cognitive construction and transfer their knowledge in complex problem-solving contexts, making it difficult to cultivate higher-order cognitive abilities such as critical thinking and creativity required in the new era.

With the integration of artificial intelligence into education systems, there is an urgent global need to shift teaching paradigms from a "knowledge-oriented" approach to a "thinking-oriented" one. In response to increasingly diverse and personalized learning needs, higher education must adopt adaptive, dynamically regulated teaching models that are closely aligned with societal demands. This case aims to develop an AI-driven, metaverse-enabled embodied and contextualized teaching model, strengthening students' deep thinking and innovation capabilities, and providing a replicable, scalable and transferable pathway for global educational transformation.

Case Implementation Status

1. Personalized Customization: Student Profiling and Adaptive Learning Pathways in the Digital Intelligence Era

In the digital intelligence era, students are able to access, analyze and integrate cross-disciplinary information through current technological environments. However, their understanding of problems often exhibits a tendency toward "surface-level depth" whereby cognitive processing that should be internally by students themselves is outsourced to AI tools, resulting in insufficient depth of understanding and a lack of proactive innovation.

To address this issue, this case develops differentiated learning tasks based on individual student profiles, breaking away from the traditional one-size-fits-all teaching model. By leveraging a multimodal virtual resource repository, the system dynamically recommends personalized learning resources and adaptive pathways to better support individualized learning needs.

2. Needs Analysis: Teaching Reconstruction Oriented Toward Thinking Development

Based on student learning profiles, this case constructs a teaching pathway of "scenario-driven, task-oriented and practice-based learning" and establishes three core instructional objectives: fostering proactive innovation, promoting cross-domain integration of AI technologies and cultivating higher-order thinking skills.

Furthermore, it clearly defines the key stages and degree of AI intervention, forming a human-AI collaborative teaching model driven by intelligent innovation as the internal mechanism and realized through contextualized and immersive learning experiences.

3. Technology Development: Multimodal Intelligent Teaching Support System

Aligned with the instructional objectives, this case identifies key challenges in current student learning behaviors, including increasing dependency on technology, superficial engagement, insufficient participation in higher-order thinking, lack of contextual support in teaching, and limited dynamic regulation of the learning process.

To address these issues, a two-phase instructional structure (in-class and extracurricular) is established, reconstructing the full-cycle teaching process across pre-class, in-class and post-class stages. Through the integration of metaverse-based experiential environments, a three-level progressive teaching framework-including cognitive layer, experiential layer and validation layer-is developed. Specifically, large language models and related AI technologies are employed to generate multi-modal learning scenarios (including text, images, video and interactive products), facilitating the development of higher-order thinking. In addition, a VR-based human–AI collaborative immersive learning environment is constructed to enhance embodied cognition and stimulate proactive innovation among students.

Table 1 AI-Driven Situated Innovative Thinking Teaching Implementation Framework

Teaching Stage	Instructional Design	Technological Mechanism	Key Activities	Cognitive Mechanism
Pre-class (Cognitive Level)	Metaverse-based scenario construction and problem exploration	AI-generated learning scenarios+learning profile tracking	Role-playing	Activation of students' problem awareness

Teaching Stage	Instructional Design	Technological Mechanism	Key Activities	Cognitive Mechanism
In-class 1 (Experiential Level)	Problem construction and in-depth analysis; metaverse scenario immersion	AI-assisted problem decomposition+solution exploration (AI interactive Q&A); VR virtual environment (ChatGPT)	Group discussion and problem structuring	Logic construction
In-class 2 (Experiential Level)	Knowledge transfer and conceptual innovation	AI-supported solution exploration (Seedance)	Multi-solution design, presentation and optimization	Critical thinking
Post-class (Validation Level)	Technical support and practical implementation	AI-supported solution generation and refinement (VR/UE/Unity)	Competitions and project development	Creative thinking generation; metacognitive enhancement

4. Teaching Implementation: Scenario and Task-Driven Metaverse Classroom

In practical implementation, the teaching process is restructured across pre-class, in-class and post-class stages. A two-phase, three-level instructional framework—comprising the cognitive layer, experiential layer and validation layer—is established based on temporal progression and task segmentation.

The first phase corresponds to the in-class stage, covering both the cognitive and experiential layers. In the cognitive layer, students are guided to construct virtual roles and develop corresponding role profiles. Adopting these roles, they utilize AI tools for information mining to define research problems, facilitating knowledge transfer and deepening of thinking. This is followed by the experiential layer, where students engage in embodied experiences within a teacher-designed metaverse environment, exploring the underlying causes of problems and constructing potential solutions.

The second phase corresponds to the post-class stage, namely the validation layer. After in-depth problem analysis, students are guided to produce practical outputs through project-based learning or competition-based formats. Within this new instructional framework, teachers and students collaboratively complete conceptual understanding and technological exploration during class time, while post-class activities focus on project-based implementation and application.

5. Application Optimization: Dynamically Driven Iterative Mechanism

During implementation, the system is continuously optimized based on students' personalized learning pathways and instructional feedback. The VR models are iteratively refined and narrative scenarios are expanded in response to evolving teaching needs, forming a dynamic, feedback-driven optimization mechanism.

Case Innovation and Breakthroughs

1. Main Innovation Content

This case achieves an effective integration of science and art, establishing a multimodal learning resource system that integrates text, images and virtual interaction-namely, a multimodal metaverse knowledge base. This system provides coordinated support for knowledge acquisition, contextual experience, problem construction and solution generation.

In addition, the case develops a cognition-oriented instructional mechanism centered on students' thinking development. It guides students in the appropriate use of AI tools, effectively preventing issues such as "cognitive outsourcing" and "surface-level depth" in learning.

Furthermore, a human-AI collaborative platform is developed, where scenario-driven and task-oriented approaches guide students to engage in embodied participation in problem construction and logical reasoning, thereby strengthening deep thinking and proactive innovation.

In summary, this case promotes the transformation of higher education in the digital intelligence era from a content-delivery paradigm to a model characterized by scenario-driven learning, human-AI collaboration, and cognitive construction. It achieves a dynamic balance between technological empowerment and cognitive agency, and establishes a new teaching paradigm for the digital age.

2. Technology Breakthrough Content

This case achieves systematic innovation and breakthroughs in educational and teaching models as well as technological applications. First, based on virtual reality (VR) technology, an immersive, teacher-student collaborative learning environment is constructed, embedding learning activities into interactive scenarios. This approach effectively enhances learners' embodied participation and contextual awareness, promotes the practical application of embodied cognition and establishes an integrated teaching mechanism of "perception–action–cognition".Specially in the field of design, it breaks through traditional technological constraints and plays a leading role in advancing industry technology.

Furthermore, the case integrates generative models with Unreal Engine (UE) modeling technologies to enable multimodal scenario generation and dynamic interaction. A "controlled intervention" mechanism is introduced to define the boundaries of AI participation, thereby preventing cognitive outsourcing.

These innovations facilitate a shift from passive knowledge input to active knowledge output, providing a key pathway for educational informatization and digital transformation. The resulting teaching model demonstrates strong scalability and is currently at a leading level within the domestic context.

3. Application Practice Breakthrough Content

At the level of teaching models, this case breaks through the constraints of traditional classroom time by extending learning into post-class project- and competition-based activities, emphasizing a complete practice loop from initial cognitive development to final outcome transformation. It constructs a novel instructional paradigm characterized by scenario-driven learning, task-oriented guidance and human–AI collaboration, moving beyond the conventional one-way model centered on knowledge transmission.

At the level of technological application, a human–AI collaborative learning environment is established, supported by a multimodal resource repository and a metaverse-based learning space. This approach transcends the superficial use of AI tools, effectively preventing cognitive outsourcing while reinforcing

students' roles as active cognitive agents.

At the level of cognitive development mechanisms, the case addresses the bottleneck in cultivating higher-order thinking in the context of AI integration. By introducing a "thinking evolution"–oriented framework and leveraging narrative-driven scenarios, it enhances the development of critical thinking, creativity, and other higher-order cognitive abilities.

Therefore, this case holds significant value for the future-oriented cultivation of talent in basic education and demonstrates strong potential for scalable implementation and as a model for human–AI collaborative digital teaching.

4. Intellectual Property Status

The relevant outcomes are centrally managed by the host institution and independently developed by the project team, providing a solid foundation for continuous iteration. The technical modules are designed with strong scalability and portability, enabling deployment across diverse disciplines and educational contexts.The major outcomes include a metaverse-based VR exhibition for history learning, an image generation system, cognitive games and therapeutic games. To date, four software copyrights have been obtained.

Promotion Value and Risks

This case is implemented through practice-oriented courses and is open to students from multiple disciplines. Since its implementation, it has promoted deep interdisciplinary integration and the coordinated development of project-based learning. Centered on real-world social issues, a series of multi-themed projects have been developed and implemented, including an animal rescue app, applications of green ecological materials, urban ecological regeneration, psychological healing, music cognition for the hearing-impaired and future-oriented design projects.In terms of application outcomes, the case has achieved a total of 26 awards, including 2 international awards, 2 national first prizes, and 5 national second prizes. In addition, four software copyrights have been granted, demonstrating the effective implementation of practice-based teaching.The case has initially established a replicable implementation pathway and provides a representative Chinese practice model for global digital education innovation, with strong potential for promotion across diverse fields worldwide.

This case establishes an AI-driven, scenario-based learning system that guides students to engage with and proactively respond to real-world or quasi-real-world societal challenges. It significantly enhances students' sense of social responsibility, depth of thinking and innovative capacity.

At the societal level, the case contributes to promoting the sharing of educational resources and improving the quality of talent cultivation. At the economic level, through an industry—academia—research integrated education model, it facilitates the transformation of teaching outcomes into real-world applications, aligns student projects with industry needs and fosters the effective integration of the education chain and the industrial chain.

This case achieves an innovative transformation of teaching paradigms in the era of digital intelligence, realizing deep integration between foundational cognitive development and technological application. By constructing an industry–academia–research integrated model characterized by scenario-driven learning, task-oriented guidance and human–AI collaboration, it promotes the development of

higher-order thinking and the comprehensive capability for translating learning outcomes into practical applications within digital contexts.

A VR-based immersive human–AI collaborative learning environment is established to facilitate the practical transformation of embodied cognitive experiences, enhancing students' ability to identify and explore problems. In addition, a multimodal AI-driven scenario resource database is developed, alongside clearly defined boundaries for AI intervention, guiding the appropriate use of AI tools and effectively preventing cognitive outsourcing.

The outcomes of this case contribute to shaping a new paradigm for talent cultivation in higher education in the digital intelligence era.

During the implementation of the case, particular attention should be paid to the topics selected by students, especially those related to psychological issues, with continuous monitoring of students' real-time emotional In addition, during project-based practice, it is important to closely observe whether students are over-reliant on AI tools and to ensure appropriate levels of AI usage to prevent excessive dependence.

Other Relevant Information

1.Case Award Status

Include the award time, award name, and awarding institution.

Recipient of 26 Competition Awards:

National College Digital Arts&Design Awards,First-, Second-, and Third-Class Awards in the National Finals； First-, Second-, and Third-Class Awards in the Tianjin Division,2022-2025

24th National College Student Robot Competition ROBOTAC 3D Digital Design Contest (Interaction Design Track),Third-Class Award, National Finals,2025

China Creative Challenges Contest, Second-Class Award, National Finals; Second- and Third-Class Awards, Tianjin Division,2022-2025

22th China University Robot Competition–ROBOTAC 3D,First-Class Award, National Finals,2023

Japan Concept Art Design Award (International Division),Bronze Award,2025

BICC China–UK International Creative Competition, Outstanding Award,2023

Outstanding Instructor:

National College Digital Art & Design Awards (NCDA); China Creative Challenges Contest; Japan Concept Art Design Award； BICC China–UK International Creative Competition

2.Third-Party Evaluation

Present evaluations received by the case regarding its application effects, innovative practices, etc., such as user evaluations, expert review opinions, third-party testing and certification, positive public opinions, etc. (If available, the evaluation subject, information source, and other relevant supporting documents should be specified).

Based on post-course feedback, students widely recognized that the course effectively fostered higher-order thinking and facilitated the integration and application of cross-disciplinary technologies.

Figure 1 Metaverse Virtual Learning Environment

Figure 2 Student Project Showcase

Figure 3 Supporting Certificates

Case 84

Cultivating Global Leadership for Educational Transformation Through Design Thinking and Intelligent Technologies – Global Competition on Design for Future Education (GCD4FE)

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Background

In response to the growing global learning crisis, UNESCO launched the Futures of Education initiative (2019) to rethink knowledge, learning, and education for a rapidly changing world. The UN Transforming Education Summit (2022) further consolidated global consensus on the urgent need for deep, systemic educational transformation. As the primary force driving future educational innovation and social progress, university students play an irreplaceable role in shaping inclusive, equitable, and sustainable education systems. Cultivating their leadership for educational transformation has therefore become a strategic priority to translate global commitments into real action.

However, higher education institutions worldwide still face profound and persistent challenges in this endeavor. Many universities lack a systematic, competency-based training framework for educational change leadership. Educators often lack up to date knowledge of digital transformation, design thinking, and AI applications in education. Students are provided few authentic, project-based platforms to practice innovative problem-solving. Meanwhile, limited cross-border collaboration, weak global networking, and insufficient industry academia integration further restrict students' global competence and practical capacity.

To tackle these bottlenecks, Beijing Normal University and the UNESCO Institute for Information Technology in Education jointly launched the Global Competition on Design for Future Education (GCD4FE). This initiative builds an open, global practice platform for educational innovation. It empowers young people worldwide to understand educational transformation, apply design thinking and intelligent technologies to address real educational challenges, and grow into active promoters and practitioners of education reform. The project aims to establish a replicable, scalable model for nurturing global leadership for educational transformation.

Case Implementation Status

This case establishes a global leadership development system for educational transformation grounded in design thinking and intelligent technologies, centered on the GCD4FE platform. After years of practice, it has achieved four core outcomes.

1. Theoretical System: NCIP Design Methodology for Educational Change

Against global educational transformation priorities, the research team has built a systematic theoretical system centered on the NCIP Design Methodology and a supporting international curriculum. Focusing on high-profile global educational issues and aligned with UNESCO Sustainable Development Goals, the team has developed forward-looking theories including Three Levels of Smart Education, Nine-Grid Map, Butterfly Effect Model, Two-Way Empowerment of Technology and Education, and Six Themes of Future Educational Transformation. These outcomes have been published in bilingual works such as Artificial Intelligence and the Future of Education, forming a comprehensive Global Educational Transformation Issue Bank that anchors student innovation in real-world challenges and key trends.

By integrating Stanford EDIPT, IDEO 3I model, and NetDragon Design Methodology, the team pioneered the education-specific NCIP (Needs–Context–Ideation–Meaning Presentation) framework. It covers need assessment, context identification, user/stakeholder analysis, competitor review, and function definition, offering a human-centered, structured workflow for solving complex educational problems.

Working with over 30 experts from 7 countries, the team developed the international Design and Learning curriculum system, including a Chinese textbook, an English monograph Envisioning the Future of Education Through Design, and AI-enhanced bilingual MOOCs. Together, these provide new content for innovation and entrepreneurship education and a dedicated methodology to support cross-disciplinary youth in addressing global educational challenges.

Figure 1 Cover and Partial Table of Contents of the Chinese Textbook *Design and Learning.*

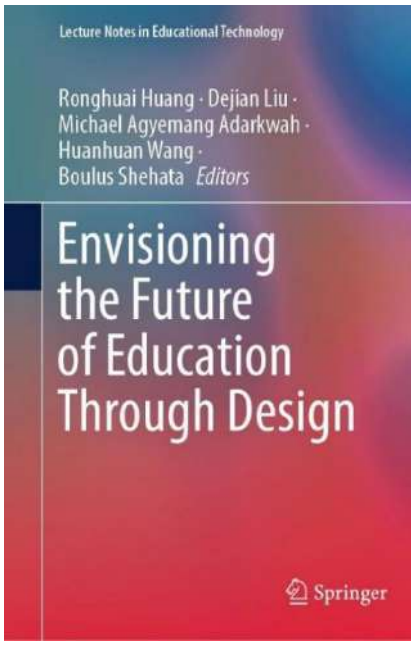

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Figure 2 Cover and Partial Table of Contents of the English Monograph *Envisioning the Future of Education Through Design*

Figure 3 *Design and Learning MOOC*

2. Practical System: Human–AI Collaborative Innovation Literacy

Supported by the UNESCO Chair on AI and Education and a series of national and provincial research projects, this case has established a systematic human–AI collaborative innovation system that elevates education from simple tool use to targeted literacy development for intelligent-era talents. Focused on the goal of smart education, the research team constructed a complete human–AI collaborative innovation process covering independent thinking, problem identification, AI tool selection, human–AI interaction, output comparison, strategy optimization, ethical reflection, and knowledge transfer. This process provides clear guidance for teachers to supervise students in using AI appropriately and creatively.

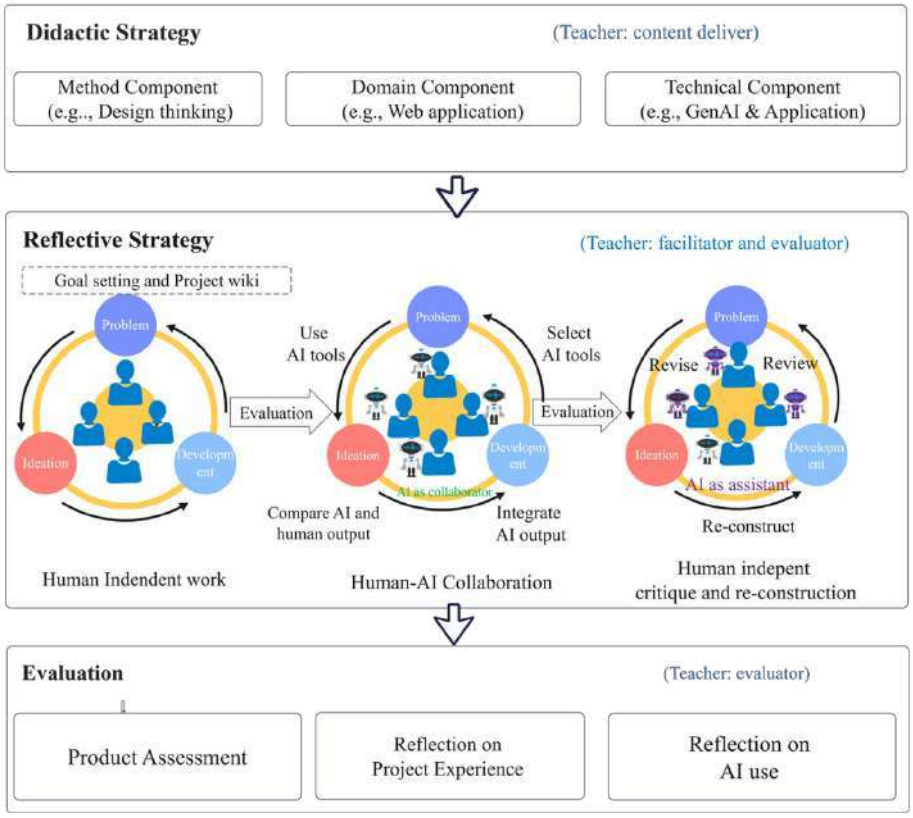

Figure 4 Teaching Process of Human–AI Collaborative Innovation.

The team further proposed the iSTAR collaborative teaching framework (intelligent, Student, Teacher, AI, Robot), which centers on human teachers and integrates three types of intelligent technologies to form a multi-scenario collaborative network across physical, virtual, and hybrid spaces. It defines four progressive collaboration levels from basic tool operation to complex human–AI synergy, with ethics embedded throughout design, teaching, and assessment.

To support real-world practice, the team identified 10 AI-enabled educational design scenarios and built a self-developed platform integrating more than 500 GenAI tools. It also created an AI teaching assistant with a continuously updated knowledge base and five specialized AI mentors for writing, creativity, design, education policy, and solution evaluation. This intelligent environment has served over 10,000 students, enabling personalized guidance, real-time feedback, and responsible innovation throughout the design process.

3. Training Model: Course–Bootcamp–Competition Integrated Pathway

This case has established a progressive, spiral-upgrading global leadership development model that deeply integrates courses, bootcamps, and global design marathons into a unified system of "theoretical empowerment, practice-driven growth, and challenge-based elevation." Guided by the core mission of nurturing talent through innovation education, the model creates a seamless pathway: theoretical understanding → targeted skill building → integrated practice.

A large-scale blended curriculum has been delivered since 2017 at more than 20 universities, including Beijing Normal University, Harvard University, and Central Academy of Fine Arts. It equips students from over 40 countries with solid foundations in educational transformation and systematic mastery of the NCIP design methodology, with course satisfaction exceeding 95%.

Figure 5 Professor Dejian LIU Teaching “Design Methodology” at Harvard University .

More than 40 frontier-themed bootcamps have been held worldwide in China, Croatia, Maldives, Republic of Korea, the Philippines, Tunisia, Serbia, and other countries, focusing on design thinking, GenAI, and AI agent development to turn theory into actionable skills.

Figure 6 Webinar: Innovation, Design and Learning.

Figure 7 Offline Bootcamps Held in Maldives, Croatia, Republic of Korea, and the Philippines.

Since 2018, the annual **48-hour Global Design Marathon** of the GCD4FE has been organized for eight consecutive years. Centered on the vision of "harmonious coexistence," it motivates students to address real educational challenges through human–human and human–AI collaboration. Evidence shows that over 90% of participants achieve significant and sustained improvement in topic selection, design, and presentation. This integrated model sharpens students' problem awareness, creativity, teamwork, cross-cultural competence, and global leadership, unifying knowledge, capabilities, and literacy.

Figure 8 Global Competition on Design for Future Education 48H Design Marathon (2025).

4. Impact Ecosystem: From Creative Ideas to Real-World Impact

Drawing on extensive experience in industry–education integration, the project has built a global, high-level collaborative mentoring network that brings together over 200 international experts from Beijing Normal University, UNESCO IITE, leading enterprises including Huawei, Tencent, Alibaba, and NetDragon, as well as professional institutions. More than 40% of these mentors are industry

practitioners, who embed real-world needs and cutting-edge trends into teaching and competition design to align talent development with global educational transformation.

This initiative has cultivated a transnational, inter-university, and interdisciplinary innovation community, engaging more than 10,000 students from over 40 countries and 600 universities. Guided by mentors, students have developed more than 3,000 forward-looking and practical educational solutions through cross-cultural and cross-disciplinary teamwork.

To maximize impact, the project has established a full-chain innovation ecosystem covering **patents, publications, and enterprise incubation**. More than 30 outcomes have been patented or published in international case collections, with outstanding works showcased at the Global Smart Education Conference and featured in the UNESCO IITE E-Library. The project has successfully incubated high-impact edtech startups such as *One Child Vision*, and supported students in translating ideas into sustainable careers. Surveys show that over 30% of active participants pursue careers in educational technology and social innovation, making innovation education a powerful catalyst for long-term professional growth.

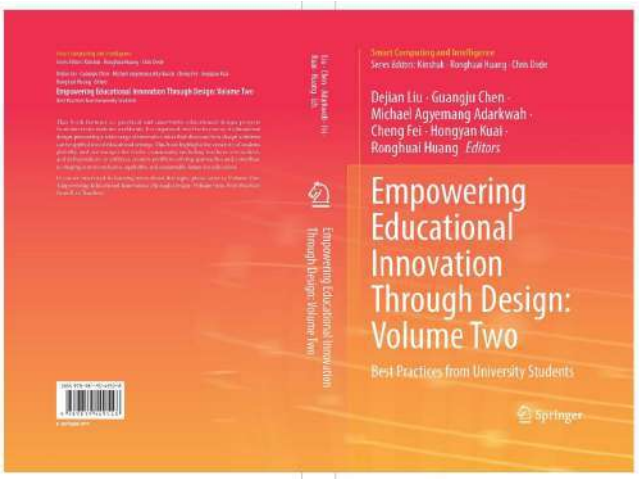

Figure 9 *Empowering Educational Innovation Through Design: Best Practices from University Students* (Published by Springer).

Figure 10 Young Students Forming Transnational, Inter-university, and Interdisciplinary Teams to Design Educational Innovation Solutions.

Case Innovation and Breakthroughs

1. Theoretical Innovation

Global efforts to cultivate leadership for educational transformation are widely challenged by the lack of context specific, education oriented design theories and standardized analytical frameworks. Traditional design thinking models are often generic and fail to address the systemic, human centered complexity of educational change. This project makes a fundamental theoretical breakthrough by creating and validating the NCIP Design Methodology, the first education tailored design framework that systematically integrates needs assessment, contextual analysis, ideation, and meaningful presentation.

Unlike general design models, NCIP is built to resolve real world educational dilemmas and support cross disciplinary youth collaboration. It has been verified through research programs, published in high impact monographs, and adopted by universities worldwide.

By establishing a global educational transformation issue bank and forward looking theoretical models such as the Three Levels of Smart Education and technology–education two way empowerment, the project fills critical gaps in design driven educational innovation theory and provides a solid knowledge foundation for cultivating future oriented educational change leaders.

2. Methodological Innovation

A core global challenge in leadership development is the outdated mindset that reduces AI education to tool operation rather than higher order collaborative literacy. This case achieves a paradigm shift by advancing a human–AI collaborative innovation system that redefines talent cultivation from “learning to use AI” to “learning to innovate with AI.”

Supported by the UNESCO Chair on AI and Education, the project establishes a complete human–AI collaborative workflow covering independent thinking, AI interaction, output comparison, ethical reflection, and knowledge transfer. It also proposes the iSTAR teaching framework, which centers on human teachers and structures progressive collaboration from basic tool use to complex human–AI synergy.

To ground these methods in practice, the team identified 10 representative GenAI application scenarios in education and developed an integrated platform with more than 500 GenAI tools, AI teaching assistants, and specialized AI mentors. These methodological innovations enable responsible, creative, and sustainable human–AI collaboration, equipping students with the core literacy required to lead education in the intelligent era.

3. Model Innovation

Most leadership programs remain fragmented across separate courses, competitions, and training activities, resulting in weak coherence and low practical impact. This project pioneers a deeply integrated course–bootcamp–competition trinity model that reconstructs the logic of leadership development.

It moves beyond fragmented skill training to build a spiral pathway: theoretical grounding → intensive skill upgrading → high intensity comprehensive practice. Systematic blended courses establish theoretical mastery of educational change and design methods. Frontier bootcamps held globally translate theories into operational skills. The annual 48 hour global design marathon fosters problem awareness, creativity, cross cultural teamwork, and global leadership under real world pressure.

This model unifies knowledge, capability, and values, fully embodying the people centered mission of education. It achieves sustained, measurable improvement in students' innovative performance and effectively addresses the long standing problem of disconnected learning and practice in global leadership education.

4. Ecosystem Innovation

A key bottleneck in global educational leadership development is insufficient industry engagement, limited international collaboration, and weak translation from ideas to real impact. This project breaks through traditional models by building a transnational, cross sector co creation ecosystem that transforms one way resource input into genuine multi stakeholder partnership.

The network brings together more than 200 distinguished mentors from universities, UNESCO IITE, and leading tech enterprises, with industry practitioners accounting for over 40%. These experts deeply participate in teaching, mentoring, and evaluation rather than only serving as judges. The ecosystem supports a vibrant community of over 10,000 students from more than 40 countries and 600 universities, who collaborate across borders, institutions, and disciplines to produce more than 3,000 practical educational solutions.

By linking innovation to patenting, publishing, and enterprise incubation, the project turns creative ideas into social and economic value. This replicable, scalable ecosystem provides a new global model for empowering youth to drive sustainable educational transformation.

5. Intellectual Property Status

The project has formed a comprehensive, well protected intellectual property portfolio that underpins its global scalability and long term impact.

Outcomes include the NCIP methodology, bilingual curriculum systems, authoritative textbooks, internationally published monographs, bilingual MOOCs, student case collections, and patented technological applications. More than 30 innovative solutions have been granted official design and invention patents. All intellectual property, including frameworks, curricula, platforms, publications, and patents, is legally owned by Beijing Normal University and its core partners. Rigorous IP management ensures stable, standardized, and sustainable global promotion.

These achievements not only protect the project's innovations but also provide reliable conditions for wide replication, international cooperation, and continuous upgrading in the field of educational transformation leadership.

Promotion Value and Risks

1. Global Reach and Scalability

This case has achieved extensive global influence and strong scalability through a multi-channel dissemination system. The NCIP design methodology and the Design and Learning curriculum system have been widely promoted worldwide through textbooks, English monographs, and bilingual MOOCs. They have been implemented and applied at more than 20 world-renowned universities, including Harvard University and Beijing Normal University.

Supported by the **Global Competition on Design for Future Education (GCD4FE)**, the project has built a global practice network covering more than 40 countries and regions, over 600 universities, and more than 10,000 young participants. As a typical theoretical and practical model originated from China, it provides a replicable, scalable solution for global higher education innovation and digital transformation in education.

2. Social and Economic Value

The project has delivered remarkable social and economic value. Data shows that over 90% of students have achieved significant and continuous progress in topic selection, design, and presentation. Their global competence, critical thinking, creative problem-solving, human–AI collaboration, and communication skills have been greatly improved, with participant satisfaction exceeding 95%.

Up to now, more than 30 student innovation solutions have been patented or published in international case collections. The project has successfully incubated influential edtech enterprises such as One Child Vision, realizing the transformation from innovative ideas to real industrial value.

Tracking surveys indicate that more than 30% of deeply engaged participants have entered the fields of educational technology and social innovation, which strongly proves the long-term driving effect of the project on youth career development.

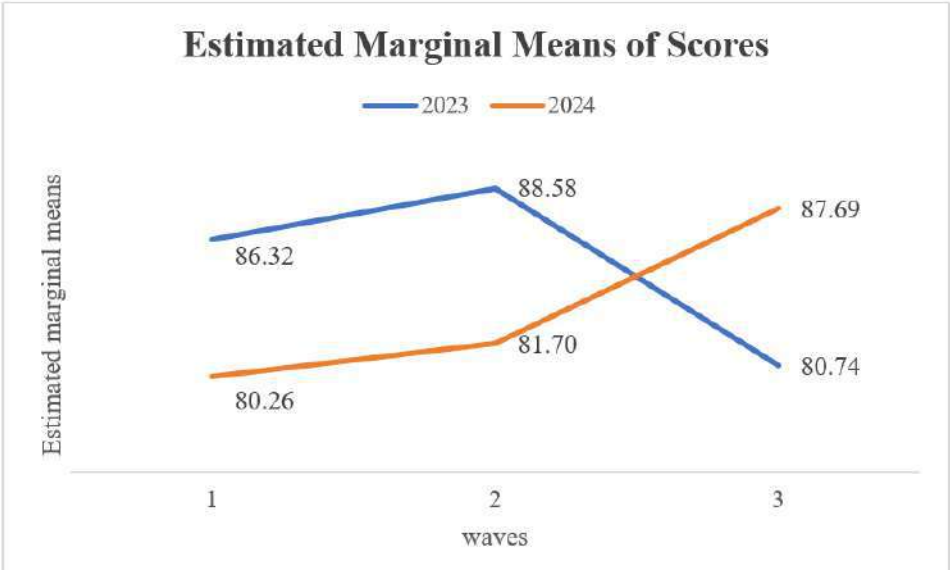

Figure 11 Students' Significant Score Improvements in Topic Selection, Design, and Presentation

3.Demonstration and Leadership

This case sets a benchmark for scenario-driven AI-enabled educational innovation worldwide. It integrates global competitions, cross-cultural collaboration, and real-world problem-solving, forming a complete and replicable implementation path for digital and intelligent transformation in both basic education and higher education. It provides a valuable reference for global universities to carry out educational reform, cultivate innovative talents, and promote the deep integration of technology and education.

4.Potential Risks

Potential risks mainly include three aspects. First, **technical risks**: continuous updates of generative AI tools require long-term platform maintenance and dynamic curriculum adaptation. Second, **ethical risks**: human–AI collaboration must strictly abide by norms such as data privacy, algorithm transparency, and responsible innovation to avoid technology abuse. Third, **implementation risks**: cross-cultural promotion needs flexible localization of training content, organization methods, and evaluation standards to ensure effective landing in different regions.

Other Relevant Information

1. Bilingual Design and Learning MOOCs (XuetangX / YouTube)

https://www.xuetangx.com/course/bnu13051011055/23905078

https://www.youtube.com/watch?v=3m6qi4J_FDA&list=PLfSzu6KzIsXDMKCMVVNtO7bdi8GmiajJX

2. GCD4FE official website with AI assistant

https://gcd4fe.bnu.edu.cn/

3. Overseas AIGC-enabled education bootcamps (Maldives, Croatia, Tunisia, Korea, Philippines, etc.)

https://gcd4fe.bnu.edu.cn/spa/#/trends/6698ccf39d464800208d99c7

https://gcd4fe.bnu.edu.cn/spa/#/trends/667411e0e1564c00205beb1f

https://mp.weixin.qq.com/s/_P5Ql7FV54g7RWhzczfHnQ

mp.weixin.qq.com/s/EcIN6Yj5RvoPGD5MKsUndQ

https://mp.weixin.qq.com/s/MRu6K7nyJKoQEIibo9tUWQ

4. Competition reports and media coverage (People's Daily Online, China Education Daily, etc.)

2022

China Youth Daily: https://s.cyol.com/articles/2022-07/26/content_r2pvJLI3.html?gid=VnDMvYk4

2024

People's Daily Online: http://edu.people.com.cn/n1/2024/0801/c367001-40290710.html

China Education Television (CETV): https://m.cetv.cn/p/519769.html

China Education Daily: http://m.jyb.cn/rmtzcg/xwy/wzxw/202408/t20240801_2111229436_wap.html

2025

Beijing Normal University:

https://news.bnu.edu.cn//zx/zhxw/f8737bf49f5141ec9e69458a125b3df7.htm

University of Maribor: https://feri.um.si/novice/ekipa-um-feri-in-pef-med-najboljsimi-na-svetu-srebro-na-8-svetovnem-tekmovanju-o-prihodnosti-izobrazevanja-gcd4fe-hi/

Ministry of Foreign Affairs of the People's Republic of China:

https://www.fmprc.gov.cn/web/gjhdq_676201/gj_676203/yz_676205/1206_676452/1206x2_676472/202507/t20250703_11664257.shtml

Consulate in Laoag: https://mp.weixin.qq.com/s/rDtNunAW7UmCfcVDbgHTAQ

Case 85

From Technology to Pedagogy in FramerSpace: AI-Enhanced Learning Experiences and Education for Peace and Sustainable Development

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Introduction

The twenty-first century has confronted humanity with an unprecedented convergence of crises including armed conflict, climate breakdown, and the erosion of democratic norms, collectively challenging the foundations of peaceful and sustainable coexistence. In response, the international community has increasingly recognised education as a force capable of reshaping values, fostering empathy, and cultivating the dispositions necessary for active global citizenship. Sustainable Development Goal 4, Target 7 (SDG 4.7) embodies this recognition, calling on all nations to ensure that learners acquire the knowledge and skills necessary to promote sustainable development, a culture of peace and non-violence, global citizenship, and appreciation of cultural diversity (United Nations, 2015), positioning education for peace and sustainable development (EPSD) as constitutive of the broader sustainable development agenda.

The translation of this vision into effective pedagogical practice, however, remains a persistent challenge. Traditional educational models have proven ill-suited to cultivating critical reflection, social-emotional competence, intercultural understanding, and commitment to non-violence across diverse cultural, linguistic, and socioeconomic contexts (Mezirow, 1991; UNESCO MGIEP, 2019). The rapid advancement of artificial intelligence (AI) and Learning Experience Platforms (LXPs), distinguished by their learner-centred and adaptive architectures, has opened new possibilities for the personalised, scalable education that SDG 4.7 demands (Holmes et al., 2019). A critical gap, however, persists: the

AIED literature has developed largely in mainstream academic contexts, with limited attention to EPSD, where learner responses are frequently value-laden, affectively charged, and culturally situated (Holmes et al., 2022; UNESCO, 2021).

FramerSpace, an AI-powered co-creation LXP, represents a substantive attempt to address this gap by embedding AI across multiple dimensions of the learning experience. Its organising premise, that technology must remain subordinate to pedagogy, provides the conceptual anchor of this chapter, which examines what AI does within FramerSpace, how it advances the platform's EPSD objectives, and what this reveals about the broader possibilities and limitations of AI in this domain. The chapter proceeds as follows: Section 2 presents FramerSpace's reach, course portfolio, and data architecture; Section 3 describes its AI features; Section 4 critically evaluates their pedagogical effectiveness; and Section 5 draws implications for platform design, policy, and future research.

FramerSpace: A Learning Experience Platform for EPSD

FramerSpace is a co-creation, AI-powered LXP developed by UNESCO MGIEP for delivering EPSD at a global scale, reaching over a million learners across 100+ countries. Designed around a learner-centred philosophy, the platform integrates Social-Emotional Learning with thematic content and is designed to elicit reflection, encourage dialogue, and prompt critical engagement with values, perspectives, and lived experience (Mezirow, 1991; Salomon & Nevo, 2005).

I. Course Portfolio and Thematic Content Areas

The course portfolio spans thematic domains including Social-Emotional Learning, Media and Information Literacy, climate change and environmental sustainability, and global citizenship, unified by a pedagogical orientation that integrates disciplinary content with social and emotional competencies and delivered across multiple languages. Taken together, the portfolio maps systematically onto SDG 4.7's vision of education for peace, sustainable development, and global citizenship.

2. Data Collection Architecture

The capacity of FramerSpace to deliver personalised and evidence-informed learning experiences rests on a systematic data infrastructure that serves a dual purpose: providing the operational foundation for the platform's AI-driven features, and generating the empirical datasets through which learning behaviour, engagement patterns, and the effectiveness of pedagogical interventions can be studied and refined. The infrastructure captures learner interaction across three levels. Behavioural trace data is accumulated through an event-logging system recording enrolment and access events, module navigation and completion, content interactions, and certificate generation, alongside contextual metadata including cohort type, course type, and device specifications. Incourse performance data captures both objective and subjective responses, logged with scores and attempt counts, alongside revision histories. Demographic and psychometric data are collected through structured questionnaires, capturing variables including gender, geographical location, language, and institutional affiliation, alongside pre-assessment surveys documenting learners' baseline knowledge, attitudes, and course-relevant constructs, establishing the empirical foundation for comparative pre- and post-course analysis of learner development.

Informed consent is obtained prior to any data being recorded, each learner is assigned a unique anonymised identifier, and data from learners who decline consent are excluded from analysis and permanently deleted.

3. AI features in FramerSpace

AI-Based Response Evaluation and Feedback: The platform integrates the AI Response Block, an LLM-powered feature that processes learners' open-ended responses and performs two primary functions. The first is automated evaluation, in which the system assesses each submitted response for its relevance, coherence, and completeness against predefined criteria, generating a quantitative score. The second is feedback generation, delivered in two complementary forms. Standardised feedback, consisting of a system-generated response indicating the quality of the submission, is delivered in two forms: a positive acknowledgement when the learner's score meets or exceeds the predetermined threshold, and a prompt to revise and resubmit when it falls below. Personalised feedback involves a comparison of the learner's response with expert reference answers and rubric, producing targeted guidance that identifies specific gaps in understanding and offers concrete suggestions for improvement.

Behavioural Nudging Mechanisms: FramerSpace employs a data-driven nudging system that delivers personalised, timely interventions to learners through a cycle of four interconnected processes. It begins with data collection, aggregating clickstream logs, learning artefacts such as quiz scores and forum posts, and demographic data. This data is processed through machine learning models in quasi-real time, identifying behavioural patterns indicative of disengagement including extended absences, incomplete course activities, and declining participation, and generating predictions of dropout risk at the individual learner level. On the basis of these predictions, the system formulates intervention messages; at this stage, platform administrators are able to provide contextual notes that inform the content of the nudge, ensuring that interventions reflect the specific circumstances of a given cohort rather than a generic template. The resulting nudge is delivered through in-platform notifications or email reminders, with the channel selected by the moderator. A feedback loop closes the cycle by tracking whether learners respond to nudges and using this information to refine subsequent interventions over time.

Peer Evaluation with AI Scaffolding: FramerSpace's peer evaluation feature guides learners through a structured four-stage process. In the first stage, the learner submits their own response to an open-ended question. In the second, they read structured evaluation guidelines establishing the criteria against which peer responses will be assessed. In the third stage, they evaluate a designated number of peers' responses against these criteria. In the fourth and final stage, they moderate the quality of feedback that another learner's response has received, assessing the relevance and quality of the evaluation provided. The scoring mechanism distributes marks across three components: the quality of the learner's own response; the quality of evaluations provided to peers; and the accuracy of moderation decisions. Where peer reviewers are not available within a specified threshold period, the system incorporates an AI fallback, providing AI-generated evaluations and responses to ensure continuity in the feedback cycle, with credit allocation also managed by the system to maintain consistency with the scoring framework.

Human-AI Collaborative Discussion Forum Moderation: The system operates through a four-stage workflow integrating automated AI screening with structured human review. When a learner submits a comment to a course discussion forum, the submission is routed to an LLM-based moderation engine that evaluates it across categories of concern including toxic or abusive language, misinformation about course content, and other forms of harmful discourse, producing a binary safety classification, category labels, and a natural-language explanation of the reasoning behind the classification. Comments assessed as safe are published immediately. Those flagged are withheld, with the learner offered the option to revise and resubmit for automated re-screening, or to escalate to human review. Escalated cases are routed to a moderator dashboard presenting the original comment alongside its contextual metadata and the LLM-generated rationale. Moderators may approve the comment, optionally appending guidance, or delete it and issue a warning, the initial draft of which is generated by the LLM but remains fully editable to ensure alignment with institutional norms and constructive feedback principles.

Effectiveness of AI Features

This section evaluates the extent to which FramerSpace's AI features advance the platform's goal towards EPSD, maintaining a critical orientation toward both demonstrated promise and documented limitations.

AI-Based Response Evaluation and Feedback: A persistent challenge in large-scale online learning is ensuring the quality of learner engagement with open-ended, reflective questions in the absence of real-time instructor oversight. Empirical analysis of FramerSpace data identified three categories of disengaged response behaviour: non-constructive submissions consisting of random characters or minimal text; contextually irrelevant responses, and generic templated answers. Alpha testing demonstrated that the first two categories, non-constructive and contextually irrelevant submissions, are fully resolved by the system, with near-complete detection accuracy. For generic templated answers, expert evaluation revealed moderate agreement between AI evaluations, reflecting the inherently greater difficulty of detecting plausible but superficial responses in value-laden EPSD contexts.

Behavioural Nudging: The nudging system's integration of learning analytics, machine learning-based disengagement prediction, contextual administrator input, and multi-channel delivery reflects a level of sophistication that goes beyond the simple reminder-based nudges documented in earlier research (Tempelaar et al., 2020), and its adaptive feedback loop further distinguishes it from static intervention approaches. While the system has, at the time of writing, been evaluated at alpha-testing stages, establishing technical feasibility and proof of concept rather than longitudinal efficacy, its design is theoretically grounded in well-established research. A critical tension, however, exists between sustaining engagement and the risk of undermining learner autonomy: Self-Determination Theory (Deci & Ryan, 2000) cautions that poorly calibrated extrinsic prompts may erode the intrinsic motivation they seek to support.

Peer Evaluation: The integration of AI into the peer evaluation workflow serves two distinct functions: automated assessment of peer feedback quality and generative

response production when human peers are unavailable. Alpha-testing of both components was conducted with subject-matter experts, whose initial assessments indicated that the AI performed satisfactorily in executing these functions. Beta-testing further revealed that learners were unable to distinguish AI-generated responses from those produced by human peers. A consequential pedagogical limitation nonetheless remains: AI-generated responses provided in the absence of human peers may lack the authentic diversity of perspective, cultural situatedness, and emotional authenticity that makes peer learning in EPSD contexts pedagogically distinctive (Nicol, Thomson & Breslin, 2014; Sadler & Good, 2006).

Human-AI Forum Moderation: Alpha-testing demonstrated that the LLM-based screening component performed reliably in identifying harmful content across varying linguistic styles and levels of ambiguity. The human-AI collaborative design represents an ethically defensible approach to maintaining constructive discourse at scale without suppressing the critical and affectively charged expression that genuine engagement with issues of conflict and social change requires (Gorwa, Binns & Katzenbach, 2020; Gillespie, 2020). A significant limitation, however, lies in the risk of over-flagging culturally nuanced or emotionally charged content that may be misclassified by an LLM trained on datasets insufficiently representative of FramerSpace's linguistically and culturally diverse global learner community.

Conclusion

This chapter has examined the integration of AI within FramerSpace across four features: automated response evaluation and feedback, behavioural nudging, peer evaluation with AI scaffolding, and human-AI collaborative discussion forum moderation. Together, these features represent a deliberate attempt to harness AI as a pedagogical instrument for advancing EPSD. As a case study, FramerSpace demonstrates that AI integration in digital learning is both technically feasible and pedagogically meaningful, provided that design decisions remain subordinate to clearly articulated educational goals. It further illustrates that a human-AI collaborative approach, in which AI augments rather than replaces human judgement, represents a more ethically defensible model than fully automated alternatives in contexts where learner expression is culturally situated and affectively charged.

The implications span three domains. For platform design, AI features in EPSD contexts must be developed with explicit attention to cultural diversity, linguistic equity, and human oversight. For educational policy, the platform's global reach demonstrates that AI-enhanced LXPs can serve as viable instruments for delivering EPSD at scale, warranting greater institutional investment. For future research, priorities include longitudinal evaluation of AI features in EPSD contexts, and participatory studies of algorithmic bias in moderation systems.

FramerSpace's modular architecture and UNESCO MGIEP's established Member State networks provide a ready pathway for scaling the platform's approach to new contexts, with adaptation requiring attention to linguistic localisation, culturally responsive rubric design, and local moderator training. The design principles embodied in FramerSpace, deliberate pedagogical alignment, human-AI collaboration, and a commitment to equity and cultural responsiveness, offer a replicable model for institutions seeking to harness AI responsibly in the service of EPSD.

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Case 86

Innovation in Eye Care Medical-Education-Research-Industry Collaborative Talent Cultivation via the "EYE" Smart Education Large Model

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Background

The ophthalmic field faces dual pressures from national eye health demands and the need to overcome critical technological bottlenecks. However, the existing education system is constrained by three major challenges:

Lagging Knowledge Supply: Interdisciplinary theoretical frameworks and curricula lag behind rapid industry advancements.

Fragmented Competency Development: Clinical skills, research thinking, and innovation-to-commercialization abilities are cultivated in isolation, failing to support the integrated competency required for "surgical application + device R&D + clinical validation."

Inefficient Resource Conversion: The low efficiency of transforming high-quality clinical cases and research outcomes into teaching resources hinders resource flow due to a disconnect between industry and education.

Consequently, there is an urgent need to construct a knowledge hub that responds dynamically to technological shifts, establish pathways integrating clinical, research, and industrial capabilities, and create mechanisms for efficient resource conversion. Traditional digital tools cannot achieve dynamic cross-domain knowledge association or complex competency modeling; thus, a vertical-domain Large Language Model (LLM) has become an indispensable platform to resolve these structural educational contradictions.

Aligned with the national strategy for educational strength, this project leverages AI to build the first "EYE" Smart Education LLM, targeting three breakthroughs:

1.Establishing a real-time, interdisciplinary intelligent teaching infrastructure for agile knowledge iteration.

2.Creating a new standard for talent development driven by dual cores: "Clinical Competency" and "Technological Innovation."
3.Developing an on-demand engine for converting industry-academia-research resources to enhance utilization.
This initiative aims to cultivate a cluster of strategic talents possessing both medical depth and engineering breadth, providing core support for China's independent innovation in eye health.

Case Implementation Status

Against the backdrop of myopia prevention and control being elevated to a **national strategy** and the rapid expansion of the **big health industry**, the ophthalmic and optometric field faces a tripartite challenge: cultivating high-level talent to support a full-cycle eye health system, advancing original innovation to elucidate the pathogenesis of major ocular diseases, and accelerating technology transfer to address the heavy reliance on imported high-end medical devices and pharmaceuticals. Consequently, a new round of education reform is imperative to address the following systemic issues:

1. Prominent Disciplinary Silos

Current curricula lag significantly behind industrial transformation. There is an urgent need to break down the “isolated islands” among basic medicine, clinical medicine, and optometric modules, and to construct robust knowledge bridges linking medical science with engineering.

2. Weak Clinical Competency Training

Traditional pedagogical approaches lack precise assessment metrics and methodologies for clinical skills. This deficiency fails to meet high-quality, personalized training requirements and hinders the shift toward competency-based medical education (CBME), making it difficult to achieve clinically competent training outcomes.

3. Inefficient Resource Conversion

Students lack accessible pathways to acquire cutting-edge disciplinary resources. Innovation capability training and high-quality self-directed learning are severely constrained by the absence of an integrated “Industry-Academia-Research” (IAR) resource ecosystem.

Needs Positioning:

To address these gaps, we must construct a **digital-intelligent platform** that achieves three goals:
Interdisciplinary Integration: Seamlessly connect the “Medicine-Engineering” knowledge systems.
Quantitative Assessment: Establish a data-driven model for quantifying clinical competency.
Resource Synergy: Integrate IAR resources to realize the precise alignment of talent cultivation with industrial demands.

Case Innovation and Breakthroughs

1. Main Innovation Content: Focus on introducing the innovations in educational and teaching models, technology application, and other related aspects.

Taking the **"EYE" Smart Education Large Model** as its core engine, we have constructed a five-layer closed-loop architecture to establish China’s first vertical large model technology system in the ophthalmic and optometric field.

Figure 1 "EYE" Smart Education Large Model

1. Five-Layer Technical Closed-Loop Architecture

(1) **Foundation Layer:** Integrates curriculum resources, literature databases, and case libraries to build an AI corpus containing over **1 million specialized data entries.**

(2) **Training Layer:** Conducts reinforced pre-training based on a knowledge graph covering four major modules, including optical correction and visual evaluation.

(3) **Capability Layer:** Generates domain-specific vertical capabilities such as clinical diagnostic reasoning and surgical simulation decision-making.

(4) **Service Layer:** Supports calls from teaching systems and AR training platforms via open **API interfaces.**

(5) **Application Layer:** Develops 12 teaching applications—including AI Teaching Assistants and Intelligent Review—realizing a full-link closed loop from underlying data to top-tier services.

2. Personalized Smart Learning System

Multimodal Learning Analytics: Constructs dynamic **"Learning Portraits"** using student operation logs, AR training trajectories, and knowledge graph mastery data.

AI Agent Collaboration:

AI Teaching Assistant: Pushes personalized learning paths and provides real-time Q&A based on the learning portrait.

AI Training Coach: Delivers real-time feedback on operational precision within the AR virtual clinic (e.g., triggering an alarm for refraction errors exceeding $\pm$0.25D).

Research Agent: Links to the industrial needs database to assist students in designing device improvement plans and simulating the technology transfer pathway.

3. Application Practice Breakthrough Content: Clarify the breakthroughs made in application practices, and their significance and value for the development of domestic basic education.

Closed Loop of Full-Process Digital Teaching

By reconstructing the teaching closed loop and resource ecosystem, we have realized full-process digital teaching. In the **Intelligent Lesson Preparation** phase, the AI large model automatically generates interdisciplinary lesson plans—for instance, creating content on "Myopia Prevention Drug R&D" that integrates pharmacology with optical design. **AR-assisted** Instruction builds blended

physical-digital clinical scenarios, such as cataract surgery simulations, supporting multi-user collaborative operations and real-time data acquisition. **AI-powered Review** technology analyzes clinical operation videos to output scores for 29 competency indicators, covering aspects like instrument handling fluency and diagnostic logic completeness. The **Learning Portrait** feature dynamically generates a competency radar chart, identifies knowledge gaps, and recommends targeted reinforcement resources. This forms a complete "Preparation-Instruction-Review-Feedback" closed loop, significantly enhancing teaching efficiency and the personalized learning experience.

4. An Ecosystem Integrating Industry, Academia, and Research Resources

Resource Aggregation: Collaborated with industry leaders such as Zeiss and Aier Eye Hospital to establish an "AI + Optometry" Innovation Lab, importing over **200 real-world industry cases and demands.**

Innovation Training: Students utilize the large model to connect with industry projects (e.g., "Design of Wearable Myopia Monitoring Devices") and complete prototype verification within a virtual production line.

National Collaboration: Leveraging the Ministry of Education's Virtual Teaching and Research Office for Optometry, we facilitate resource sharing and co-development among all universities offering optometric education nationwide, resulting in the cumulative development of **48 courses.**

3. Intellectual Property Status: Provide information about the distribution, ownership, and other relevant details of intellectual property rights.

Intellectual property rights (IPR) primarily cover areas such as the education large model training framework and clinical skill assessment algorithms. All IPR belongs to the university and its affiliated hospital where this case study originates.

Promotion Value and Risks

1. Outcomes of AI-Empowered Smart Courses Based on Educational Knowledge Graphs

We have completed the development of smart courses including Surgery, Internal Medicine, Ophthalmology, Ophthalmic Optics, Contact Lens Studies, and Applied Optics in Optometry. These courses are structured around a four-dimensional autonomous knowledge system integrating "Knowledge-Ability-Quality," and have been shared across institutions nationwide. To date, they have served **27,809 learners** from **496 schools.**

2. Nationwide Coverage of Optometric Professional Corpus Digital Resources

The university leading this case is the founder and pioneer of optometric higher education in China, having spearheaded the construction of over **90%** of the country's optometric teaching resources. Within this project, we established China's only discipline-specific large model and AI Knowledge Innovation Center for optometry. Our resources and outcomes have been adopted by all **33 universities** in China offering optometric medical education.

3. Application of the "EYE" Smart Education LLM in Virtual Teaching and Research Offices (VTROs)

Under the framework of the Ministry of Education's Optometry VTRO, we have built a "unified faculty team" to co-create a new ecosystem for smart education. This empowers a high-quality, standardized teaching system for optometry nationwide, providing solid talent support for the **"Healthy China" strategy** and the **national policy on myopia prevention and control.**

Socio-Economic Value

The proprietary AI corpus and knowledge graph within the "EYE Smart" Education LLM efficiently integrate domain-specific knowledge, significantly reducing the burden of information curation for teachers. The AI+AR clinical training system provides a high-fidelity operating environment, effectively lowering reliance on expensive precision equipment and reducing training costs. Furthermore, the Industry-Academia-Research (IAR) fusion AI Innovation Center drives R&D and application, systematically cultivating versatile optometric talents. This provides core support for overcoming "chokepoint" technologies, improving national eye health, and promoting high-quality industrial development.

Demonstration and Leadership

The "EYE" Smart Education LLM provides a **replicable infrastructure template** for the digital transformation of medical education. By leveraging the Ministry of Education's Optometry VTRO, we pool premium resources from **33 universities** nationwide, effectively breaking down institutional and geographical barriers. Through our industry-education integration platform, we achieve deep docking and conversion between cutting-edge research, clinical resources, and industrial demands, providing a successful model for the integration and innovation of "Industry-Academia-Research" in medical sciences.

Technical and Ethical Risks

Data Security Risk: Computing power and data are deployed locally to prevent the leakage of teacher and student behavioral data generated during the teaching process.

Algorithmic Bias Risk: Educational models may harbor "biases" or "discrimination" from training data, necessitating regular algorithmic audits.

Risk of Over-reliance on AI Tutors and Teacher Absence: We conduct targeted training for faculty based on the Ministry of Education's Digital Literacy Requirements. This ensures educators correctly understand the role of AI while consolidating the status of the "teacher as the principal body" and the "student as the center."

Other Relevant Information

(I) Awards and Achievements

1. Program Development

- Jan 2020: National First-Class Undergraduate Major (Optometric Medicine), Ministry of Education (MoE).

2. Party Building & Ideological-Political Education Honors

- Jan 2025: National May Fourth Red Flag League Branch (Class 1, Optometric Medicine 5+3 Integrated Program, Class of 2017), Communist Youth League Central Committee.
- Mar 2022: National Model Party Branch (3rd Batch) – Staff Party Branch No. 3, MoE.
- May 2021: National Model Course Ideology Team & Distinguished Teacher (First Batch), MoE.
- Apr 2021: MOE Fine Project on Ideological and Political Work in Universities (Public Welfare Project on Targeted Poverty Alleviation for Eye Health), MoE.

3. National & Provincial Education Platforms

- Jan 2025: State Key Laboratory of Vision Health, Ministry of Science and Technology.
- Feb 2022: National Virtual Teaching and Research Office (VTRO) Pilot Site – Optometry Courses VTRO, MoE.

- Aug 2022: "Sci-Tech China" Innovation Base – China Eye Valley, China Association for Science and Technology.
- Feb 2021: Key Laboratory for Clinical Research and Evaluation of Ophthalmic Medical Devices and Drugs, NMPA.
- Dec 2021: Zhejiang Provincial Key Modern Industry College – Wenzhou Medical University Optometry Industry College, Zhejiang Department of Education.

4. Curriculum Development

(Note: Due to space constraints, representative national awards are listed. Provincial awards follow.)

- May 2023: National First-Class Blended Undergraduate Course (Ophthalmic Optics), MoE.
- May 2023: National First-Class Online Undergraduate Course (Myopia Prevention and Control), MoE.
- May 2023: National High-Quality Online Medical Teacher Development Courses (Low Vision Science, Fundamentals of Ophthalmology), Chinese Medical Association.
- May 2021: National Model Course Ideology Course (Ophthalmology), MoE.
- May 2020: National First-Class Offline Undergraduate Course (Contact Lens Studies), MoE.
- May 2020: National First-Class Blended Undergraduate Course (Ophthalmology), MoE.
- Nov 2022 / Aug 2021: Multiple Provincial First-Class Courses (Online, Blended, Offline, International) recognized by the Zhejiang Department of Education, covering Low Vision Science, Clinical Refraction, Fundamentals of Ophthalmology, Ophthalmic Instruments, Theories and Methods of Optometry, Myopia Prevention and Control (English), etc.

5. Textbook Development

- Sep 2021: National Advanced Collective for Textbook Development (School of Optometry & School of Biomedical Engineering, WMU), National Textbook Committee.
- Sep 2021: National Excellent Textbook (Second Prize) – Ophthalmology (2nd Edition)(Editor-in-Chief), National Textbook Committee.
- Sep 2021: National Excellent Textbook (Second Prize) – Contact Lens Fitting Techniques (2nd Edition)(Associate Editor), National Textbook Committee.
- Sep 2021: National Excellent Textbook (Second Prize) – Eyeglass Dispensing Techniques (2nd Edition)(Associate Editor), National Textbook Committee.

6. Faculty Development

- Mar 2024: National Lei Feng Model Post (9th Batch), Publicity Department of the CPC Central Committee.
- Mar 2023: National March 8th Red Banner Holder, All-China Women's Federation.
- Sep 2021: National "Ten Thousand Talents Plan" Distinguished Teacher, Organization Dept. of CPC Central Committee & MOHRSS.
- Jan 2025: Zhejiang Provincial Young Talent Cultivation Plan for Education, Zhejiang Department of Education.
- Dec 2023: Zhejiang Provincial Moral Model, Zhejiang Provincial Party Committee & Government.
- Jul 2022: "Most Beloved Secretary" Award (7th Session), Zhejiang Provincial University Party Building Research Association.
- May 2025: Zhejiang 5th University Teaching Innovation Competition – Grand Prize (Contact Lens Studies); Second Prize (Digital Image Processing, Optometric Theories and Methods), Zhejiang Higher Education Society.

- Apr 2024: Zhejiang 4th University Teaching Innovation Competition – First Prize (Contact Lens Studies); Second Prize (Low Vision Science, Clinical Ophthalmology – Ophthalmic Microsurgery), Zhejiang Higher Education Society.
- Apr 2024: Zhejiang 1st University Teaching Innovation Competition (Course Ideology Micro-lecture) – Second Prize (Ophthalmology), Zhejiang Higher Education Society.

7. Teaching Reform & Research Projects

- Mar 2024: 2023 Thematic Case (MoE Degree Center): Bright Journey – Belt and Road Optometry Development; Digital Empowerment of Optometry Development in Aksu, Xinjiang.
- Nov 2022: Industry-University Collaboration Project (MoE): Multi-dimensional Teaching Resource & Practice Base Construction via VTRO; Raman-based Rapid Pathogen Detection System for Ocular Infections.
- Nov 2020: Industry-University Collaboration Project (MoE): Construction of Ophthalmic Clinical Thinking System Based on OBE Concept.
- Dec 2023: Zhejiang Excellent Graduate Teaching Case: PBL: Bringing Anisometropia from Hospital to Classroom, Zhejiang Graduate Education Society.
- Aug 2023: Zhejiang Industry-University Collaboration Project: Contact Lens Care Practice under "Healthy China" Vision, Zhejiang Department of Education.
- Jun 2023: Zhejiang Higher Education Research Projects: Safety & Efficacy of High-fidelity Surgical Simulators; Systematic Teaching Model for Clinical Thinking – Case Study of Strabismus & Binocular Vision, Zhejiang Higher Education Society.
- Jan 2023: Reform of Compound Innovative Talent Training Mode under "Four New" Initiative, Zhejiang Degree Committee.
- Dec 2022: Zhejiang "14th Five-Year" Teaching Reform Project (Medical Modern Industry College): Talent Training Pathways – Case Study of Optometry Industry College, Zhejiang Department of Education.
- Dec 2022: Zhejiang "Five Batches" Industry-Education Integration Project: Intelligent Cataract Surgery Interactive Training System, Zhejiang NDRC, MIIT, MoE, etc.
- Jun 2022: Practice-oriented, Case-based, Ideology-integratedClinical Teaching System for Residents, Zhejiang Higher Education Society.

8. Academic Competition Awards (National Gold/Special Prizes)

- Oct 2024: 19th "Challenge Cup" National "Unveiling the Leader" Special Prize – VisionPilot: Intelligent Biomechanical Imaging-Driven Myopia Risk Prediction, CYL Central Committee, CAST, MoE, etc.
- Apr 2023: National "Top 100 Postgraduate Party Member Models" (3rd Batch), MoE.
- May 2023: National English Competition for College Students (NECCS) – Special Prize (Qian Yingying), National Steering Committee for Foreign Language Teaching.
- Dec 2023: 15th National College Mathematics Competition – First Prize, Chinese Mathematical Society.
- 2020–2024: 23 Silver/Second Prizes in National Student Competitions (Challenge Cup, Internet+, etc.).

(II) Third-Party Evaluations

(Note: Images referenced are uploaded in the attachment.)

1. User Feedback

The model is currently deployed across Eastern, Central, and Western Chinese institutions. Feedback from faculty and students at Wenzhou Medical University, Tianjin Medical University, Xinjiang Medical University, and North Sichuan Medical College indicates significant improvements. Users report: "The 'EYE' Smart Education LLM solidifies knowledge mastery and significantly boosts learning efficiency. The personalized learning paths are highly tailored, accurately identifying weaknesses and recommending exclusive resources, leading to remarkable outcomes. The AI Teaching Assistant provides instant Q&A, while AR training offers immersive experiences, greatly stimulating interest and engagement. This promotes resource sharing and collaborative education, providing strong support for the balanced development of optometry education nationwide."

2. Expert Evaluation

Prof. Lu Fan (Vice Chair, Clinical Medicine Steering Committee, MoE), Dr. Howard Purcell (President, New England College of Optometry), and Prof. Guilherme Alberi (VP, SUNY College of Optometry) commented: "This case is pioneering in optometric education. By constructing a vertical large model, it effectively resolves key issues like lagging knowledge supply and fragmented competency training. The technical architecture—from foundation to application layers—forms a complete closed loop, providing a replicable paradigm for higher education digital transformation. Furthermore, the innovative talent cultivation model is expected to produce versatile medical professionals capable of clinical practice, research, and industrial translation, positively driving the development of optometry and medical education. We recommend further promotion and application."

3. Industry Partner Evaluation

Prof. Xu Liangde (Director, China Eye Valley Office) and Mr. Sun Dabing (Chief Advisor, Zhihuishu) stated: "The 'EYE' Smart Education LLM deeply aligns with industrial needs, supplying high-quality compound talents. Its IAR integration ecosystem strongly facilitates the resolution of industrial technical challenges and accelerates the translation of scientific achievements. The innovation platform co-built with universities accelerates R&D for new devices and technologies, enhancing overall industrial competitiveness. We look forward to deepening cooperation to jointly advance the upgrading of the optometry industry."

4. Mainstream Media Reviews

- People.cn (Health): "The application of the 'EYE' Smart Education LLM in national optometry teaching will create a new ecosystem for 'AI + Optometric Medicine.' It promotes the deep integration of AI technology with education, exploring novel AI-enabled teaching models and future learning paradigms."
- Tide News: "As China's first optometry education LLM, built on multiple national AI computing frameworks and integrating extensive clinical imaging data, international guidelines, and cases, the 'EYE' model constructs four core modules: 'Optics & Refractive Correction,' 'Visual Function & Evaluation,' 'Ophthalmic Disease Diagnosis & Treatment,' and 'Eye Health Popularization.' It aims to build a new educational ecology for 'Artificial Intelligence + Optometric Medicine' nationwide."

Case 87

From Knowledge Infusion to Competency Construction: An AI-Driven ASM Domain Model and a New Paradigm for Talent Cultivation in Future Schools

Chaoyun Peng

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Case Background

1. Real-World Challenges

The current coexistence of difficult graduate employment and difficult employer recruitment reflects a deep-seated misalignment between the supply of university talent cultivation and market demand. This structural mismatch between the talent supply chain in higher education and the market demand chain has become a key constraint on the effective supply of talent. Specific manifestations include: course content taught in universities consistently lags behind market developments; graduates exhibit high levels of knowledge mastery but low problem-solving capability; and university program development remains at a stage of "experience-based establishment and inertia-driven operation," lacking the capacity to sense and respond to external changes.

2. Analysis of the Challenges

Lagging Market Perception. There is a significant information barrier between universities and market demand, characterized by a lack of systematic data collection and dynamic monitoring of market needs. Most collected job demand information focuses on immediate skill points, neglecting skill transferability and developmental scalability, thereby trapping talent cultivation in a reactive "chasing the market" pattern. Sole reliance on AI to predict future market demand is susceptible to data quality issues, making accuracy difficult to guarantee. The absence of a collaborative mechanism that integrates expert tacit knowledge with algorithmic models further undermines the robustness and credibility of demand forecasting.

Ineffective Teaching Models. The proliferation of generative AI has challenged the traditional

"bottom-up," "knowledge-first" model. The transformation in knowledge acquisition necessitates a shift from linear knowledge transmission to "top-down," problem-oriented learning, enabling students to actively construct knowledge and competencies by solving real-world problems and receiving diverse feedback.

Rigid Program Development. There is a lack of scientific mechanisms for dynamic, long-term monitoring of program status. Evaluation subjects are limited, primarily driven by internal disciplinary cycles, with assessment panels often composed mainly of experts from the same discipline, lacking participation from industry organizations, leading enterprises, and government representatives. Among evaluation indicators, market demand alignment relies on short-term, explicit metrics such as employment rates and job-matching rates, neglecting core competency requirements.

3. Opportunities and Challenges in the AI Era

In the AI era, the alignment between talent cultivation and market demand is undergoing profound transformation. By leveraging AI for real-time sensing of market signals from industry reports and job postings, combined with the structured extraction of tacit knowledge from government representatives, corporate executives, and academic experts—such as policy analysis, industry insights, and technological foresight—a dynamically evolving "future competency demand forecasting" domain model can be constructed. This enables talent cultivation standards to shift from static disciplinary knowledge to competency models that evolve in sync with the market. It also provides intelligent environments and tools to support "top-down" teaching and learning, facilitating personalized learning paths through intelligent diagnostics, thereby achieving a leap from "one-size-fits-all" to "tailored education." A professional intelligent evaluation system further provides closed-loop feedback for optimizing talent cultivation systems.

However, market signals are subject to volatility and lag, making it critical to distinguish between "short-term trends" and "long-term competencies." The structured extraction of expert experience and tacit knowledge is highly challenging, and the balance between domain model generality and specificity must be carefully managed. Issues such as data barriers, algorithmic bias, and the transformation of teacher roles also impose higher demands on implementation capabilities.

Implementation Process

This case focuses on aligning talent cultivation with market demand. By leveraging AI to deeply analyze future trends in national strategy, market needs, and academic development, and by integrating forward-looking tacit knowledge from experts (including government representatives, corporate executives, and academic experts), it accurately identifies future competency demands. An ASM domain model is then constructed to forecast future competencies, driving the diagnosis and optimization of talent cultivation plans, transforming teaching and learning models, and establishing a multi-dimensional program diagnosis system. This systematically shifts university talent cultivation from lagging response to forward-looking guidance. The framework is illustrated in Figure 1.

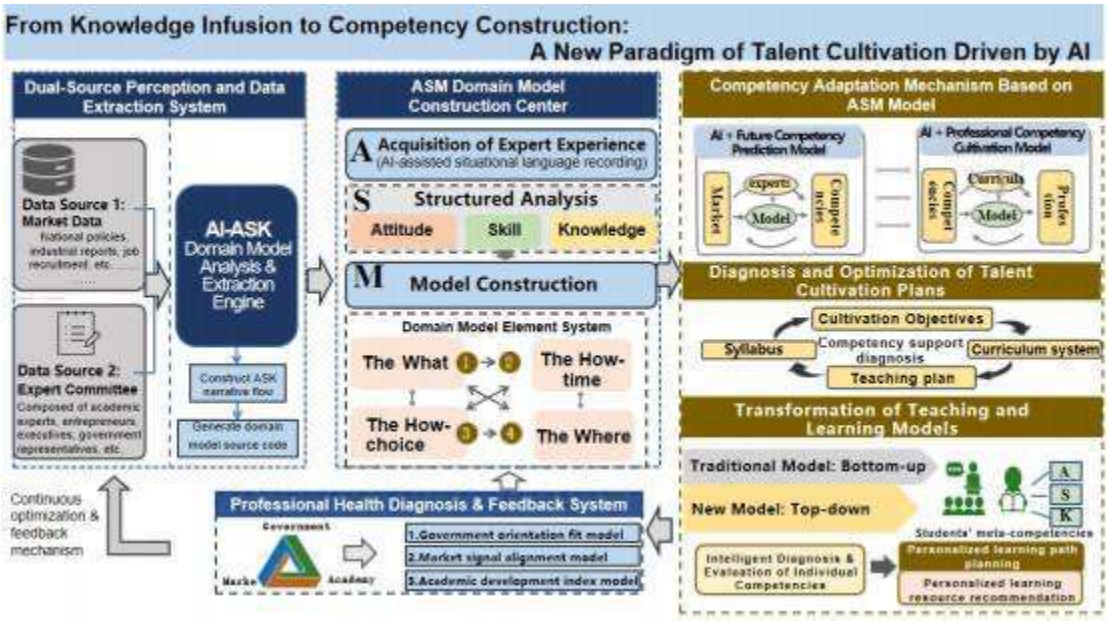

Figure 1 A New Paradigm of Talent Cultivation Driven by AI

1.Seeing the Future: Dual-Source Sensing and Data Extraction System

Market Data Sources. A market demand sensing engine is built by scraping public data sources, including industry reports, national policies, and real-time job postings, and integrating local authoritative industry data provided by the university, forming a multi-source heterogeneous market data pool.

Expert Knowledge Sources. To compensate for data biases and incorporate deeper social insights, universities should establish an "expert committee" decision-making mechanism, composed of government representatives, corporate executives, and academic experts, to conduct in-depth annual evaluations and interviews for each program. Using AI-assisted qualitative research tools, expert interviews are recorded, automatically transcribed, and subjected to thematic analysis, transforming tacit expert knowledge into structured formats and enabling rapid and accurate extraction of cutting-edge industry trends and future competency demands.

Specific methods for expert knowledge extraction:

a. Define Interview and Review Framework:

The ASK model is used to structure the interview framework, focusing on key questions such as "the most important competencies in the next 3–5 years," "core deficiencies of current graduates," and "technological nodes that are becoming obsolete."

b. Utilize AI to Codify Expert Assets:

Each expert comment and suggestion is digitally stored, and semantic alignment is performed using large language models to build a university-specific "industry intelligence repository."

c. Secondary Validation and Consensus Building:

The preliminary talent cultivation adjustment plan is fed back to the expert panel for validation. This "human-in-the-loop" design ensures that decisions are supported by both data and expert insights.

2.Understanding the Future: ASM Domain Model Construction Center

This layer aims to transform the data and knowledge collected from the base layer into a computable and simulatable domain model, serving as the "source code" for the comprehensive reconstruction

of the talent cultivation chain. Using an AI-driven common competency extraction engine, the tacit experience, forward-looking judgments, and problem-solving wisdom of government representatives, corporate executives, and academic experts are deconstructed through the ASK analysis framework. This is combined with market-identified skill shortage lists to generate a three-dimensional ASK competency map. This is further described as a narrative flow: "in a specific context, to achieve a goal, how to mobilize K, apply S, and make decisions based on A." These narrative flows are then integrated, abstracted, and elevated into a domain model.

Construction Method:

A (Acquisition – Expert Experience Acquisition):

Utilizes in-depth interviews, seminars, workshops, project retrospectives, etc., emphasizing "dialogue in context." AI meeting assistants record in real-time, extract key statements, and pose follow-up questions to guide in-depth exploration, ensuring the acquisition of "live" expert thinking processes.

S (Structuring – Structured Analysis):

Uses the ASK analysis model to deconstruct expert descriptions.

A (Attitude/Value Judgment):

What do experts value in decision-making? How do they weigh trade-offs? What are the industry's ethical and value orientations?

S (Skill/Procedure):

What specific steps, operations, and methods are needed to solve typical problems?

K (Knowledge/Concepts):

What core concepts, principles, data, and information need to be understood?

The output is not an isolated ASK list, but a narrative flow describing: "in a specific context, to achieve a goal, how to mobilize K, apply S, and make decisions based on A."

M (Modeling – Model Construction):

Integrates, abstracts, and elevates the structured narrative flows from the ASK analysis into a domain model. Model elements include: core entities and relationships, system dynamics, decision rules and heuristics, key challenges, and typical problem patterns. The form can be a concept map, system dynamics diagram, computational model, or a set of formalized rule descriptions.

3. Facing the Future: Comprehensive Restructuring of Talent Cultivation Mechanisms

3.1 Diagnosis and Optimization of Talent Cultivation Plans

Objective: To address the lag and disconnect from market demand inherent in traditional cultivation plan development, shifting from "static formulation" to "dynamic optimization."

Methods: Competency Gap Diagnosis: Based on the ASK domain model, an "AI + Program-Specific Competency Model" is constructed. By comparing the ASK distribution of the cultivation plan with the future competency prediction model, the system automatically identifies three types of competency gaps—Attitude (A), Skill (S), and Knowledge (K). It diagnoses the extent to which the program's cultivation plan supports industry needs and dynamically monitors whether cultivation objectives, curriculum systems, and teaching goals cover future competency requirements.

Regularized Early Warning Response: An "ASK Supply-Demand Early Warning Platform" is established, ensuring program cultivation plans are no longer revised only every four years. Instead, the NLP engine continuously measures the overlap between the competency model embedded in the cultivation plan and the future competency prediction model. Based on the match level, a tiered response mechanism

is triggered:

Yellow Alert: Targets sudden, drastic changes at the Skill (S) level (e.g., a skill being massively replaced by AI). It prompts the relevant academic department to supplement targeted courses in the next semester's elective modules.

Red Alert: Targets fundamental shifts at the core Knowledge (K) level. It initiates substantive program direction adjustments, including revising cultivation objectives and restructuring the curriculum system.

3.2 Transformation of Teaching and Learning Models

Teaching Paradigm Shift: From "Covering Knowledge Graphs" to "Constructing Models" Objective:

To transcend the limitations of linear knowledge coverage in traditional teaching, shifting towards a new teaching paradigm centered on problem-driven learning and competency construction.

Methods: Adopts a "top-down, project-driven" pedagogy. Starting with real, complex domain problems (projects), students are guided to actively identify their needs for A, S, and K while attempting to solve problems and receiving feedback, thereby constructively building and consolidating their domain model in reverse.

Learning Paradigm Shift: From "Uniform Pace" to "Personalized Construction" Objective:

Learning is no longer a passive reception of knowledge at a uniform pace. Instead, based on individual competency status, it becomes a personalized construction process achieved through intelligent diagnosis and dynamic adaptation, moving from "one-size-fits-all" to "tailored for each."

Methods: Employs a "bottom-up, diagnosis-driven" learning model. First, AI performs an intelligent diagnosis and assessment of the learner's competency level, accurately identifying strengths and weaknesses across each dimension of the ASM domain model (Knowledge, Skills, Attitudes). Based on this, the system automatically generates a personalized learning path, specifying the sequence, depth, and pace of learning. It then dynamically matches and recommends personalized learning resources, ensuring content precisely aligns with current competency gaps. Finally, it generates a personalized model attainment report, visually presenting the learner's progress in constructing the domain model and their competency attainment status, forming a continuous optimization loop of "diagnosis → planning → recommendation → feedback."

3.3 Program Health Assessment and Dynamic Early Warning

Objective: To overcome the lag inherent in traditional periodic evaluations by constructing a multi-dimensional, real-time program health diagnosis system.

Methods:

Indicator System Construction: Based on Burton Clark's "Triangle of Coordination" theory and existing research on program evaluation indicators, a set of program health assessment indicators is constructed across three dimensions: government, market, and academia. The Delphi-AHP method is employed, with committee expert consultations to determine the weights of each dimension, ensuring scientific weighting of the indicator system.

Dynamic Assessment and Early Warning: Three quantitative assessment models are built: Government Orientation Alignment, Market Signal Alignment, and Academic Development Index. Dynamic early warnings are achieved through comprehensive scoring and ranking. The TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method is used to rank programs from best to worst based on their health scores. Programs scoring within the "Substandard" range (e.g., less than 0.3) are automatically placed on a mandatory early warning list.

Innovation Highlights

Teaching Paradigm Shift from "Bottom-Up" to "Top-Down": The traditional model of progressively teaching based on disciplinary knowledge systems is challenged. Future teaching will increasingly start from real-world projects, work scenarios, and complex problems (the "top"), driving students towards exploratory, interdisciplinary learning, with AI serving as a core supporting tool.

Cultivation Objective Shift from "Knowledge Coverage" to "Meta-Competencies and Domain Model Construction": The focus of talent evaluation shifts from the amount of knowledge mastered to whether the learner has constructed core mental models (domain models) for solving problems in specific domains, along with transferable underlying competencies (meta-competencies). A critical stance is taken towards the instrumental application of popular, static "knowledge graphs" or "competency maps."

Evaluation System Shift from "Course Grades" to "Process-Oriented and Comprehensive Outcomes": Graduation requirements may no longer be limited to completing specific course credits but could involve demonstrating comprehensive competence through completing a series of challenging projects or deliverables. Assessment will be more flexible and process-oriented.

System Support Shift from "Experience-Based Decision-Making" to "Data- and Intelligence-Enhanced Collaborative Governance": AI integrates multi-source information—market signals, policy directions, and expert tacit knowledge—to build quantitative assessment and predictive models (e.g., program health scores). This makes program adjustments and cultivation plan design more forward-looking and scientific, forming a closed loop of intelligent collaboration among government, market, and academia.

Educational Ecosystem Shift from "Rigid Disciplinary Boundaries" to "Interdisciplinary and Lifelong Learning": Disciplinary boundaries become increasingly blurred, and learning extends throughout one's career. Educational system design must support such flexible, personalized lifelong growth pathways.

Case Outcomes

Significantly Improved Alignment Between Talent Cultivation and Market Demand. In recent years, the university has focused on future strategic fields such as artificial intelligence, integrated circuits, and intelligent manufacturing. It has added new engineering programs including Artificial Intelligence, Data Science and Big Data Technology, Intelligent Manufacturing Engineering, Integrated Circuit Design and Integrated Systems, and Urban Underground Space, as well as two new liberal arts programs: Financial Engineering and International Economic and Trade Rules. This enhances the alignment of program offerings with national strategic needs. Focusing on fields such as the digital economy, intelligent manufacturing, new energy, and smart cities, the university has launched 11 micro-programs, including Digital Trade, Lean Intelligent Manufacturing, Data Governance and Data Asset Management, New Energy Materials and Devices, Future Robotics and Intelligent Control, and Urban Smart Construction and Renewal. These programs employ teaching models combining online and offline methods with a focus on practical application, enhancing the alignment between talent cultivation and job requirements. The initial employment rates for the 2024 and 2025 graduating classes achieved steady year-on-year growth.

Figure 2 Significantly Improved Alignment Between Talent Cultivation and Market Demand.

Initial Success in Personalized Student Development. An "AI Career Path" application was developed, planning personalized learning paths for students based on job competency models, effectively supporting "top-down, project (job)-driven" personalized growth. The application has shown significant results: in 2024, 26.59% of undergraduate graduates and 41.02% of graduate graduates achieved a monthly salary exceeding RMB 8,000 and RMB 10,000, respectively. This application has formed a replicable and scalable "AI + Career Guidance" new model.

Figure 3 Initial Success in Personalized Student Development.

Intelligent Early Warning Achieved for Dynamic Program Adjustment. An "Undergraduate Program Status Data Dynamic Monitoring System" was developed, enabling real-time monitoring and tiered early warning for the construction status of 56 undergraduate programs. This promotes a shift in program management from "passive response" to "active optimization," providing scientific support for the dynamic adjustment of program structures.

Figure 4 Intelligent Early Warning Achieved for Dynamic Program Adjustment.

Case 88

The Construction and Practice of a New Model of Digital-Empowered Intelligence Education

Yanglingzi School, Hangzhou, Zhejiang, China

Case Background

Promoting the full coverage of artificial intelligence is an inevitable path to implementing educational digitalization and promoting the high-quality development of special education. However, traditional special education for students with intellectual disabilities still faces three major practical bottlenecks: First, personalized teaching is difficult to implement. Students have significant differences, and due to the limitations of time, space and teachers, precise stratified teaching and effective potential development are difficult to be implemented on a regular basis. Second, the evaluation lacks a scientific closed loop. Evaluation mostly relies on teachers' experience, lacking real-time dynamic data collection and analysis, and teaching adjustments lack evidence-based support. Third, data integration is insufficient and technology adaptation is weak. Data from schools, families, communities and medical institutions are fragmented, and general tools do not fit the laws of special education and have low scene adaptability, making it difficult to support differentiated teaching and collaborative education. Therefore, how to break the barriers between teaching, evaluation and technology by relying on artificial intelligence, empower students' personalized learning, assist teachers' growth, and build a collaborative education system involving families, schools, communities, and medical institutions has become a key issue that urgently needs to be addressed to improve the quality and efficiency of special education for students with intellectual disabilities in the new era.

Implementation Process

(I) Specific Measures

Based on the above educational scenario requirements, the school accurately selected the appropriate technolog Figure 1. Overall architecture of Yangling Brain 3.0ies and tools to systematically build the AI large model base - "Yangling Brain", the specific architecture is shown in Figure 1.

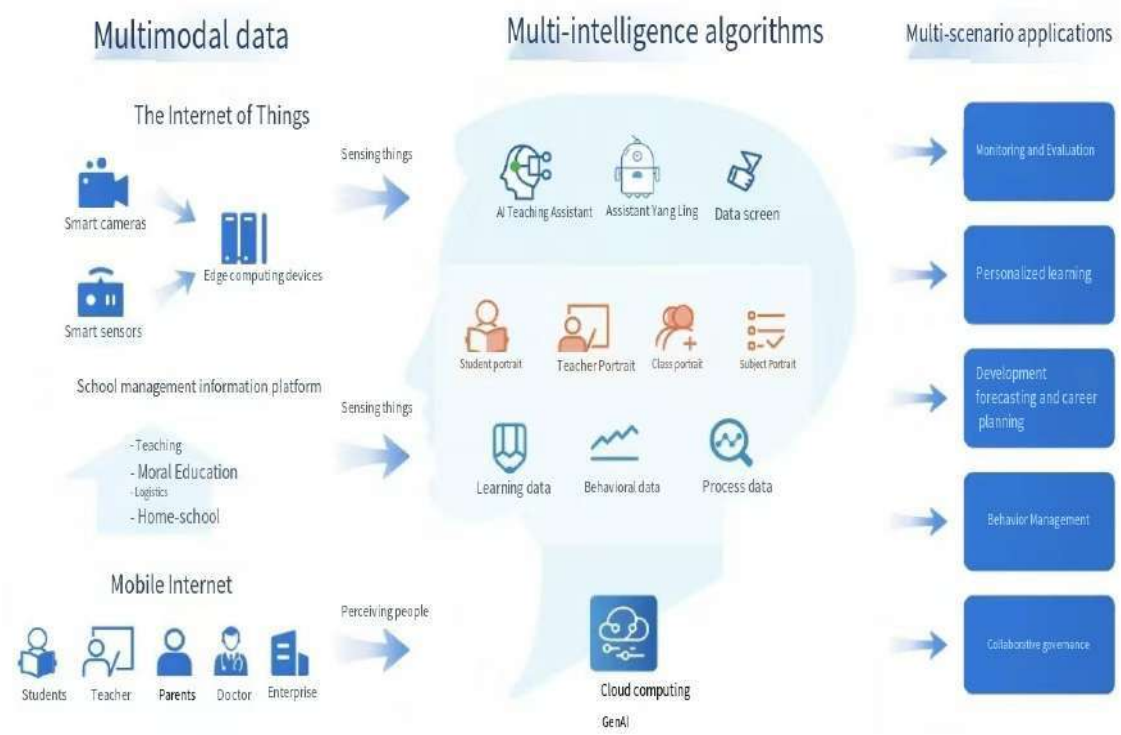

Figure 1 Overall architecture of Yangling Brain 3.0

"Yangling Brain" is an integrated smart campus data hub system built on the internet within the school, imitating the intelligent processing logic of the human brain, and concentrating on carrying the school's data perception, analysis, decision-making and application capabilities. The system collects and analyzes massive data from the entire educational process in real time, forming an overall solution for educational practice, covering five application systems: intelligent adaptive learning, growth incentives, quality monitoring, collaborative governance, and intelligent feedback. The overall architecture of "Yangling Brain" is divided into three major sections: multi-modal data, multi-intelligent algorithms, and scene applications. First, multi-modal data collection. Relying on sensing devices such as smart cameras, smart bracelets, campus terminals, mobile devices, and voice recognition, it routinely collects multi-dimensional data on students' and teachers' learning, behavior, life and management, and aggregates it to the algorithm center. Second, multi-intelligent algorithm analysis. Through intelligent models, the original data is cleaned, mined and calculated to extract key indicators such as learning data, behavioral data, and process data to accurately generate four types of digital profiles for students, teachers, classes, and subjects. Third, immersive scene implementation. The algorithm analysis and profiling results are used to empower front-line education scenarios and are applied to academic monitoring and quality evaluation, personalized adaptive learning, student development prediction and career planning, precise management of student behavior, and collaborative governance among home, school and community, so as to achieve individualized teaching, precise education and intelligent school governance.

(II) Technical Solution

To realize the functions of the five major systems, the relevant artificial intelligence tools and models used by the school are all based on mature general AI models. They have undergone comprehensive

secondary development and personalized customization, combining with the cognitive characteristics of students with intellectual disabilities, the laws of special education teaching, and the school's educational goals. This enhances scenario adaptability and addresses the pain point of the disconnect between general technologies and special education scenarios. To ensure the security of students' personal information and growth data and improve system response efficiency, all artificial intelligence technologies, models, and tools that have undergone secondary development and personalized customization are deployed locally. Specific application scenarios, technology selections, and application methods are shown in Table 1.

(III) Implementation steps and schedule

By focusing on key issues, the school has achieved a profound breakthrough in educational innovation through a three-stage iterative reform:

1. Infrastructure Development and Initial Exploration Phase (2012-2019): Exploring new information infrastructure construction and application in schools, breaking down data barriers, and empowering digital governance in schools. Based on the development of a network-based individualized education plan system for schools with intellectual disabilities, the pioneering "Yangling Brain" system for monitoring the quality of education in schools with intellectual disabilities was created, promoting an innovative evaluation model that shifts from "experience" to "evidence-based" methods.

2. Technological Integration and Deepening Stage (2020-2023): With the development of generative artificial intelligence, "Yangling Brain" incorporates intelligent algorithms, pointing to the intelligentization of the decision-making process, and integrates five functions of intelligent adaptive learning, growth incentives, quality monitoring, collaborative governance, and intelligent feedback, empowering the integrated development of "teaching - learning - evaluation - management - research" in schools.

3. Ubiquitous Ecosystem and Spatial Reconstruction Phase (2024-2026): Implement local deployment, using embodied intelligence and multimodal large models as technical carriers, develop accompanying intelligent agents and labor education apps, break through the limitations of learning space, and build a ubiquitous lifelong learning environment with the holistic growth of students as the guide.

Table 1 Core Application Scenarios, Technology Selection and Application Methods

Application scenarios	Core implementation carrier	Core technology types	Specific application methods
Student intelligent adaptive learning	AI Learning Companion Ling Xiaozhi Intelligent Agent, Labor Education App, Innovative Campus AI Foundation, Xiaobu Zhiping Integrated Intelligent Agent for Classroom Teaching Evaluation, Multi-modal Accompanying Intelligent Agent	Machine learning technology, natural language processing technology, computer vision technology, intelligent recommendation technology, knowledge graph technology	Centering on "Ling Xiaozhi", a student learning profile is constructed through machine learning to recommend personalized learning paths and support classroom interaction. The Labor Education App, in conjunction with the "Yoko Brain" assessment system, delivers stratified tasks and micro-lessons. The Xiaobu Zhiping intelligent entity collects multimodal data in an accompanying manner, enabling real-time evaluation and feedback in classroom teaching.
Student growth incentives	Stepwise Point System, Growth Forest, Yangling Bank Token Savings Program, Alipay-Smile Coin Digital Token Conversion Platform, Multimodal Behavior and Emotion Management System, Intelligent Surveillance Cameras, Mood-Tracking Smartwatches	Machine learning technology, computer vision technology, data visualization technology, sensor technology, and multimodal data fusion technology	Through the dual acquisition of student physiological and behavioral data via smart cameras and emotion-monitoring wearables, multimodal fusion analysis enables early warning of emotional and behavioral anomalies while delivering targeted intervention plans. "Yangling Bank" and "Smile Trail" integrate positive behavior reinforcement with incentives based on tradable digital tokens. "Growth Forest" visualizes students' developmental trajectories, dynamically mapping their evolving growth profiles.
Quality Monitoring of Teacher Professional Development	Intelligent Educational Research Assistant for Special Education, Digital Repository of Instructional Resources, Autonomous Educational Research System, Interdisciplinary Thematic Curriculum Resource Database, VR Immersive Teaching Assistant	Machine learning technology, data collection and analysis technology, intelligent platform technology, 3D engine and rendering technology, VR panoramic interaction technology	Leveraging the "E-Exemplary Educator" quality monitoring system—which integrates four core modules: teacher digital portfolios, cloud-based curriculum resource repository, intelligent professional development, and precision teacher training—this framework employs machine learning to assess educators' competency gaps, deliver personalized development resources, and dynamically monitor the training process. Driven by a VR panoramic teaching intelligent agent, it facilitates immersive classroom observation and reflective teaching practices, thereby accelerating the transition toward technology-enhanced pedagogical excellence.
Collaborative governance among families, schools and communities	Task Alliance, AI Infinity Charity Alliance, "Smart Tree" Disabled Services Society, and Off-Campus Practical Training Base.	Intelligent platform technology, data sharing and interconnection technology, resource integration and multi-terminal collaboration technology	By leveraging the "Task Alliance" as a central hub, the initiative integrates corporate, academic, and public welfare resources from the "AI Infinite Public Welfare Alliance" to align vocational skills training—including data annotation and Chinese-Western pastry making—with relevant employment opportunities. It also facilitates collaboration between "Smart Tree" and off-campus practice bases, enabling tripartite information sharing and resource coordination among families, schools, and communities.
Intelligent feedback	Yang Ling brain	Computer vision technology, intelligent platform development technology, natural language processing technology, machine learning technology, real-time data processing technology	With the "Yangling Brain" serving as the data hub, this system comprehensively covers the entire spectrum of teaching and learning scenarios. It captures real-time data on students' learning gaps, emotional states, and attention fluctuations, delivering precise intervention recommendations accordingly. Additionally, it analyzes teachers' instructional behaviors in the classroom to generate actionable strategies for pedagogical optimization. By connecting with the parent-side application, a closed-loop system for real-time bidirectional feedback between school and home is established.

Innovation Highlights

- **Conceptual Innovation**

The school pioneered the core concept of "centering education on students with intellectual disabilities and empowering the entire process with data," breaking through the limitations of experience-driven approaches. It constructed a closed-loop education mechanism of "multi-modal data collection—intelligent analysis and judgment—precise solution output—dynamic feedback optimization," achieving deep integration of smart technology with education, rehabilitation training, and home-school collaboration. Based on this, the school innovatively proposed the educational proposition of "digital empowerment, precisely anchoring special education's respect for uniqueness," promoting a fundamental transformation in special education from "standardized assistance" to "personalized symbiosis," allowing technology to accurately respond to individual differences and leading school governance from extensive to intensive approaches.

- **Technological Innovation**

Based on the developmental needs of students with intellectual disabilities, the school innovatively promoted the local deployment of artificial intelligence, achieving a transformation from "general intelligence" to "contextual intelligence" and "caring intelligence." Addressing the real challenges of students with intellectual disabilities, such as varying cognitive characteristics, diverse behavioral expressions, and fluctuating emotional states, local deployment ensures data security and timely response, making AI more understanding of special education scenarios.

The school has created "Yangling Brain," the first national brain for special education schools, embedding a self-developed labor literacy model to empower multiple scenarios including teaching, learning, assessment, management, and research. This model breaks down labor skills into observable and evaluable behavioral units, enabling personalized teaching and precise assessment. The school has

also developed accompanying intelligent agents such as the AI learning companion "Ling Xiaozhi," and built an "AI Innovation Campus" platform combining cutting-edge technologies like MCP and SKILL. An AIGC-based labor education app has been created, achieving seamless integration of technology and teaching, and ubiquitous learning that combines virtual and real-world elements. The intelligent agents capture student behavioral data in real time, providing standardized evaluation and immediate feedback, achieving deep integration of technology and the teaching process.

The school has obtained several original intellectual property rights, including the Special Education Brain Data Screen System 1.0, Curriculum Teaching System 1.0, Curriculum Management System 1.0, Xiaobu Jifen System 1.0, and Yangling Bank System 1.0, constructing a complete technical support system.

- **Practical Innovation**

Focusing on the core concept, we have constructed four new models of education: "whole-cycle education—full-chain teaching—all-domain evaluation—all-dimensional teacher development", forming a co-creation and co-construction mechanism of "school leadership—enterprise collaboration—parent empowerment—student participation", providing a systematic operational model for the digital transformation of special education.

We have taken the lead nationwide in implementing industry-education integration for data annotation for students with autism, achieving professional co-construction and cost optimization, reducing data annotation costs by more than 40%, and providing a replicable economic paradigm for the low-cost promotion of artificial intelligence in special education. We have established an AI-enabled teaching assessment pilot base, relying on cameras and humanoid robots to collect multimodal data, automatically generating standardized evaluation reports and personalized improvement suggestions to support the intelligent transformation of teaching assessment.

We have developed a personalized "AI memory," constructing a new human-machine collaborative interaction model of "teacher-student-intelligent agent." This memory records students' growth trajectory, behavioral characteristics, and learning preferences, forming a unique "digital profile," allowing teachers to understand students more accurately and students to receive more suitable support. This innovation is reshaping the teaching practice paradigm, prompting teachers to transform from knowledge transmitters to learning guides and growth companions, creating a new model for the future classroom, and promoting the implementation of a ubiquitous supportive learning paradigm.

Case Results

Personalized customization through digital technology has fundamentally changed students' learning and lifestyles, encouraging active participation and fostering self-confidence. In the classroom, students' interest in learning has significantly increased, with participation time rising from 35% to 68%, active expression from 52% to 85%, and knowledge and skills mastery improving by 100%. In daily life, the accompanying communication and emotional support from intelligent learning companions have reduced the frequency of students' emotional outbursts by an average of 60%, and significantly enhanced their social skills. Furthermore, parents report that with the support of digital technology, students' learning autonomy has increased by 40%, and their digital literacy has significantly improved.

In addition, based on the strengths of students with autism, the school is training them to become AI trainers, increasing their career suitability by 50%.

All teachers are participants, learners, and promoters in the development of the school's proprietary intelligent models, transforming themselves from knowledge transmitters to learning designers and guides, human-machine collaborative decision-makers, and lifelong learners. Teachers have conducted over 200 smart classroom sessions, created over 5,000 digital resources for special education, won or published over 30 papers, won over 20 teaching case awards in national competitions, published 2 related monographs, and compiled over 30 officially published textbooks at the provincial or school level. They also conducted the first nationwide demonstration of a future classroom for special education.

Over the past decade, the school has independently developed 23 digital applications for special education, successfully applied for 5 national software copyrights, won 5 national awards, and received more than 10 provincial-level or above research grants or awards. Its "School Brain" system has been replicated by more than 30 schools nationwide. The school receives an average of over 400 visitors from home and abroad annually, and has been featured in over 50 special reports by provincial and national media outlets. It has become a Chinese model for digitally empowering special education, providing a replicable practical example for the digital transformation of special education globally. Simultaneously, the school has partnered with over 60 enterprises to establish the AI Unlimited Public Welfare Alliance, broadening students' specialized employment opportunities and earning multiple recognition as a model of urban civilization.

Scalability

This achievement has resulted in a series of replicable and scalable guidelines, paradigms, tools, and resources dedicated to the future development of special education schools, empowering high-quality development of special education for students with intellectual disabilities. It has generated standardized operational guidelines for applications including "Yangling Brain," personalized assessment toolkits, and digital resource libraries; the newly constructed digital education model has been replicated by more than 30 schools, providing a systematic reform path for special education schools of different regions and types; and through in-depth cooperation with ByteDance, Zhejiang University, and other institutions, a long-term, four-dimensional linkage mechanism involving government, schools, enterprises, and research institutions has been established, possessing strong self-iteration capabilities and long-term application value, and can continue to play a demonstrative and leading role in the digitalization process of special education. It can also provide a referable practical paradigm for differentiated teaching and personalized learning in regular schools.

In the future, a radiating path of "pilot schools - regional clusters - national network" will be adopted to select more units across the country to carry out digital education reforms and form a community of practice. Through systematic collaboration in technology adaptation, curriculum adaptation, and resource adaptation, it will connect with existing regional education management platforms to achieve a deep transformation from "technology migration" to "ecological migration." Important platforms such as the 2026 World Digital Education Conference and national special education symposiums will be used to share keynote speeches, release interim results, and open standards.

This case study leverages technological innovation to drive high-quality development of special education, promote employment integration, reduce social expenditures caused by educational inequality, and contribute to common prosperity. It anticipates a 30% increase in personalized learning pathway coverage for students in pilot schools in the short term, the formation of a replicable regional model in the medium term to drive digital transformation in the field of special education, and, in the long term, the development of a "Digital Special Education China Solution" with supporting environment, consensus, and action pathways at the international level.

Case 89

From Learners to Innovators: Artificial Intelligence Education and Teaching STEP

Zhejiang University, Zhejiang, China

Background

Unlike general - purpose technologies such as the steam engine, electricity, chips, and the Internet, which have augmented human physical capabilities through mechanization, artificial intelligence (AI) represents the first systematic amplification of human intellectual capacity. In particular, generative AI (GenAI) is profoundly reshaping traditional learning paradigms and driving a fundamental transformation in education and teaching models.

Different from the educational approaches epitomized by Confucius instructing 72 virtuous disciples on the Apricot Altar and Plato's Academy centered on knowledge accumulation and transmission, modern education aims to cultivate in students the essential qualities to understand, utilize, innovate with, and govern artificial intelligence for good. It should enable every individual to understand the ongoing paradigm shift in cognition and construct a cognitive framework for the AI era.

To this end, Zhejiang University has launched the initiative Artificial Intelligence Education and Teaching STEP (AI STEP). Structured around the progressive pathway of Start, Train, Explore, Progress, the initiative advances AI-empowered education and teaching across the university in a holistic manner, covering knowledge acquisition, competency training, innovation and creation, and advanced development. It aims to elevate students' knowledge, ability, and literacy, nurture outstanding talents equipped with innovative competence and entrepreneurship, and empower students to evolve from learners to innovators.

Case Implementation Status

1. Knowledge Acquisition (Start)

Zhejiang University has established a comprehensive AI curriculum comprising general education courses, interdisciplinary courses, and specialized courses. It has rolled out tiered and categorized

compulsory general education courses of AI for the entire university, and launched 220 AI-integrated interdisciplinary courses with other academic disciplines. It has also introduced an innovative "AI+X" micro-major program tailored to non-computer or non-AI major students. It is designed to break down disciplinary barriers, address students' needs for personalized development, and foster interdisciplinary talent. In addition, Zhejiang University has upgraded conventional MOOCs to "smart MOOCs", developing 157 personalized, interactive, and intelligent online courses.

2. Competency Training (Train)

Zhejiang University has built Zhihai Platform for Science and Education, an open and shared next-generation platform for AI-empowered education, research, and innovation. Delivering interactive and immersive teaching experiences, it provides millions of students and teachers in more than a thousand institutions with one-stop hands-on training to cultivate their AI competencies. In 2024, the platform was selected as among the first batch of exemplary "Artificial Intelligence + Higher Education" application scenarios by the Ministry of Education. Zhejiang University has further refined its research training system and strengthened its discipline competition system, encouraging students to move from classrooms to laboratories and from laboratories to competitions, while systematically engaging undergraduates in high-level research. A notable example is Zhu Qiuguo, founder of DeepRobotics, one of Hangzhou's "Six Little Dragons" in tech innovation, who launched his career in robotics R&D through participation in the Robot World Cup (RoboCup).

3. Innovative Exploration (Explore)

Zhejiang University has developed domain-specific large language models (LLMs) for vertical fields including AI, medicine, mechanics, and pharmacy, as well as AI teaching assistants. The WisdomBot AI Education Large Model and the Socratic AI Agent have been launched on the Smart Education of China · Higher Education. Zhejiang University has organized a series of education reform projects and training programs under themes such as "AI for Education", accelerating the transformation of teachers' roles into designers of innovation ecosystems and coaches for human-AI collaboration. More than 500 faculty teams have explored human-AI interactive teaching models in their courses, supporting students in personalized learning, interdisciplinary exploration, and knowledge innovation with human-AI collaborations.

4. Progressive Advancement (Progress)

As a pioneer among Chinese universities, Zhejiang University has established the Intensive Training Program of Innovation and Entrepreneurship (ITP), advocating the philosophy of innovation-based entrepreneurship education. It has integrated innovation and entrepreneurship courses into its undergraduate education program, offering more than 160 quality courses in this field. It has also launched a dual-degree program of "PhD of X + Master of AI" and a micro-program in Science, Technology Innovation and Entrepreneurship Management. A university-wide innovation and entrepreneurship education system covering curriculum, practice, institutional framework and ecosystem has taken shape. Going beyond the physical boundaries of the university, it has fostered an open, symbiotic relationship between the university and the city of Hangzhou. Through multi-stakeholder interactions, it has explored new forms of university organization and constructed a Silicon

Valley-style innovation education community and ecosystem, nurturing innovators for the society in a steady stream.

Case Innovation and Breakthroughs

1. Main Innovation Content: Focus on introducing the innovations in educational and teaching models, technology application, and other related aspects.

With the deep integration of AI with education and teaching, digital intelligence empowerment is transforming core elements of AI instruction to reforms in the teaching system. Zhejiang University has offered tiered and categorized interdisciplinary general AI courses and "AI+X" micro-major program, as well as an innovation-based entrepreneurship education system to foster a Silicon Valley-style community and ecosystem for innovative talents. This comprehensive endeavor aims to transform students from learners to innovators.

1.1 Digital intelligence empowerment is transforming core elements of AI instruction to reforms in talent development system.

Zhejiang University has published a series of AI textbooks that keep pace with cutting-edge developments, merge interdisciplinary contents, cover both specialized and general education, and emphasize AI-empowered applications. A supporting hybrid online and offline curriculum has been established, accompanied by structured and interconnected digital resources including micro-videos, practical training cases, knowledge graphs and competency graphs. Leveraging disciplinary LLMs, scenario-based training platforms and smart course agents, digital intelligence approaches facilitate three progressive shifts: a shift from textbook systems structured by knowledge logic to curricula centered on learning logic; a shift from a teacher-centered curriculum to a student-centered learning experience; and a shift from learning experience focused on knowledge acquisition to systematic competency development centered on independent learning ability.

1.2 Tiered and categorized general AI courses and "AI+X" micro-major program have been established through interdisciplinary integration. Zhejiang University has set up the Research Center for AI in Education (RCAIED), launched the Global University Collaborative Mechanism for Innovation in AI Education and Teaching , and released Zhejiang University Artificial Intelligence Education and Teaching STEP (AI STEP). A tiered and categorized knowledge system for AI general education has been constructed, accompanied by the publication of the Red Book on Artificial Intelligence Literacy of College Students and the Red Book on Artificial Intelligence Literacy of University Educators. Compulsory general AI courses are offered to all undergraduates to cultivate their ability and cognitive framework to understand, apply, innovate with and govern artificial intelligence for good. To break down disciplinary and professional barriers, Zhejiang University has designed and launched the "AI+X" micro-major program in 2021, an initiative proposed by five prestigious universities in East China, co-developed with other five universities, namely, Shanghai Jiao Tong University, Fudan University, Nanjing University, University of Science and Technology of China and Tongji University, and supported by enterprises. Through inter-university, interdisciplinary and cross-industry cooperation, the "AI+X" micro-major program provides non-computer majors with access to core AI theories and practical applications, breaks down disciplinary barriers, deepens supply-side reform of university majors, and meets students'

needs for personalized development and the cultivation of interdisciplinary talents. To date, the “AI+X” micro-major program has been adopted by 33 universities in eastern, central and western China, with the participation of 1,500-odd undergraduate students and secondary school students, promoting the co-construction and sharing of higher education resources between China’s eastern and western regions and the development of AI literacy in basic education.

1.3 An innovation-based entrepreneurship education system has been established to foster a Silicon Valley-style ecosystem for nurturing innovative talents. Zhejiang University has placed equal emphasis on talent development and innovation, integrated innovation and entrepreneurship courses into undergraduate education programs, and followed the philosophy of “innovation leading entrepreneurship”. A four-in-one innovation-driven entrepreneurship education system encompassing institutional mechanisms, teaching, practice and ecosystem has been constructed to cultivate a core force of talents equipped with innovative competence and entrepreneurship. By bringing together innovative talents, institutional frameworks for innovation and a culture of innovation, Zhejiang University has developed a high-caliber innovation and entrepreneurship ecosystem and established in Hangzhou the core of a new Silicon Valley-style ecosystem comprising researchers and entrepreneurs.

2. Technology Breakthrough Content (If Any): Specify what kind of technological breakthroughs have been achieved, the significance and value of these technological breakthroughs for educational informatization and digital transformation, and the technical level of the case in the industry.

Zhejiang University has adapted general-purpose LLMs to discipline-specific and industry-specific LLMs, and developed smart course agents tailored to diverse scenarios. It has created a comprehensive AI empowerment framework: General-purpose LLMs – Discipline-specific LLMs – Industry LLMs – Smart Agents, supporting students in conducting interdisciplinary, interactive exploration of cutting-edge unknown fields.

Zhejiang University has constructed Zhihai-Mo, an open AI training platform and learning community. As an integrated environment of teaching and practice, Zhihai-Mo provides strong support for personalized and autonomous learning. Learners can complete the full workflow from model design and training to deployment on a single platform, achieving an immersive learning experience that integrates study with practice, learning by doing and doing by learning. Zhihai-Mo offers 300-plus AI courses, covers over 2,000 application scenarios, and serves 150,000 users. Through collaboration with enterprises, it has developed a large-scale and sustainable AI learning community.

3. Application Practice Breakthrough Content: Clarify the breakthroughs made in application practices, and their significance and value for the development of domestic basic education.

3.1 Centered on systematic AI textbooks and courses, Zhejiang University has created a diversified talent cultivation model that responds to the needs of interdisciplinary integration and industrial development, filling gaps in talent development approaches. Guided by the philosophy of understanding, utilizing, innovating with and governing AI for good, Zhejiang University has designed tiered and categorized general AI textbooks and curricula that progress iteratively from knowledge acquisition to competency development and further to literacy development. Compulsory general AI courses are offered to all undergraduates, complemented by the “AI+X” micro-major program and the “PhD + Master of AI” dual-degree program. These initiatives cover education groups at different levels,

including higher education, basic education, vocational education and lifelong learning. High-quality AI resources are openly shared with universities, colleges and primary and secondary schools in central and western regions, establishing a long-term mechanism for diversified talent cultivation across universities, disciplines and industries.

3.2 Zhejiang University has developed AI-empowered educational technologies to foster interdisciplinary inquiry and knowledge innovation capabilities through human-AI collaboration. Domain-specific large language models (LLMs) have been built for disciplines such as AI, pharmacy, and mechanics. Meanwhile, AI teaching assistants have been developed for foundational public courses, including mathematics, physics, chemistry, biology, and computer science, empowering the entire teaching-learning process and enabling new models of exploratory learning. Zhihai-Mo, a next-generation open AI training platform, serves approximately 150,000 learners and 1,000 schools, boosting the transformative learning pathway from knowledge acquisition to competency building and further to comprehensive literacy.

3.3 Zhejiang University has established an education and teaching system dedicated to nurturing talents with innovative abilities and entrepreneurship. Innovation and entrepreneurship courses have been integrated into undergraduate education programs. Zhejiang University has pioneered the concept of “innovation leading entrepreneurship” and constructed a four-in-one innovation-driven entrepreneurship education system covering institutional mechanisms, teaching, practice and ecosystem building. Zhejiang University has explored an integrated approach to education, technology and talent development, rooted in China, and cultivated a distinctive innovation and entrepreneurship culture together with local governments and enterprises. In February 2025, The Economist published an article entitled Behind DeepSeek lies a dazzling Chinese university, stating that “it is at the heart of a dynamic new ecosystem of researchers and entrepreneurs in the city that models itself on California’s Silicon Valley”.

Intellectual Property Status: Provide information about the distribution, ownership, and other relevant details of intellectual property rights.。

Intellectual property rights of the relevant resources are collectively owned by Zhejiang University, other co-building universities, and teaching teams.

Promotion Value and Risks

1. Explain the application prospects of the case or the application achievements already obtained (including but not limited to the current application scale, current depth and breadth of application, operation and management model, large-scale promotion, etc.).

Zhejiang University has developed systematic AI textbooks and curricula, creating a diversified model for talent cultivation. Full series of high-quality systematic textbooks have been published, covering specialized, general education and popular science content, spanning higher education and basic education, integrating theory and practice, and available in print and digital formats. A supporting hybrid online-offline curriculum has been constructed, supported by structured and interconnected digital resources including micro-videos, practical training cases, knowledge graphs and competency graphs. Diversified talent development pathways have been implemented, including tiered and categorized general AI courses, the AI+X micro-major program, and the “PhD + Master of AI” dual-degree program. These initiatives cover learners across higher education, basic education, vocational

education and lifelong learning, while exploring a long-term mechanism for interdisciplinary, inter-university and cross-industry talent cultivation.

Supported by digital intelligence platform empowerment, Zhejiang University has addressed the lack of advanced instructional technology and tools. It has developed next-generation AI training platforms such as Zhihai, generative discipline-specific LLMs including WisdomBot, and smart agents. Zhejiang University has explored effective AI-empowered teaching and learning approaches under the framework of AI for Education, and pioneered a new "teacher-AI-student" instructional model that integrates virtual and physical environments with human-AI collaboration. This provides an intelligent foundation for large-scale personalized instruction and innovative pedagogical reform, embodying Zhejiang University's philosophy of "Enhancing Quality through Intelligence, Achieving Excellence through Quality".

Zhejiang University has built an innovation-driven entrepreneurship education system and established a silicon valley-style ecosystem for nurturing innovative talents. By integrating innovative talents, institutional frameworks and a culture of innovation, it has developed a world-class innovation and entrepreneurship ecosystem, establishing in Hangzhou the core of a new Silicon Valley-style community composed of researchers and entrepreneurs.

2. Illustrate the social and economic value it brings.

Zhejiang University has continuously deepened the reforms of empowering education, teaching and talent development with AI, advanced the cultivation of interdisciplinary and versatile talents, and systematically carried out pioneering practices in integrating AI into education and teaching, offering a body of experience and developing solutions that can be shared and replicated by universities nationwide. Zhejiang University has published the Red Book on Artificial Intelligence Literacy of College Students and the Red Book on Artificial Intelligence Literacy of University Educators, promoted AI course and discipline-specific LLMs, and opened access to high-quality MOOC resources. The AI+X micro-major program has been adopted by 33 universities across eastern, central and western China, with more than 1,500 students enrolled. Shared courses have reached 3,674 university sessions nationwide, attracting 430,000 student participations, contributing to the "MOOC Western Journey Plan 2.0". It has also launched the DeepSeek series of open classes, attracting over 80 million views. Public services and science popularization have been provided for basic education, continuing education, industrial sectors and other fields, supporting the building of a lifelong education ecosystem that is accessible to everyone, anytime and anywhere.

3. Elaborate on its demonstration and leading role in the entire basic education field.

Zhejiang University has been selected as a Pilot University for AI-empowered Education by the Ministry of Education. Its Zhihai AI Open Training Platform, AI+X Micro-major Program, and Digital intelligence Mechanics Education Infrastructure have been recognized as Exemplary Cases of "AI + Higher Education" by the MOE for three consecutive years. The WisdomBot AI Education LLM has been launched on the Chinese smart education online platform, serving nearly 2,000 colleges and universities.

Zhejiang University has been approved as the National Research Base for AI Textbooks and the National Platform for AI Industry-Education Integration. It has also been selected as a pilot university for comprehensive higher education reform and serves as the secretariat institution.

4. Identify potential risks such as technical risks and ethical risks that may arise during the application of the case.

The application of GenAI in education has also posed a series of challenges: 1) Weakening learners' "cognitive sovereignty". Over-reliance on AI tends to induce risks such as intellectual dullness, reward hijacking, cognitive usurpation, attention diversion, and information cocoons; 2) Widening social cognitive divide. There is a clear polarization in the ways and effects of using AI tools. Without effective intervention, the use of these tools is likely to create a Matthew effect in cognition, where the strong become stronger and the weak become weaker, potentially exacerbating educational inequality in society; 3) Limitations of current training models and evaluation systems. Traditional evaluation methods centered on exam scores are ineffective in effectively assessing learners' innovative thinking, critical thinking, cognitive abilities, problem-solving skills, and communication and collaboration competencies. As access to specific knowledge becomes extremely convenient in the AI era, there is an urgent need to develop new training models and evaluation systems oriented towards comprehensive literacy and cognitive capabilities.

Other Relevant Information

1. Case Award Status: Include the award time, award name, and awarding institution.
2021, Introduction to Artificial Intelligence, included in 101 Plan for Computer Education, Ministry of Education
2023, National Innovation Platform for AI Industry-Education Integration, Ministry of Education
2024, The National Research Institute for Teaching Materials (Research on AI Textbooks for Higher Education), Ministry of Education
2024, Zhihai-Platform for Science and Education: Micro-Course Education that Empowers Knowledge, included in the First Batch of "Artificial Intelligence + Higher Education" Exemplary Application Cases, Ministry of Education
2024, "AI+X" micro-major program, included in the Second Batch of "Artificial Intelligence + Higher Education" Exemplary Application Cases, Ministry of Education
2024, "101 Plan" for Mechanics Discipline, Ministry of Education
2025, AI Empowers the Mechanics "101 Plan" — The "AIM" Large Language Model, included in the Third Batch of "Artificial Intelligence + Higher Education" Exemplary Application Cases, Ministry of Education
2025, Pilot University and Secretariat Institution for Comprehensive Reform in Higher Education

2. Third-Party Evaluation: Present evaluations received by the case regarding its application effects, innovative practices, etc., such as user evaluations, expert review opinions, third-party testing and certification, positive public opinions, etc. (If available, the evaluation subject, information source, and other relevant supporting documents should be specified).

3. Case-related images, videos, and other materials. (Can be attached via cloud drive or provided as separate attachments).

Case 90

AI-Empowered & Interdisciplinary Innovative Talent Training Case Driven by Joint Research on a Low-Altitude Vehicle

Beihang University, Beijing, China

Background

Higher education in the new era is undergoing a profound transformation from knowledge transmission to competency development. Traditional engineering education is plagued by prominent issues such as disconnection between theory and practice, insufficient interdisciplinary integration, shallow adoption of artificial intelligence, and inadequate practical platforms. It can hardly meet the national strategic demand for interdisciplinary innovative talents in low-altitude economy and intelligent aviation.

Against the rapid development of AI and the full opening of low-altitude airspace, and combining the strong demand for navigation and positioning technologies in future low-altitude industries and vehicles as well as China's goal of building a more ubiquitous BDS-2035, enhancing AI literacy, engineering practice and interdisciplinary capacity has become an urgent task.

Centered on innovative talent training models, this case focuses on curriculum reform, taking project-based learning of low-altitude vehicles and the featured program "BDS LEO Constellation Design" as practical carriers. It deeply integrates BUAA-developed large models, BDS technologies, panoramic experimental classrooms and the fully digitalized aircraft science-education innovation center.

An AI-empowered, deeply interdisciplinary and closed-loop engineering training system is established via scenario-driven panoramic education. It aims to improve students' intelligent design, systems engineering and innovation capabilities, supporting the integrated development of low-altitude economy and BDS, and the high-quality advancement of China's aerospace science and technology.

Case Implementation Status

This case carries out full-process and systematic practices around AI-empowered talent training, forming a implementable and iterable implementation path in terms of demand analysis, technical support, teaching reconstruction, application optimization and other aspects.

In the demand analysis stage, closely focusing on the development trend of artificial intelligence and the urgent demand for talents in the low-altitude field, we focus on strengthening the capabilities of low-altitude aircraft navigation and positioning as well as satellite system design, and clarify the core capabilities that students in the aerospace field should possess, including aircraft overall design, Beidou navigation application, intelligent algorithm application, interdisciplinary collaboration, digital verification and so on. We have shifted the training goal from knowledge memory to problem solving and system innovation, promoted the overall transformation of the curriculum system, teaching methods and evaluation methods, and established the implementation route of "project traction, AI empowerment, platform support and interdisciplinary integration".

In terms of technology research and development and platform construction, we have built new digital means integrating science and education and empowering with digital intelligence. Integrating revolutionary and disruptive technologies such as big data, artificial intelligence and virtual reality, we have invested more than 23 million yuan to build a "new generation of fully digital aircraft science-education collaborative innovation platform" that integrates science and education, combines virtual and real, and integrates software and hardware. The cloud end integrates 109 industrial software, more than 30 customized professional modules, virtual simulation systems, more than 4000 equipment example data, 1 set of "AI+" aircraft scheme intelligent design system and panoramic experimental classrooms. Based on real Beidou satellite orbit data, a high-precision satellite operation environment is constructed to comprehensively support the innovative practice of "jointly developing a low-altitude aircraft" and the design of Beidou low-earth orbit constellation, providing students with a full-cycle engineering environment and cultivating "future designers who understand flight and navigation". We have upgraded curriculum textbooks digitally, creating 20 digital courses such as "Aircraft Overall Design" and "Application and Practice of Beidou Satellite Navigation System", 12 digital textbooks and other digital resources, forming a pattern of "building digital means, researching digital low-altitude and cultivating innovative talents".

In terms of teaching implementation and application optimization, taking "low-altitude project-based learning", "jointly developing an aircraft" and the design of Beidou low-earth orbit constellation as the core carriers, we implement project-based teaching throughout multiple semesters. For more than 20 consecutive years, we have continuously deepened integration with industrial departments such as Aviation Industry Corporation of China and Commercial Aircraft Corporation of China, building a multi-level and full-chain project-led talent training model at the curriculum level, cross-major, cross-college and national levels. Centering on national strategic needs, we have integrated 109 industrial software, nearly 30 digital design professional modules and virtual simulation experiments into curriculum design, professional design, graduation design and other links. Curriculum teaching has shifted from one-way teaching to seminar-based, inquiry-based and collaborative teaching, and teachers have turned into guides and organizers, cultivating students from "being able to learn" to "being able to create", with engineering practice capabilities in Beidou navigation system design and low-altitude aircraft application.

Case Innovation and Breakthroughs

1. Main Innovation Content

Innovation in Teaching Model: We have constructed a competency-oriented training model led by

"low-altitude project-based learning + joint research on a low-altitude aircraft + Beidou low-earth orbit constellation design". It integrates scattered courses into integrated engineering tasks, realizes a fundamental transformation from knowledge transmission to competency development, and forms a new paradigm of "learning by doing and innovating by researching".

Innovation in Technology Application: We have deeply embedded BUAA self-developed large model technology, AI-aided Beidou constellation design engine, panoramic experimental classrooms, fully digital aircraft science-education collaborative innovation center, domestic industrial software and other elements into the multi-level whole teaching process. It realizes the full-domain integration of AI technology and professional education, forms a cycle of scientific research feeding back teaching and industry driving innovation, and achieves the teaching practice of "designing domestic equipment with independent technology".

Innovation in Interdisciplinary Integration: Taking low-altitude aircraft and Beidou navigation system as carriers, we have broken through the boundaries of aviation, aerospace, satellite navigation, artificial intelligence, management and other disciplines, formed a training pattern of collaborative application of interdisciplinary knowledge, methods and tools, and improved students' ability to solve complex engineering problems across disciplines.

2. Content of Technological Breakthroughs

Multiple landmark technological breakthroughs have been achieved: First, the large model independently developed by BUAA has been applied on a large scale in the teaching of aircraft design and Beidou constellation design, with capabilities of intelligent scheme generation, multi-objective optimization and natural language interactive design. It can automatically generate multiple sets of aircraft and satellite constellation concept schemes within a few minutes, improving the efficiency by more than 80% compared with traditional manual design. It fills the gap in the engineering application of AI-aided design teaching in universities and realizes the leap of large models from "auxiliary tools" to "core teaching support".

Second, a full-process digital aircraft science-education collaborative platform with more than 450 sets of equipment has been built, which has completely changed the previous situation where students could not fully carry out the whole process of aircraft design practice due to the lack of complete hardware conditions and digital environment. The platform can accommodate more than 40 students to carry out more than 10 digital aircraft design experiments at the same time, realize cross-regional distributed linkage among 3 campuses and collaborative design among multiple colleges, provide key support for students' innovative practice with cutting-edge digital means, and set a benchmark platform for the digital transformation of aircraft engineering education in universities.

Third, the in-depth integration of immersive panoramic experimental environment and intelligent teaching system has solved the pain points of traditional experiments such as "high risk, high cost and difficulty in reproduction". The cost of experimental teaching has been significantly reduced, the efficiency has been greatly improved, and students' sense of immersion and interactivity have been significantly enhanced, building a new experimental teaching paradigm of "combination of virtual and real, intelligent interaction and full-process traceability".

3. Content of Application and Practice Breakthroughs

In the past three years, the achievements have been featured on CCTV 10 times and reported more than 30 times by mainstream media such as CCTV News, CCTV Science and Education and Xinhua News,

CCTV Science and Education and Xinhua News Agency. Curriculum-level student teams have completed more than 1,000 aircraft concept schemes, and the interdisciplinary model aircraft team designs 5-10 aircraft every year, winning championships in international and national competitions repeatedly. For four consecutive years, it has jointly carried out cross-college joint team graduation design with more than 200 teachers and students from 10 colleges of 3 universities. It takes the lead in holding national competitions, radiating more than 4,000 teams from nearly 300 universities in 30 provinces and cities. More than 40 teaching papers have been published in core journals such as "Research in Higher Education of Engineering". The achievements have been learned from and applied by nearly 50 universities and industrial departments including Tsinghua University, Peking University and AVIC 601 Institute, covering more than 90% of key universities in China that offer majors related to aircraft design and engineering, aerospace engineering.

4. Status of Intellectual Property Rights

All intellectual property rights related to this case belong to Beihang University and the project R&D team, covering multiple types such as teaching models, software systems, experimental platforms, teaching resources and intelligent algorithms, forming a full-dimensional independent intellectual property system of "patents, software copyrights, teaching achievements and standards". A total of more than 20 authorized invention patents and software copyrights have been formed, and it has won the first prize of Beijing Teaching Achievements as a core achievement, all of which are independent intellectual property rights. It is leading domestically and first-class internationally in the fields of AI-empowered aircraft engineering education, digital science-education collaborative platforms and immersive experimental teaching, providing a replicable and promotable intellectual property protection and application paradigm for the digital transformation of engineering education in universities.

Promotion Value and Risks

1. Application Prospects and Achievements

This case has been steadily implemented in majors such as Aircraft Design and Engineering, Low-Altitude Technology and Engineering of Beihang University, forming a replicable system. Since its operation in September 2022, the Fully Digital Aircraft Science-Education Collaborative Innovation Center has supported more than 10,000 student experiments and scientific innovations, 4 rounds of cross-college team graduation designs (winning Beijing Excellent Graduation Thesis (Team Category)) and 7 virtual simulation experiments. The low-altitude project-based learning covers 2024 and 2025 grades of Low-Altitude Technology and Engineering major, with co-constructed bases with COMAC, XPeng Huitian, etc. Relying on the Ministry of Education Virtual Teaching and Research Office for Aircraft Design and Engineering and the Low-Altitude 101 Plan, it serves more than 40 aerospace universities nationwide.

2. Social and Economic Value

The project-based learning and "joint research on an aircraft" model radiates 300 universities nationwide through the national China University Student Engineering Practice and Innovation Ability Competition (Aircraft Design Simulation Event). The digital laboratory serves more than 5,000 person-times annually. The digital transformation of education reduces investment in high-risk and high-cost physical experiments, greatly lowers enterprise adaptation costs, and enables students to have

interdisciplinary engineering practice capabilities upon graduation.

3. Demonstration and Leading Role

This case sets a benchmark in full-cycle AI integration, project-driven teaching, interdisciplinary integration and scientific research platform feeding back teaching. The constructed "AI + Panoramic Classroom" integrated with Beidou navigation teaching model contributes a Chinese solution to global digital education innovation. Meanwhile, relying on the Ministry of Education Virtual Teaching and Research Office, it has radiated more than 40 aerospace universities and nearly 10 research institutes.

4. Potential Risks

Technological Risks: Large model iteration requires continuous computing power and data investment, with high annual maintenance costs of hardware platforms; data security and algorithm reliability need long-term guarantee. Ethical Risks: Over-reliance on AI may weaken students' basic abilities and critical thinking; institutional norms are needed for team evaluation fairness, intellectual property ownership and achievement transformation to prevent ethical and management risks.

Other Relevant Information

1. Case Award Status

Serial Number	Project Name	Award Time	Awarding Department
1	"Construction of Digital Teaching Resources for the Course of Aircraft Overall Design" — Excellent Project Case of the University-Industry Collaborative Education Program of the Department of Higher Education, Ministry of Education, PRC	2024.11	Department of Higher Education, Ministry of Education, PRC
2	"Construction of Digital Teaching Resources for the Course of Aircraft Overall Design" — Typical Project Case of the 10th Anniversary of the University-Industry Collaborative Education Program of the Department of Higher Education, Ministry of Education, PRC	2023.04	Department of Higher Education, Ministry of Education, PRC
3	"Virtual Simulation Experiment on Exploration and Design of Stealth Aircraft" — First Batch of National Virtual Simulation Experiment Teaching Courses of the Ministry of Education, PRC	2020.11	Ministry of Education, PRC

Serial Number	Project Name	Award Time	Awarding Department
4	"Virtual Simulation Experiment on Design and Application of Aviation Emergency Rescue System" — Third Batch of National Virtual Simulation Experiment Teaching Courses of the Ministry of Education, PRC	2025.12	Ministry of Education, PRC
5	"Yuling — High-Security Aircraft Architecture Scheme" — National Special Prize of the "Challenge Cup" "Top Talent Recruitment" Special Competition of the Ministry of Education, PRC	2025.12	Ministry of Education, PRC
6	"Exploration of Intelligent Aircraft Design Methods — Research and System Development of Aircraft Overall Scheme Design Methods Based on Generative Artificial Intelligence" — First Prize of the "Qingju AI" Artificial Intelligence + Special Competition of the Beijing Municipal Commission of Education	2025.12	Beijing Municipal Commission of Education

2、Third-Party Evaluation

Partial news reports

CCTV 13
新 闻
时空观察
压学分减"水课" 高校人才培育如何添分量？
学分减了 人才培养该"加"些什么？

CCTV 1
综 合
学生要学习怎样应用无人机遥感以及人工智能技术

央视财经 正直播
财经时刻 AI "智"造 3分钟就能设计出国产超音速飞机？

3、Case-related images, videos, and other materials

(1) Aircraft conceptual design system based on LLM： AI-link

(2) New Generation Fully Digital Aircraft Science and Education Collaborative Innovation Center

Case 91

ATMO Platform

Zakhar Symchych

Atmospheric School, Ukraine

Function Overview

ATMO Platform is an integrated, AI-enabled digital education technology solution developed and operated by Atmospheric School. It combines (1) an LMS core, (2) a structured multi-curriculum content library, (3) learning analytics with AI-enabled insights, and (4) an end-to-end Career & University Track — in one connected system. The platform was built for real operational constraints, including crisis and displacement contexts, where learners may face unstable connectivity, fragmented schedules, and learning gaps.

Core functions (end-to-end learning lifecycle)

1) Learning delivery (LMS core): role-based access (student/teacher/parent/admin), course & lesson delivery, assessment workflows, communication and support.
2) Multi-curriculum content: structured learning objects aligned to different curricula; consistent lesson/test structure; reusable content components.
3) Learning progress & evidence: continuous progress tracking at lesson/module/course level; dashboards for students and parents; teacher and admin reporting views. *Example metric used in dashboards: "My performance" is expressed as a percentage of the maximum achievable grade points for the selected period (see Figure 3 in Appendix A).*
4) AI-enabled analytics and learning support: data-driven insights from platform usage and learning signals; diagnostics for learning difficulty and gaps; improvement loops supported by embedded feedback and analytics.
5) Career & University Track: interest and pathway tracking, curated professions and universities, and structured admissions preparation steps.
    - The "Career Fit Score" shown as percentages (0–100%) summarizes the alignment between a learner's profile (interests, academic performance, learning progress) and the selected pathway requirements (see Figure 2 in Appendix A).

    Educational pain points addressed
    - Continuity of learning for geographically distributed and displaced learners (cross-border mobility, time-zone shifts, and disrupted routines).

- Fragmented digital stacks: separate logins and disconnected data between LMS, content tools, analytics, and counselling systems.
- Limited visibility of progress for teachers, parents, and administrators; delayed identification of learners at risk.
- Guidance disconnected from evidence: career planning and university readiness often sit outside learning data and classroom practice.

Core Value

ATMO Platform provides a single, integrated ecosystem where learning content, learning evidence, analytics, and guidance work together as one system. This reduces integration burden for schools and families and enables measurable improvement through continuous monitoring and feedback loops. The same data loop supports: (a) teaching & learning (instruction and support), (b) educational governance (transparent progress and early interventions), and (c) public-service outcomes in crisis contexts (continuity and equity of access).

High-level product architecture diagram

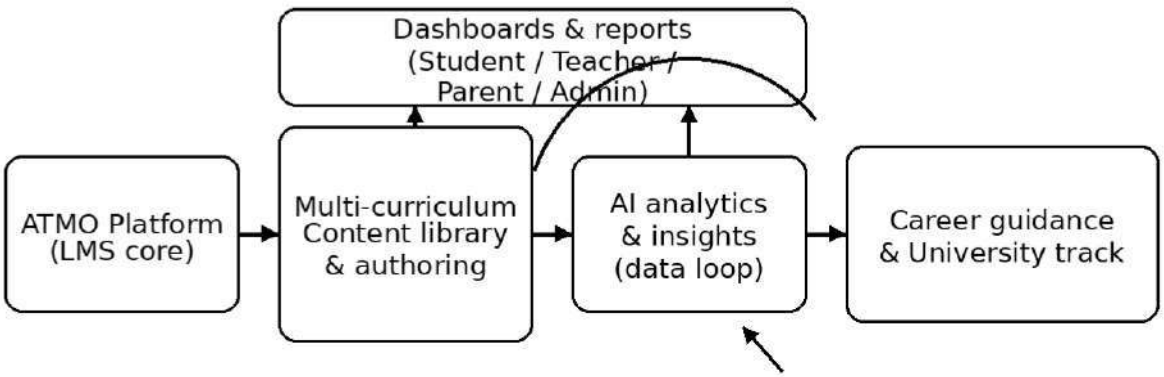

Figure 1 provides a high-level architecture overview.

Technical Highlights / Innovations

1) Integrated “data loop” across modules

Unlike modular stacks that connect separate LMS, content tools, analytics, and counselling platforms, ATMO Platform is designed as one integrated system. A unified data model links learner activity, assessment evidence, feedback signals, progress trends, and career pathway actions—enabling consistent dashboards and decisions.

2) Designed for crisis, displacement, and low-resource environments

ATMO Platform was built to operate under unstable connectivity and disrupted schedules, supporting continuity of learning for mobile and displaced learners and enabling families to sustain learning routines across locations.

3) Embedded feedback at scale + mature monitoring loops
The platform captures in-product lesson/test ratings and structured feedback and combines them with operational analytics to prioritize improvements and track impact over time—creating a repeatable "measure → improve → re-measure" loop informed by educators and learners.

4) Role-specific dashboards that enable action
Students and parents receive transparent progress visibility; teachers and administrators receive aggregated progress and engagement signals to support timely interventions and learning governance (see Appendix A examples).

5) Responsible and pedagogically guided AI (teacher agency + trust)
AI-enabled features are used with pedagogical intent: they support learning through explanations, hints, and diagnostics (rather than simply "telling" answers), while keeping accountability with educators and learners. The platform is operated as a school-grade system where privacy and trust are treated as first-order product requirements.

6) Multilingual user interface for cross-border learning
ATMO Platform supports multilingual UI (e.g., English and Ukrainian), enabling use by learners, families, and educators in international and cross-border contexts (see Figure 4 for an example view).

Application Environment and Implementation Targe

ATMO Platform is suitable for fully online and blended learning models in K–12 contexts, as well as supplementary learning programs delivered by schools and partner organizations. It is accessed via standard web browsers on laptops and mobile devices, and is optimized for real-world constraints (including low-bandwidth conditions).

Implementation targets and roles

- Students: follow structured learning paths, complete lessons and assessments, track progress, and use career/university guidance tools.
- Teachers and tutors: assign learning tasks, review evidence of progress, provide feedback, and monitor engagement and learning gaps.
- Parents/guardians: view progress dashboards, support learning routines, and participate in structured progress conversations.
- School administrators / program coordinators: access aggregate dashboards, engagement indicators, and governance reports to support decision-making.

Examples of Typical Application Scenarios

Scenario A — Crisis-resilient cross-border continuity for displaced learners (Ukraine + international locations)

Context: In 2025–2026, Atmospheric School supported a distributed community affected by crisis-driven mobility and forced displacement, with learners and educators located in Ukraine and 39 other

countries. Families needed stable learning pathways, consistent teacher support, and clear progress visibility while adapting to new time zones, interrupted routines, and connectivity constraints.
Implementation: Learners access multi-curriculum learning materials and assessments through ATMO Platform. Teachers monitor progress via dashboards and assessment evidence, while parents track weekly progress and support routines using the time tracker. AI-enabled analytics provides visibility into engagement patterns and learning difficulty signals, supporting timely interventions.
Outcome focus: Continuity of learning + transparent progress for families + actionable governance signals for educators.

Scenario B — End-to-end learning + guidance for student success (teaching & learning + governance)
Context: Schools and education providers often operate separate tools for content delivery, analytics, and career counselling, making it difficult to connect learning evidence to guidance decisions.
Implementation: ATMO Platform connects learning progress, assessment evidence, analytics, and pathway planning in one system. Administrators and coordinators use aggregated dashboards for governance and student success monitoring, while students use the Career & University Track to set goals, compare pathways (Career Fit Score), and plan admissions action steps alongside academic progress.
Outcome focus: Faster interventions + fewer "data gaps" between teaching, monitoring, and guidance + clearer next steps for learners.

Operational note (implementation insight)

In new contexts, ATMO Platform is typically deployed through a structured rollout: role configuration, content/curriculum mapping, teacher onboarding, and an initial monitoring period using dashboards and embedded feedback to tune workflows before scaling.

Implementation Results, Evaluation Data or Practical Experience

Scale and reach (typical case window: 2025–2026)

- Location footprint: Ukraine + 39 countries
- Scale: ~60,000 platform ecosystem users (learners, educators, parents) reached

Operational usage and engagement evidence (aggregated, anonymized)

- GA4 analytics snapshots show approximately 7.1k active users and 3.3k new users, with an average engagement time of 1h 52m and ~2.1M tracked events during the reporting window, demonstrating stable usage under real-user load.
- Measurement notes: "active users", "engagement time", and "events" follow GA4 standard definitions; "events" refer to tracked user interactions within the platform (e.g., lesson opens, assessment actions, navigation, and support interactions). Indicators are aggregated and anonymized.

User satisfaction evidence at scale (embedded feedback)

- 69,549 ratings were submitted in-product (50,908 lesson ratings and 18,641 test ratings). Positive ratings (5/5) account for 91.0% of lesson ratings and 90.3% of test ratings.

- Definition notes: ratings are submitted immediately after a lesson or test activity; 5/5 indicates the highest satisfaction score.
- 1,016 structured feedback entries were submitted (812 lesson; 204 test), including 99 non-empty text comments.

External feedback (parents/guardians)

- In a parent feedback survey, 103 out of 122 respondents (84.4%) answered "Yes" to having a positive learning experience on the platform. Learning engagement & progress indicators (program-level metrics)
- Reported indicators include 75% retention, 66% course completion, and 70% average learning progress, supported by progress dashboards and monitoring exports.
- Definition notes: retention refers to the share of enrolled learners remaining active over the tracking period; course completion refers to the share of assigned course units completed; average progress refers to mean completion of assigned learning plans across active learners.

Usability and advocacy indicators (structured user research)

- SUS 78.4; NPS +32; weekly-use intent 82%.
- Top-rated features included "why incorrect" explanations (92%), hints (88%), privacy (90%), and personalisation (82%).
- Method note: SUS/NPS and feature ratings come from structured user research (focus groups and guided usability sessions) conducted during 2025–2026; results are reported in aggregated form.

(2) Replicability, Sustainability and Promotion Potential

Replicability: The platform is modular and curriculum-flexible, allowing adaptation across countries and curricula by configuring content and learning pathways while keeping the same LMS and analytics backbone. Role-based dashboards and embedded feedback loops support consistent implementation in new contexts.

Sustainability: ATMO Platform operates with mature monitoring, support, and improvement processes (analytics + embedded feedback + structured progress reporting). Continuous iteration is driven by real usage signals and user feedback.

Promotion potential: The integrated "platform + content + analytics + guidance" model reduces integration burden for schools and accelerates adoption. It is suitable for international partnerships here institutions seek a complete, ready-to-operate digital learning ecosystem.

Replicable implementation pathway (typical)

1) Context scoping and success metrics (teaching & learning + governance indicators)
2) Content and curriculum configuration (multi-curriculum mapping)
3) Role setup and data governance (student/teacher/parent/admin workflows)
4) Onboarding for teachers and families (how to use dashboards and feedback loops)
5) Pilot monitoring (engagement, progress, and satisfaction signals)
6) Scale-out and continuous improvement (measure → improve → re-measure)

Cooperation models (for replication and international collaboration)

- Platform adoption by schools or education providers, with onboarding, support, and shared KPI dashboards.
- Integrated “platform + content” partnership for institutions that need a ready-to-operate multi-curriculum package.
- “Analytics + guidance” module deployment as an add-on to improve governance and student success pathways.
- Joint evaluation / knowledge-exchange partnerships: shared monitoring indicators, anonymizedinsights, and implementation learnings.

(3) Illustration of a Typical Case (time, location, scale, key outcomes)

Time: 2025–2026

Location: Ukraine + 39 countries

Scale: ~60,000 platform ecosystem users (learners, educators, parents) reached.

Key outcomes: Crisis-resilient continuity of structured learning for displaced learners; measurable engagement and satisfaction at scale; transparent progress visibility for learners, parents, and educators; and an end-to-end pathway that connects learning evidence with career and university readiness support.

(4) Exhibition Materials (proposed plan)

Proposed 5–7 minute interactive demo with four role-based flows (Student, Teacher, Parent, Admin) plus a guided walk-through of the Career & University Track and analytics dashboards.

Suggested exhibition setup: 1 laptop + 1–2 tablets, stable Wi-Fi, and optional external display for dashboards.

Demo environment note: screenshots and demonstrations use a privacy-safe demo environment with synthetic user identities and illustrative avatars/photos; no personal data is used.

(See Appendix A, Figures 2–5 for example UI screenshots used in demonstrations.)

Institution Introduction

Atmospheric School is a Ukrainian education organization established in 2001. It develops and operates ATMO Platform to provide a complete digital school ecosystem supporting students, educators, parents, and administrators, with a focus on continuity and quality of learning in disrupted environments.

Establishment date: 2001

Service scope: K–12 online schooling, multi-curriculum digital learning delivery, integrated learning analytics, and student guidance services (career pathway and university readiness support).

Global presence: In 2025–2026, the platform supported a distributed community across Ukraine and 39 other countries.

Experience or Qualifications in the Field of Digital Education

Atmospheric School’s digital education experience is grounded in real-world platform operations at scale, with measurable engagement and structured monitoring and feedback practices. ATMO Platform

is operated as stable software supported by operational analytics, embedded user feedback, progress dashboards, and continuous improvement loops. Key strengths include:

- Crisis- and displacement-aware digital learning delivery (cross-border continuity).
- Integrated product design (platform + content + analytics + guidance) that reduces fragmentation and improves governance.
- Responsible, pedagogically guided AI that supports learning (explanations, hints, diagnostics) while preserving teacher agency and learner accountability.
- Multilingual delivery (e.g., English and Ukrainian) for international cohorts and cross-border families.

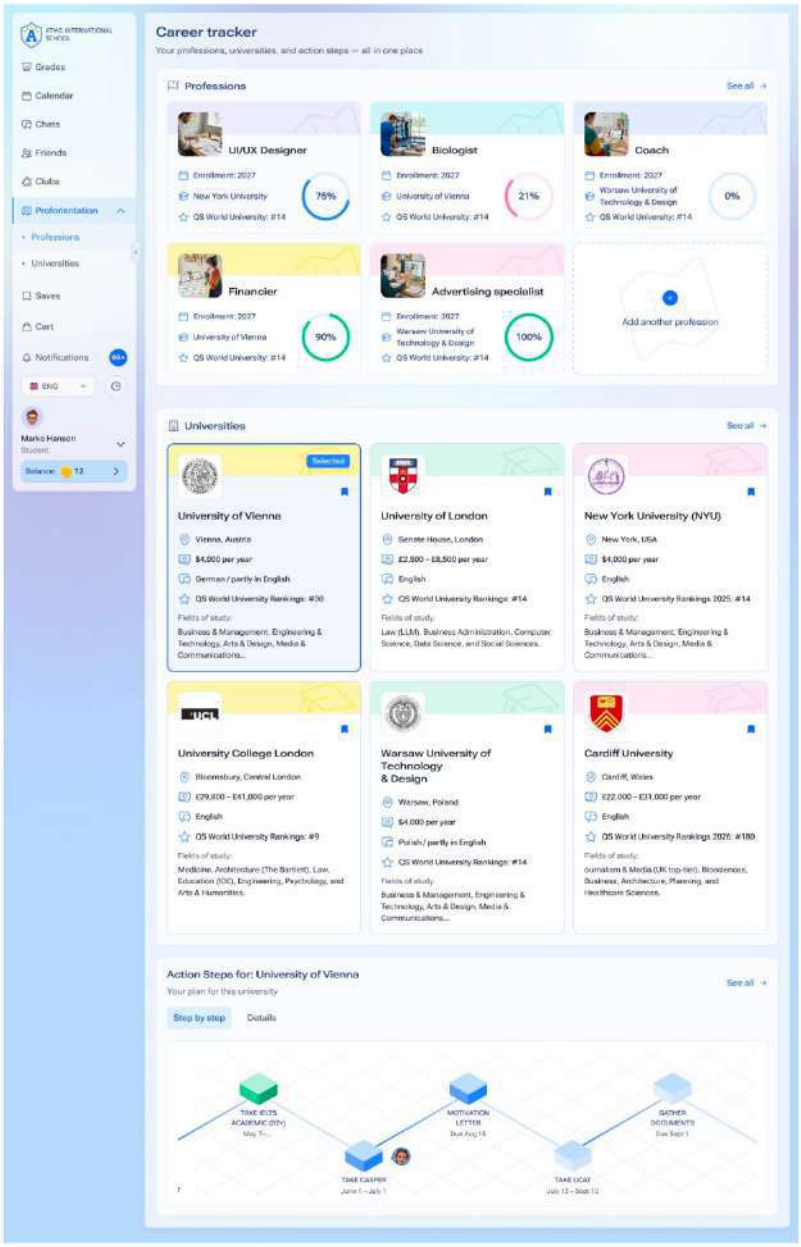

Figure 2 Career & University track (student view). Career Fit Score (0-100) indicates pathway alignment; Action Steps provide a time-bound checklist.

Case 92

AI-Driven Smart Preschool Community: Empowering Preschool Teachers' Professional Development Through Scenario Applications

Bureau of Education, Xiaoshan District, Hangzhou, Zhejiang, China

Background

Against the backdrop of high-quality preschool education development, teachers' professional competence has become the key to improving care and education quality. Policies including Kindergarten Care and Education Quality Assessment Guidelines and Preschool Education Law of the People's Republic of China emphasize strengthening teacher professional capacity and building a sound support system for teacher development.

However, regional promotion of teacher professional development faces multiple dilemmas: uneven teacher competence, with senior teachers struggling with new technologies and novice teachers lacking practical experience; unequal access to training, especially for teachers in rural and weak-kindergartens; heavy administrative workloads that drain professional energy; and difficulties in documenting, refining and disseminating excellent teaching practices.

To address these challenges, since 2022, Xiaoshan District has launched the Smart Preschool Community initiative. Guided by the logic of "AI as teaching assistant, nurturing assistant and learning assistant", the project builds an intelligent AI Preschool Platform to reduce teachers' administrative burdens, improve care and education quality, and support children's development. It aims to shift teachers from "routine paperwork" to "child-centered observation and research" through intelligent agents, mini-tools and resource repositories.

Case Implementation Status

The project follows a four-stage implementation path: demand-oriented, pilot verification, gradual promotion, and in-depth application, supported by an integrated AI Preschool Platform with modules of Teaching Assistance, Nurturing Assistance and Learning Assistance.

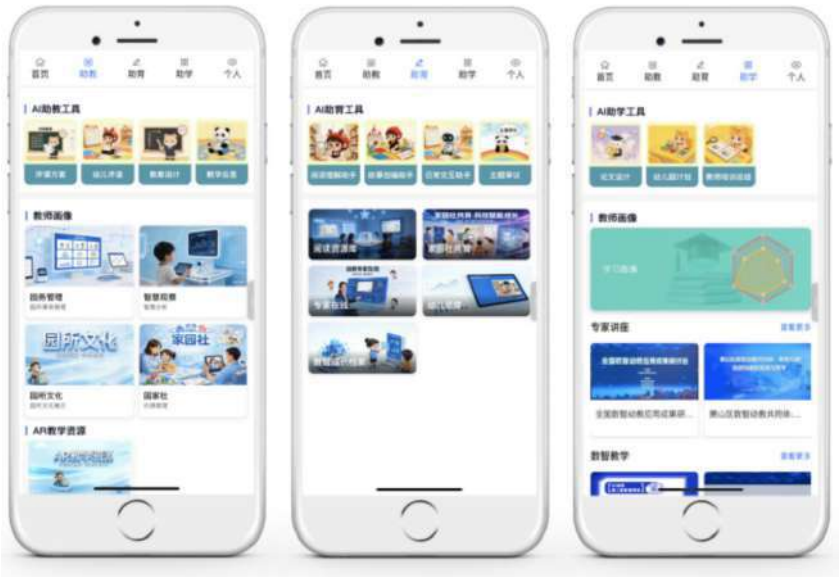

Figure 1 Mobile Client of AI Preschool Platform

Stage 1: Demand Identification (January 2022 – June 2022)

The project team conducted on-site interviews and identified four core pain points: unsustained child observation, lack of references for lesson design, excessive paperwork, and limited experience sharing. A tripartite collaboration mechanism (administrative promotion, research guidance, technical support) and a three-tier kindergarten echelon (pilot, leading, practice) were established, along with workshops and virtual teaching-research offices.

Stage 2: Tool Development and Pilot Application (July 2022 – June 2023)

Three categories of AI tools were developed:

Teaching Assistance Tools: AI writing assistant and intelligent scheduling to reduce administrative workload.

Nurturing Assistance Tools: intelligent observation recorder and curriculum generator to support evidence-based teaching.

Learning Assistance Tools: reading and physical-game resource libraries for children's development.

Five pilot kindergartens conducted in-depth trials and three rounds of iterative optimization.

Stage 3: Scenario Creation and Regional Promotion (July 2023 – December 2024)

Four core application scenarios were created:

Burden Reduction: AI tools cut weekly administrative time from 6.5 hours to 1.8 hours (72% reduction).

Scientific Care and Education: intelligent observation and curriculum reference enable data-supported teaching and daily professional dialogue.

Home-Kindergarten Collaboration: intelligent matching of teachers' intentions, parents' strengths and community resources upgrades cooperation to co-creation.

Resource Sharing: SAS platform with "one code for one kindergarten, one code for one teacher, one code for one family" enables barrier-free access to over 1,200 high-quality cases, narrowing urban-rural gaps. The model expanded from 5 to over 30 kindergartens.

Stage 4: Experience Refinement and Radiation (January 2025 – Present)

The project solidified practices into white papers and guidance manuals, realized low-cost resource

for new and weak kindergartens, exported models to Dingxi, Gansu, and continuously optimized platform precision and data security.

Case Innovation and Breakthroughs

1. Main Innovation Content

The project constructs a three-in-one support system: Teaching Assistance – Nurturing Assistance – Learning Assistance centered on teachers' real needs.

Teaching Assistance: Frees teachers from repetitive paperwork via AI writing and scheduling, allowing focus on high-value professional activities.

Nurturing Assistance: Transforms teaching from "experience-based judgment" to "evidence-supported practice" through intelligent observation and curriculum assistance.

Learning Assistance: Breaks "resource islands" via digital coding system, enabling dynamic sharing of high-quality resources and reducing urban-rural disparities.

2. Technology Breakthrough Content

Intelligent Observation Recording: AI behavior recognition auto-records child behaviors based on customized dimensions, supporting personalized analysis.

Intelligent Document Generation: NLP and education-specific corpus generate drafts of plans, records and notices within 30 minutes.

Interactive Resource Repository: Establishes "usage-feedback-iteration" mechanism for continuous optimization of resources.

SAS Platform & Coding System: "One garden one code, one teacher one code, one family one code" realizes accurate identification and efficient circulation of regional resources.

3. Application Practice Breakthrough Content

Workload Reduction: Administrative time reduced by 72%; weekly professional time increased by 2.5 hours.

Professional Capacity Improvement: Scores in observation, curriculum design and home communication rose by 28%, 35% and 22% respectively.

Resource Sharing: 1,200+ high-quality cases, 45,000+ downloads; virtual research office monthly activity rate 87%.

Urban-Rural Equity: Rural and weak kindergartens access premium resources at zero threshold; cross-regional collaboration fostered 400+ localized resources.

4. Intellectual Property Status

All achievements including the three-module system, SAS platform, coding mechanism, practical white papers and guidance manuals are original intellectual properties owned by Xiaoshan District Bureau of Education, available for research, promotion and curriculum transformation.

Promotion Value and Risks

1. Application Achievements & Prospects

The model has been applied in over 30 kindergartens in Xiaoshan, benefiting more than 256,000 children. It has been replicated in over 800 kindergartens across 30 provinces in China. The modular design and coding system support flexible replication and gradual expansion in other regions.

2. Social & Economic Value

Social Value: Empowers teachers, narrows urban-rural gaps, upgrades home-kindergarten collaboration and improves public satisfaction.

Economic Value: Low investment, high reusability; lightweight access via mobile devices without complex hardware, feasible for rural areas.

3. Demonstration & Leading Role

The "demand research – technology adaptation – mechanism guarantee – scenario creation – experience sharing" model provides a replicable path for preschool digital transformation. It promotes digital equity and inclusive high-quality preschool education.

4. Potential Risks & Mitigation

Technical Risk: Imperfect AI suggestions; teachers remain final decision-makers.

Ethical & Data Risk: Only collect educational behavior data; strict hierarchical authority and data security protocols.

Over-reliance Risk: Emphasize AI as assistant, not replacement; strengthen training on professional judgment.

Other Relevant Information

Case Award Status: Recognized as an excellent digital education innovation practice in Zhejiang Province and a typical case of national preschool education digital transformation.

Third-Party Evaluation: Highly evaluated by national preschool education experts for its practicality, innovation and equity; positive feedback from teachers, parents and kindergartens.

Supporting Materials: Platform interface screenshots, application scenarios, data charts and promotion videos are attached separately.

Case 93

Chat Alpha NKE: An AI-Powered WhatsApp Learning Assistant for Inclusive Digital Education in Africa

Emmanuel N'Guessan Krou

Groupement des Alphabétiseurs par les Techniques de l'Information et de la Communication (GA-TIC), Cote d'Ivoire

Function Overview

Chat Alpha NKE is an innovative AI-powered learning assistant integrated directly into WhatsApp, designed to democratize access to digital education in Africa. It addresses key educational challenges such as limited access to digital infrastructure, low digital literacy, lack of personalized support, and high dropout rates in training programs.

Unlike traditional e-learning platforms that require computers or advanced digital skills, Chat Alpha NKE operates within a familiar environment already used daily by learners. This eliminates technological barriers and enables immediate engagement.

The core functions of the solution include:

- Interactive learning via text and voice messages
- Real-time quizzes and exercises
- Personalized feedback and explanations
- Audio-based learning for low-literacy users
- Continuous access to learning content (24/7)
- AI-driven adaptation of learning pathways

The system follows a dynamic learning cycle: Question → Response → AI Analysis → Content Adaptation. This ensures that learners receive tailored support based on their performance, learning pace, and preferred formats. The core value of Chat Alpha NKE lies in its ability to transform smartphones into powerful learning tools, enabling inclusive, flexible, and continuous education for underserved populations.

Technical Higxhlights or Innovations

Chat Alpha NKE introduces several key technological and pedagogical innovations:

1. WhatsApp-Based Learning Integration

The solution operates entirely within WhatsApp, avoiding the need for additional applications or complex learning platforms. This significantly increases accessibility and adoption.

2. Adaptive AI Learning Engine

The system uses artificial intelligence to analyze:

- Learner performance
- Response accuracy
- Learning behavior
- Preferred formats (text, audio, interactive)

Based on this data, it dynamically adjusts content difficulty and delivery methods.

3. Scenario-Based Learning Architecture

The chatbot uses structured learning scenarios to guide learners through progressive skill acquisition, ensuring coherence and engagement.

4. Inclusive AI Design

Key features include:

- Speech recognition
- Text-to-speech
- Voice-based interaction
- Support for low-literacy learners

5. Teacher Analytics Dashboard

Educators receive real-time insights into learner progress, allowing targeted interventions and improved teaching efficiency.

6. Low-Infrastructure Technology Model

The system works on basic smartphones with low bandwidth, making it suitable for rural and underserved environments.

This combination of accessibility, adaptability, and inclusiveness makes Chat Alpha NKE a breakthrough solution in digital education.

Application Environment and Implementation Targets

Chat Alpha NKE is designed for environments with limited digital infrastructure, including rural and peri-urban areas.

Technical requirements:

- Basic smartphone
- WhatsApp application
- Low internet connectivity

Target users:

- Women in literacy programs
- Youth in vocational training
- Beginner digital learners
- Informal sector workers
- Educators and trainers

The solution is particularly effective in contexts where:

- Access to computers is limited
- Learners have low literacy levels
- Training resources are scarce

- Continuous learning support is lacking

Examples of Typical Application Scenarios

Scenario 1: Digital Literacy Training for Women (Côte d'Ivoire)

Within the Techno Agri-Women programme, learners use Chat Alpha NKE to:

- Learn reading and writing
- Practice numeracy
- Use mobile applications
- Simulate income-generating activities

Implementation:

- Learners interact daily with the chatbot
- Exercises and quizzes are delivered via WhatsApp
- Teachers monitor progress through analytics

Results:

- Increased engagement
- Improved literacy and numeracy skills
- Strong learner autonomy

Scenario 2: Continuous Learning Outside the Classroom

Chat Alpha NKE enables learning beyond physical training sessions.

Implementation:

- Learners access lessons anytime
- Practice exercises regularly
- Interact in WhatsApp learning groups

This ensures continuous education and reduces dependency on in-person training.

Implementation Results, Evaluation Data or Practical Experience

Pilot implementation results show strong impact:

Engagement:

- Participation increased from 94.7% to 100%
- 0% dropout rate after stabilization

Learning Outcomes:

- 94.4% achieved satisfactory results
- 82.2% maintained performance at higher difficulty levels

Performance:

- Over 90% above average in literacy
- 74% achieved top scores in numeracy

User Feedback:

- 93%–95% satisfaction rate

Increased confidence in digital tool usage

Replicability, Sustainability and Promotion Potential

Chat Alpha NKE is highly scalable due to:

- Use of existing platforms (WhatsApp)
- Low infrastructure requirements
- Flexible content adaptation

It can be replicated in:

- Literacy programs
- Agricultural training
- Health education
- Entrepreneurship training

Sustainability is ensured through:

- Continuous AI-driven learning
- Reduced training costs
- Hybrid human-AI model

llustration of a Typical Case

Case: Techno Agri-Women Programme

- Location: Côte d'Ivoire
- Target: Women in digital literacy training
- Duration: 6 weeks pilot

Key outcomes:

- Full participation (100%)
- Strong skill acquisition
- Improved economic application skills
- Continuous learning beyond training

Institution Introduction

GA-TIC is a non-governmental organization specialized in digital literacy and inclusive education. It focuses on empowering women and youth through innovative digital learning solutions.

The organization operates primarily in Côte d'Ivoire and aims to expand across Africa.

Its core activities include:

- Digital literacy training
- Educational innovation
- Development of AI-based learning tools

Capacity building for underserved populations

Experience or Qualifications in the Field of Digital Education

The *Groupement des Alphabétiseurs par les Techniques de l'Information et de la Communication (GA-TIC)* is a non-governmental organization established on **March 15, 2018** (official registration No. 0769/PA/SG/D2). Since its creation, GA-TIC has positioned itself as a **pioneer in West Africa** in leveraging digital technologies to enhance literacy and education for vulnerable populations.

GA-TIC's core mission is to promote **functional literacy and digital education** as key drivers of sustainable development, social inclusion, and economic empowerment. The organization provides literacy programs ranging from basic to advanced levels, integrating essential themes such as citizenship, peacebuilding, and environmental awareness. In parallel, GA-TIC develops and implements **digital education initiatives**, enabling learners to acquire practical skills in the use of smartphones, access to e-services, and digital financial tools.

Beyond education, GA-TIC operates at the intersection of **learning and development**. Its activities include economic empowerment programs (particularly for women and youth), support for income-generating activities (IGAs), and the strengthening of community resilience in fragile and underserved regions. The organization also invests in **research and innovation**, producing educational content, developing e-learning platforms such as *Chat-Alpha NKE*, and conducting field studies to inform evidence-based interventions.

GA-TIC's service scope is both **community-based and scalable**. Its methodology combines participatory approaches, local capacity building, and digital innovation to ensure sustainability and impact. The organization trains local facilitators, develops bilingual learning content (French and local languages), and deploys blended learning models adapted to low-literacy environments. Its programs cover multiple thematic areas, including literacy, digital skills, social cohesion, financial education, and professional integration.

The organization has demonstrated strong operational capacity through the implementation of large-scale projects targeting thousands of beneficiaries, particularly in rural and border regions of Côte d'Ivoire. Its interventions contribute to reducing illiteracy, bridging the digital divide, improving livelihoods, and strengthening social stability.

GA-TIC has gained **international recognition and credibility**. It was awarded the prestigious **UNESCO-Confucius Prize for Literacy in 2021**, acknowledging its innovative use of digital tools to sustain education during the COVID-19 pandemic. Furthermore, the organization holds **Special Consultative Status with the United Nations Economic and Social Council (ECOSOC)**, enabling it to contribute to global policy discussions on inclusive education, digital transformation, and poverty reduction.

With a growing network of partnerships involving government institutions, international organizations, and private sector actors, GA-TIC continues to expand its **global presence and influence**. Its scalable and adaptable model positions the organization as a key stakeholder in advancing digital literacy and inclusive education across Africa and beyond.

Case 94

Intelligence-Driven Three-Circle Model: Synergy and Mutual Growth： Practices in Building a New Ecosystem for Future Teacher Development in Nanhu District

Jin Jing

Nanhu District Bureau of Education and Sports, Jiaxing City

Background

Currently, the digital transformation of education has entered a critical phase. Artificial intelligence (AI) technology offers a historic opportunity to overcome bottlenecks in teacher professional development and reshape the regional educational ecosystem. However, at the regional level, three core challenges are commonly encountered: Firstly, there is an imbalance between teachers' digital literacy and their ability to apply AI, with a significant gap between "technical understanding" and "innovative application". Secondly, traditional teacher development models suffer from scattered resources, data silos and delayed evaluations, which makes it difficult to support large-scale personalised professional growth. Thirdly, technology is only superficially integrated with core educational scenarios, leading to a tendency to pursue "technology for technology's sake" and hindering the systematic realisation of educational effectiveness.

Nanhu District has a dual role as a Ministry of Education Experimental Zone for Compulsory Education Reform and a core pilot zone for Zhejiang Province's AI-Empowered Education Initiative. With a focus on cultivating "Future Teachers", the district has allocated nearly 100 million yuan in special funds for 2025 to implement the "AI Application Project in Education" across 33 primary and secondary schools and 25 kindergartens, benefiting over 4,000 teachers and more than 80,000 pupils. At the design stage, the district has moved beyond a mindset focused on isolated tool applications. Instead, it has anchored its efforts in three core pillars — "Digital Intelligence Hubs", "Digital Intelligence Research and Training", and "Digital Intelligence Profiling" — to systematically build a new regional ecosystem for the professional growth of "Future Teachers", characterised by data-driven approaches, human–machine collaboration, and closed-loop iteration. This approach has provided a proven and effective "Nanhu

Model" for addressing common challenges in regional educational digital transformation nationwide. In this project, the term 'future teachers' refers to a new generation of educators who possess digital literacy and the ability to apply AI tools. These educators can establish human-machine collaborative teaching models to enhance educational effectiveness systematically.

Key Approaches

In "Intelligence-Driven Three Circles · Collaborative Symbiosis", the "Three Circles" refer to the Digital Intelligence Hub (foundational support), Digital Intelligence Research and Training (capability pathways) and Digital Intelligence Profiling (evaluation loop). These three components work together through data interconnectivity to form an educational ecosystem in which teachers, technology and learning scenarios coexist harmoniously.

(1) Strengthening the "Digital Intelligence Hub" to Empower Classroom Innovation by "Future Teachers"

Nanhu District has taken the lead in establishing a regional digital infrastructure for smart education in the form of the "Nanhu District Smart Education Cloud Platform", which serves as the "nerve centre" for enhancing teacher development. Based on this cloud platform, data silos between the 'Learning in Nanhu' platform, DingTalk, and various application systems have been eliminated. It integrates applications covering teaching, learning, assessment, research and management, aggregates high-quality educational resources from cloud-based and local sources, and constructs an integrated matrix of smart teaching and learning scenarios.

Figure 1 Nanhu District Education Digital Cockpit

Nanhu District has taken the lead in establishing a regional digital infrastructure for smart education in the form of the 'Nanhu District Smart Education Cloud Platform', the 'nerve centre' for enhancing teacher development. Data silos between the 'Learning in Nanhu' platform, DingTalk and various application systems have been eliminated based on this cloud platform. The platform integrates applications covering teaching, learning, assessment, research, and management; aggregates

high-quality educational resources from cloud-based and local sources; and constructs an integrated matrix of smart teaching and learning scenarios.

Through a three-tier collaborative practice system comprising “regional leadership, subject-specific deepening and school-based grounding”, we will drive the development of an “AI-empowered” curriculum and teaching reforms. This will encourage teachers to explore the creation of immersive teaching environments featuring “teacher-machine-student” interaction and enable us to develop the distinctive “Learning at Nanhu” digital teaching system.

We will also develop a high-quality regional educational data repository. Led by the Research and Training Centre and supported by a core team of key teachers and distinguished educators, we will develop high-quality resources by building upon existing repositories such as Smart Classrooms, Spark AI Assistant, English Listening and Speaking, and Smart Homework, and regularly supplement the cloud platform with new content.

(2) Innovating “Digital and Intelligent Research and Training” to Lead the Competency Development of “Future Teachers”

The “Nanhu District Future Academy for Artificial Intelligence Applications” was established to bridge the competency gap between teachers’ theoretical knowledge and practical application. This initiative integrates AI and intelligent agents into every stage of teacher development—including training, research, competitions and evaluation—to create new professional development pathways for teachers.

We will conduct in-depth analyses of teachers’ “digital and intelligent profiles” across the district to assess their current professional competencies and training needs. Using the data mining and analysis capabilities of the cloud platform's big data educational insights system and the service support capabilities of the regional digital and intelligent research and training system, we will customise multi-level, series-based training courses for different groups of teachers. We will construct a four-dimensional integrated model for developing teachers' AI literacy, comprising 'theoretical immersion, application immersion, reflective immersion and ecological immersion', and conduct district-level training and on-site guidance activities through a three-tiered approach of 'basic training, specialised enhancement and "Leadership by Key Teachers"'.

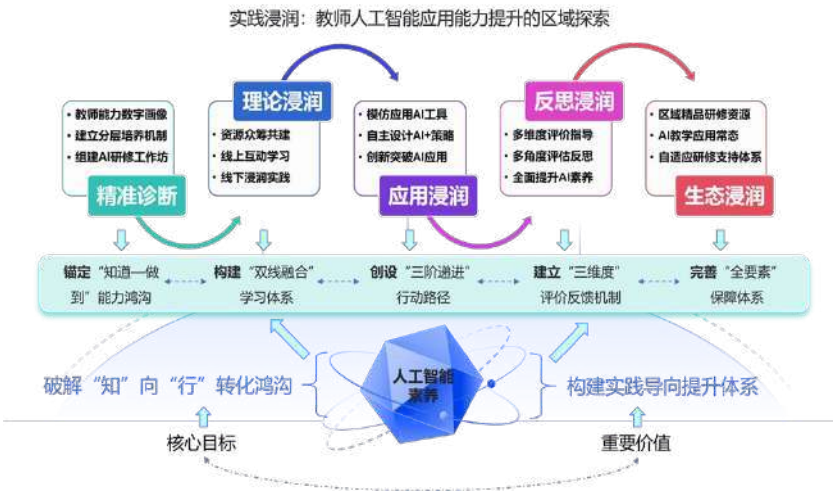

Figure 2 Model for the Development of AI Literacy Among Teachers in Nanhu District

We innovate a ubiquitous digital-intelligent research and training model characterised by 'practice-oriented, human-machine collaboration and evidence-based improvement'. Offline, we organise monthly 'immersive' subject workshops and AI-themed seminars, while holding regular events such as the 'Learning at Nanhu' Academic Festival with simultaneous live streaming via the digital-intelligent research and training system. Online, we leverage the digital-intelligent training system, centring on continuous learning, collaborative evolution and cultivating AI literacy among teachers and students. We crowdsource and co-create high-quality course resources, such as 'Model Lessons' and 'AI Courses' (including instructional videos, practical tasks and survey questionnaires). We implement a credit-based system comprising “required” and “elective” courses in order to intelligently recommend professional development resources, dynamically form thematic learning communities and fully adapt to teachers' individual learning paces.

Using the AI classroom recording analysis system, we conduct evidence-based teaching and research activities involving human-machine collaboration at district and school levels. These activities focus on real classrooms to refine lesson plans, conduct data diagnostics and analyse outcomes. District-level, subject-specific evaluation rubrics are designed for 'Exemplary Teaching and Learning Courses'. Multimodal classroom teaching behaviour data is seamlessly collected to generate AI analysis reports covering classroom structure, questioning levels, interaction frequency and so on. Targeted recommendations are provided across dimensions such as instructional process optimisation, interactive innovation, question design and balanced feedback. This drives the iterative deepening of 'student-guided teaching' across the district.

The district organises teachers to apply for specialised AI research projects, conducts periodic assessments of teachers' subject-specific competencies (including their ability to apply AI-enabled teaching methods) and hosts a district-wide AI Application Skills Challenge. This features multiple rounds of evaluation covering AI case studies, learning materials and companions, and the integration of AI into classroom teaching. Using competitions to drive research ensures that the innovative outcomes of the events are integrated back into daily teaching, forming a closed-loop system for competency enhancement that incorporates 'training, research, competition and evaluation'. Regular district-level 'Exemplary Student-Guided Lessons' showcase activities are also conducted to ensure that research outcomes and educational practice are aligned.

(3) Developing “Digital-Intelligent Profiles” to Support the Development and Evaluation of “Future Teachers”

Using specific scenarios as units, we collect and standardise multimodal data on teachers' activities in teaching, research, training and management across the region, via continuous data collection through a cloud platform. This has enabled us to construct a regional 'digital-intelligent profile' model for teachers, encompassing 15 major dimensions and 61 core indicators and dynamically presenting their comprehensive development trajectories.

We have established a multi-dimensional and integrated application mechanism for the 'Digital Intelligence Profile'. Through human-machine interaction, the profile model is dynamically refined and fine-tuned, enabling mutual empowerment and collaborative evolution between teachers and the model. Based on group profiles, regional or school administrators can accurately grasp the overall characteristics of the teaching staff, the faculty structure, and its strengths and weaknesses. They can also conduct horizontal analyses of teacher behaviour in terms of time, space and device usage. This

provides data to optimise faculty allocation and formulate research and training plans. Based on individual profiles, the cloud platform intelligently recommends personalised learning resources and development pathways for each teacher. It also provides professional growth forecasts and evidence-based recommendations to support self-directed, on-demand learning based on visual data.

Practical Outcomes

(1) Digital-Intelligence Hub Enhances Efficiency and Empowerment, Comprehensively Restructuring Classroom Teaching Models

During the first semester of the 2025–26 academic year, the entire district conducted a comprehensive exploration of 'teacher-computer-student' triadic interactive classroom teaching. A total of 820,000 resource references were accumulated, with courses conducted 40,000 times and tools applied 52,000 times. Compared to the same period in the previous academic year, the efficiency of teachers' lesson preparation and delivery increased by an average of 30%, and classroom interaction rates increased by 40%. AI-enabled teaching scenarios, such as AI virtual character interactions in Chinese, AI-powered precise feedback in mathematics, AI-assisted listening and speaking assessments in English, AI-enhanced experimental enquiry in science and AI-supported movement assessment and training in physical education, have become routine applications across the district. These developments were subsequently reported in the mainstream media, including the Guangming Daily and Xuexi Qiangguo.

Figure 3 The “Learning at Nanhu” Digital Teaching System

(2) Precision Foundation-Building Through Digital and Intelligent Research and Training, Leading to a Systematic Leap in Teachers’ Professional Competence

During the first semester of the 2025–26 academic year, over 500 on-site and district-level guidance

and training sessions were conducted. The effectiveness of research and training has significantly improved based on precise diagnostics derived from the 'digital and intelligent profiles' of all district teachers. Over 50 AI pioneer teachers have been developed and the routine usage rate of AI tools among all district teachers now exceeds 80%. An integrated 'training, research, competition and evaluation' closed-loop system has been implemented for capacity building, effectively integrating competition outcomes into daily teaching practices, significantly shortening the time it takes to move from“understanding”to “application”. Using the AI classroom recording analysis system, evidence-based teaching and research activities were conducted at district level, diagnosing a total of 441 lesson cases. Efficiency of classroom review and effectiveness of professional development increased by 86.7%, while the proportion of dialogue-based and higher-order thinking classrooms grew month by month. Twenty-four 'Exemplary Guided Learning Lessons' won awards in national, provincial and municipal competitions. The development of teachers' digital and intelligent literacy has been appropriately linked to excellence awards and performance evaluations, effectively stimulating teachers' intrinsic motivation for professional growth. The district's teacher professional development training programme has been rated 'excellent' at provincial level for nine consecutive years.

Figure 4 Nanhu District conducts a series of targeted district-school professional development activities based on teachers’ “digital and intelligent profiles”

(3) Scientific Navigation via Digital Competency Profiles: Upgrading the Effectiveness of Teacher Development Evaluation

The Nanhu District Smart Education Cloud Platform has over 1.13 million high-quality, cloud-based subject resources and more than 60,000 district-specific resources. It also has a high-quality assignment question bank containing 840,000 items. Using the digital intelligence research and training system, the platform has crowdsourced and co-created almost 500 resources, including 'Exemplary Learning-Guided Lessons' and 'AI Courses', that have received 50,000 views online. Offline research and training activities have been systematically documented to form a reusable expert training curriculum system. The established teacher digital intelligence profiling model features 15 dimensions and 61 core indicators to provide a comprehensive overview of teacher growth data across the district. This model offers scientific support for regional teacher allocation and training planning, and enables the creation of personalised development pathways for teachers. Currently, 94% of teachers in the district have

digital profiles. The structure of the teaching workforce continues to improve, with the number of senior-level teachers increasing to 21. The proportion of high-level talent is among the highest in the city, and the percentage of junior high school teachers holding master's degrees has risen to 15.26%. These developments have established a complete closed-loop system of 'data support—capability assessment—targeted measures—outcome feedback'.

Lessons Learned

Nanhu District's "Intelligence-Driven Three-Circle · Collaborative Symbiosis" initiative, centered on three core pillars—"Digital Intelligence Hub," "Digital Intelligence Research and Training," and "Digital Intelligence Profiling"—is building a new ecosystem for the future development of teachers in the region. By leveraging data integration capabilities, it organically integrates foundational support, research and training empowerment, and evaluation guidance, creating a virtuous cycle of deep collaboration among teachers, technology, and educational scenarios. This model offers a Chinese solution for overcoming bottlenecks in teacher professional development and systematically unleashing the educational potential of artificial intelligence. Moreover, through a framework of systemic transformation, it contributes the "Nanhu Wisdom"—a vision that is forward-looking, scientific, and actionable—to the global digital transformation of education, demonstrating its reference value to the world and its commitment to the times.

Case 95

AI-Empowered Lifelong Education: Innovation Practice of Artificial Intelligence Digital Infrastructure and Intelligent Applications

The Open University of China, Beijing, China

OUC Online Education Technology Co., Ltd.,Beijing, China

Solution Introduction

Lifelong education, as the core vehicle for building a learning society, is characterized by its orientation toward all people, lifespan-long coverage, massive learner scale, diverse demands, and dispersed scenarios. In the current development of large-scale online lifelong education, prominent pain points include insufficient personalized teaching support, high barriers to building intelligent applications, and the difficulty of universal access to quality resources and services, urgently requiring a unified intelligent technology infrastructure for support.

To address this, The Open University of China has independently developed an open, domestic artificial intelligence digital infrastructure for lifelong education. With “unified infrastructure-layered customization-ecosystem co-construction” as its core philosophy, this infrastructure fully integrates multiple domestic large models and multimodal AI capabilities, introduces technologies such as multi-agent collaboration frameworks and Model Context Protocol (MCP) , supports multi-agent collaboration in completing tasks, and achieves seamless integration of large models with external educational data sources and toolchains through standardized protocols, providing one-stop integrated support for the rapid development and flexible deployment of educational intelligent applications.

Built upon AI Digital Infrastructure, intelligent teaching practices have been carried out in two core scenarios: academic education and non-academic education. In the academic education scenario, multi-semester AI-empowered teaching pilots have been conducted around the artificial intelligence major, creating new paradigm courses of “AI+PBL+Cross-disciplinary”, establishing a teaching application

system covering the full process of lesson preparation before class, interactive inquiry in class and intelligent assessment after class, and simultaneously promoting application across multi-disciplinary courses within the open education operational system. In the non-academic education scenario, leveraging the Lifelong Learning Centre of the Smart Education of China Platform, comprehensive intelligent learning services have been constructed, including proactive intelligent learning companion, video learning navigation, knowledge graph, AI testing, and personalized learning reports, providing universal and personalized learning support for tens of millions of lifelong learners.

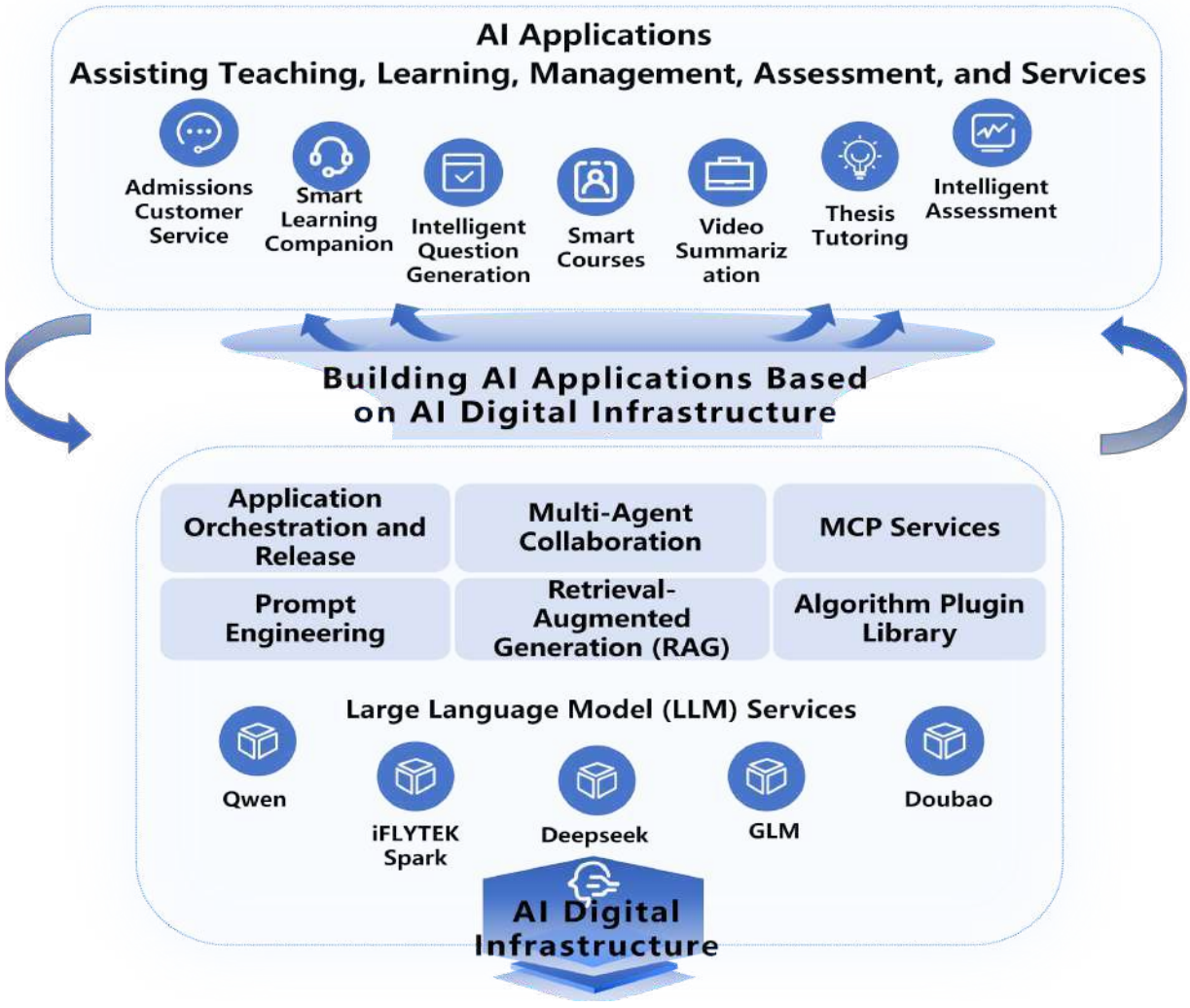

Figure 1 Overall Framework

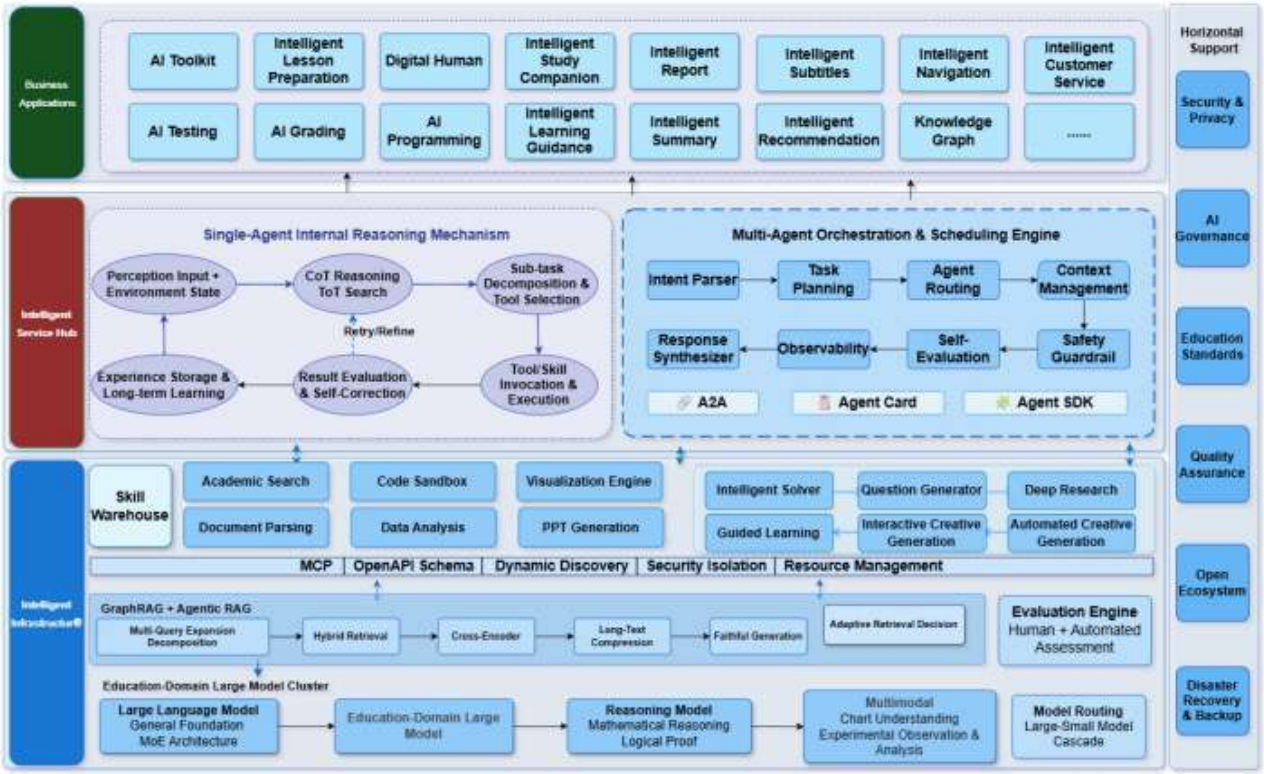

Figure 2 Technical Architecture

Application Scenario Innovation: Building a lifelong education full-chain intelligent scenario system. Distinguishing itself from traditional educational AI products that focus on single segments, this solution leverages a unified technology infrastructure to simultaneously serve two core scenarios: academic education and non-academic lifelong education. On the academic education side, with the artificial intelligence major as the pilot, it establishes teaching applications and new paradigm AI courses covering the full process of lesson preparation before class, interactive inquiry in class and intelligent assessment after class. On the non-academic education side, centering on lifelong learners' autonomous learning needs, it creates a service cluster including proactive intelligent learning guidance, intelligent study companion, knowledge graph, AI testing, and personalized learning reports. The same infrastructure outputs standardized capabilities, while two business lines customize applications on demand, achieving the leap from "single-point tools" to "full-scenario ecosystem" empowered by AI.

Teaching Paradigm Innovation: Building a new teaching model of "human-machine collaboration+educational evolution". Proposing a triadic collaborative model of teacher guidance, student inquiry and AI evolution, it deepens the philosophy of guided and heuristic teaching. In new paradigm AI courses, leveraging multi-agent collaboration technology, multiple specialized agents respectively undertake roles such as knowledge explanation, question guidance, practice assistance, and learning analytics, collaboratively building an immersive inquiry-based learning environment. This drives the transformation of teaching from one-way knowledge transmission to multi-subject cognitive collaborative development, adapting to the personalized lifelong learning needs of the new era.

Technology Architecture Innovation: Creating a self-controlled technology system of "layered decoupling+multi-agent collaboration". Independently developing a domestic AI digital infrastructure for the lifelong education domain, it constructs a specialized intelligent engine layer integrating general large models, education domain-specific knowledge injection, and deep adaptation to teaching business processes. It fully integrates multimodal large model capabilities, builds a multi-agent collaboration framework, and significantly lowers the application development threshold through pre-built components and low-code visual orchestration, achieving unified management and open scheduling of multiple AI capabilities, and supporting users to rapidly build application-layer agents in specialized domains.

Application Model Innovation: Forming a new model of "unified infrastructure-ecosystem co-construction". Adopting a promotion model of unified infrastructure, layered customization and ecosystem co-construction, it establishes standardized AI capability management specifications, breaks down resource barriers within the operational system, and achieves intensive allocation and reuse of intelligent capabilities. It builds an AI capability orchestration and agent center, realizing agile application iteration through a "data flywheel" closed loop, and supporting frontline teachers and students to autonomously build knowledge bases and agents. A replicable paradigm of "unified infrastructure+regionally distinctive applications" has been formed. Currently, the intelligent infrastructure has been promoted to 45 regional branches across the entire operational system, driving the transformation of learning services from "one-size-fits-all" to "personalized for each learner" and building a virtuous closed-loop ecosystem of technology supply, scenario innovation and education feedback.

Application Scenarios

This solution adapts to multi-level lifelong education scenarios, covering two core operational forms-academic education and non-academic education-and achieves deep integration of AI technology with teaching systems such as teaching platform of The Open University of China and the Lifelong Education Platform. In terms of hardware and software environment, it adopts a cloud-native deployment architecture and has built a high-performance computing cluster based on a hybrid architecture of private cloud and on-premise GPU servers, ensuring data security and self-controllability. The implementation scope covers teachers and students across 45 regional branches of the open education system, as well as tens of millions of lifelong learners on the Lifelong Learning Centre of the Smart Education of China Platform.

(I) Academic Education: Full-Process Intelligent Teaching in Artificial Intelligence Major Courses

Since the fall semester of 2024, The Open University of China has conducted a full-process pilot of AI-empowered teaching for the inaugural artificial intelligence major, undergoing continuous iteration across three semesters-fall 2024, spring 2025, and fall 2025, while simultaneously building various intelligent applications for multi-disciplinary courses within the open education operational system.

Pre-class: AI-Empowered Resource Production and Lesson Preparation. Building an AI Toolkit for teachers, leveraging the intelligent infrastructure to construct a multi-agent collaboration mechanism, providing efficient service support for upper-layer course resource production, lesson preparation, and question generation. The intelligent infrastructure's workflow orchestration engine automatically schedules multiple agents, including digital human courses, video segmentation, knowledge point extraction, and intelligent question generation-to collaboratively complete pre-class teaching resource preparation. Each agent accesses the course resource repository and video processing services uniformly through Model Context Protocol (MCP), building a standardized, automated resource preparation pipeline that provides technical support for upper-layer applications. Teachers use the digital human teacher avatar function in the upper-layer AI Toolkit to generate standardized, professional course learning guidance videos, lowering the threshold for video production. Utilizing AI video bookmarking and summary generation tools, teaching videos undergo intelligent segmentation, knowledge point annotation, and content summarization, enhancing the practicality and relevance of course resources. The intelligent question generation system automatically generates test questions based on course content, supporting functions such as one-click exam paper assembly and single-question refined polishing, forming a human-machine collaborative question design paradigm of AI intelligent generation and teacher professional review.

Figure 3 AI Toolkit for Teachers

Figure 4 Digital Human Course

Figure 5 Intelligent Question Generation

In-class: Intelligent Learning Companion and Scenario Simulation. Building highly interactive teaching scenarios, deepening PBL project-based teaching philosophy. During the learning process, students can access personalized Q&A support via AI Learning Companion. Based on the context of students' questions and their identified knowledge gaps, the system autonomously conducts a guided Q&A process without directly providing answers. Instead, it stimulates students' active thinking and independent inquiry through progressive questioning. Meanwhile, it continuously optimizes its questioning logic based on student feedback to achieve iterative self-improvement. An AI scenario simulation application is constructed to support role-play learning, building immersive interactive

learning scenarios for students, helping them deepen their understanding and application of knowledge points in authentic contexts. In programming practice sessions, the AI Programming Assistant provides real-time tutoring, promptly answering questions students encounter during programming, enhancing practical teaching effectiveness. Throughout the entire in-class phase, all agents achieve unified coordination and scheduling through the AI infrastructure, activating skills on demand, and dynamically matching the most suitable learning support services based on students' real-time learning progress and knowledge mastery, ensuring the relevance and effectiveness of the learning process.

Figure 6 AI Companion

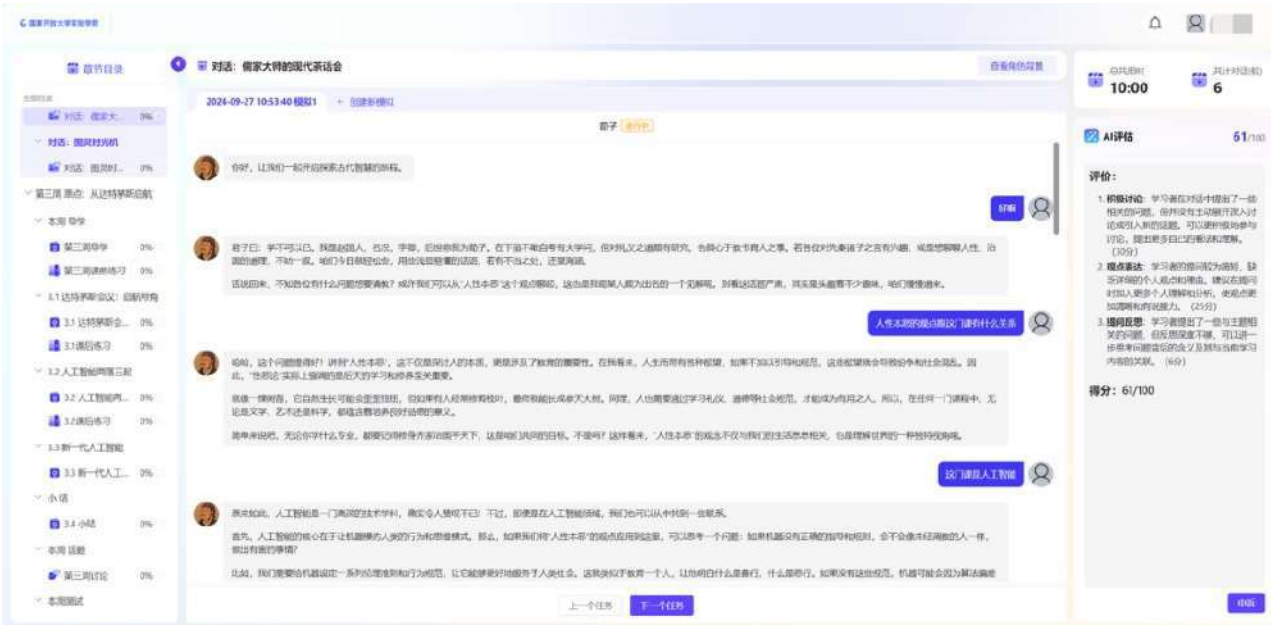

Figure 7 AI Scenario Simulation

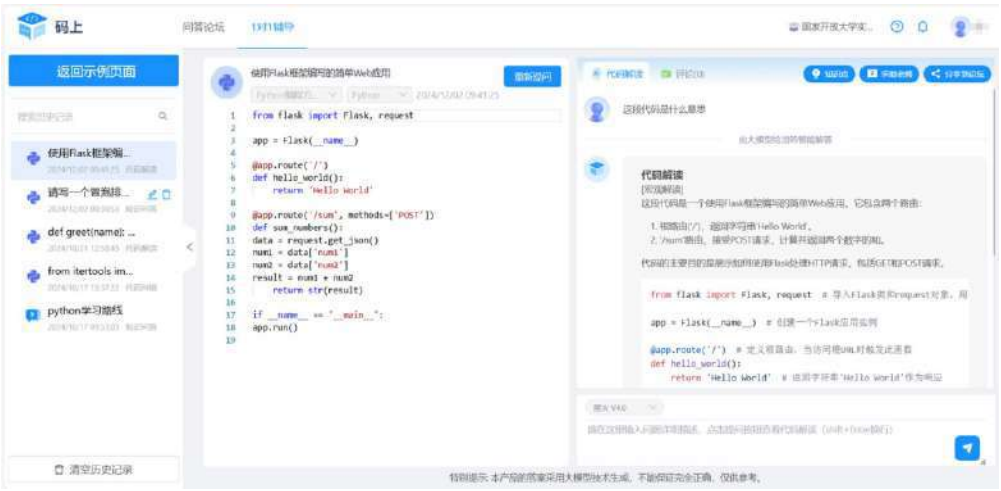

Figure 8 AI Programming Assistant

Post-class: Intelligent Grading and Learning Trajectory Tracking. Focusing on multimodal assignment assessment, optimizing the full process of grading feedback and learning evaluation, supporting customizable scoring standard settings that can configure scoring rules based on dimensions such as question type, knowledge point, and ability level. Utilizing multimodal large models for semantic analysis and logical understanding of subjective questions, supporting mixed grading of text and handwritten images, multi-dimensionally assessing answer quality and generating personalized feedback. After the machine completes initial scoring and problem diagnosis, grading recommendations are simultaneously provided, followed by manual review for confirmation and verification, ensuring grading accuracy and fairness. By analyzing the full-process data of student-AI interactions, learning trajectory tracking and continuous assessment of ability development are achieved, providing precise data support for teachers' teaching optimization and students' personalized improvement, driving the transformation of assessment from "single-result evaluation" toward "equal emphasis on process and results".

Figure 9 Scoring Standard Settings and AI Grading

(II) Non-Academic Education: New Scenarios for AI-Driven Universal Lifelong Learning Services

Addressing the core characteristics of fragmented scenarios and diverse learning demands in non-academic education, AI capabilities are deeply integrated into the full process of resource operations and learning services, building a full-cycle intelligent learning system.

Building Proactive Intelligent Learning Guidance Companions, Providing Accompanying Personalized Learning Support. Based on learner behavior data, learning needs and knowledge gaps are intelligently identified. During the learning process, relevant knowledge point explanations, extended resources, and learning suggestions are proactively pushed, helping learners quickly grasp course essentials and address learning questions in a targeted manner. Recommendation strategies are dynamically adjusted based on learning progress and interests, achieving an upgrade in intelligent learning guidance services from “passive response” to “proactive accompaniment”.

Figure 10 Proactive Intelligent Learning Guidance

Implementing Intelligent Resource Search and Recommendations, Supporting Efficient Autonomous Learning. Perceiving users’ learning intentions, quickly matching required resources through platform-wide semantic retrieval. Simultaneously, course video content undergoes intelligent decomposition processing, automatically extracting core points and segmenting knowledge point clips, supporting learners to directly access target learning content on demand, adapting to fragmented learning rhythms.

Figure 11 Intelligent Resource Search

Constructing Course Knowledge Graphs, Presenting Systematic Knowledge Structures. Integrating course knowledge points and their relationships, intuitively presenting the knowledge threads and hierarchical structure of courses in graph form, helping learners grasp the discipline system from a global perspective and navigate to specific knowledge modules for targeted learning as needed, lowering the cognitive threshold for lifelong learners to systematically acquire knowledge.

Figure 12 Knowledge Graph

Providing AI Testing and Personalized Learning Reports, Forming a "Learning-Practice-Assessment" Closed Loop. Practice questions are randomly generated based on course content, helping learners instantly verify learning outcomes and precisely identify weak areas. Furthermore, learners' learning behaviors, progress, and assessment data are intelligently analyzed to automatically generate personalized learning reports, providing targeted learning suggestions and improvement directions, supporting learners' self-reflection and continuous improvement.

Figure 13 AI Testing

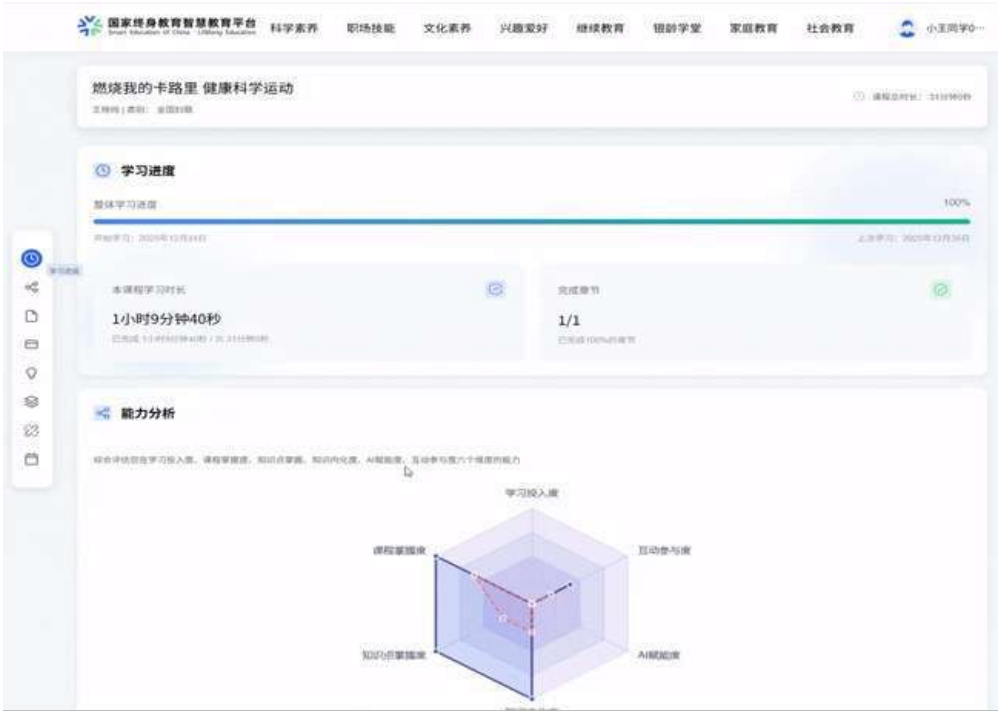

Figure 14 AI Learning Report

Impact and Case Evidence

First, a unified, open, and secure artificial intelligence digital infrastructure has been established. It integrates 127 domestic multimodal large models and AI capabilities, including DeepSeek, GlM, and Qwen,etc. To date, it has created 122 tenants, 1,880 knowledge bases, and 4,973 AI applications of various types, supporting over 2.77 million conversation rounds, 34.16 million API calls, and a cumulative token consumption of 48.2 billion. It enables teachers to conveniently build intelligent applications with no code, effectively lowering the development threshold and construction costs of educational intelligent applications, and providing a solid foundational support for the intelligentization of the entire “teaching, learning, assessment, and service” chain.

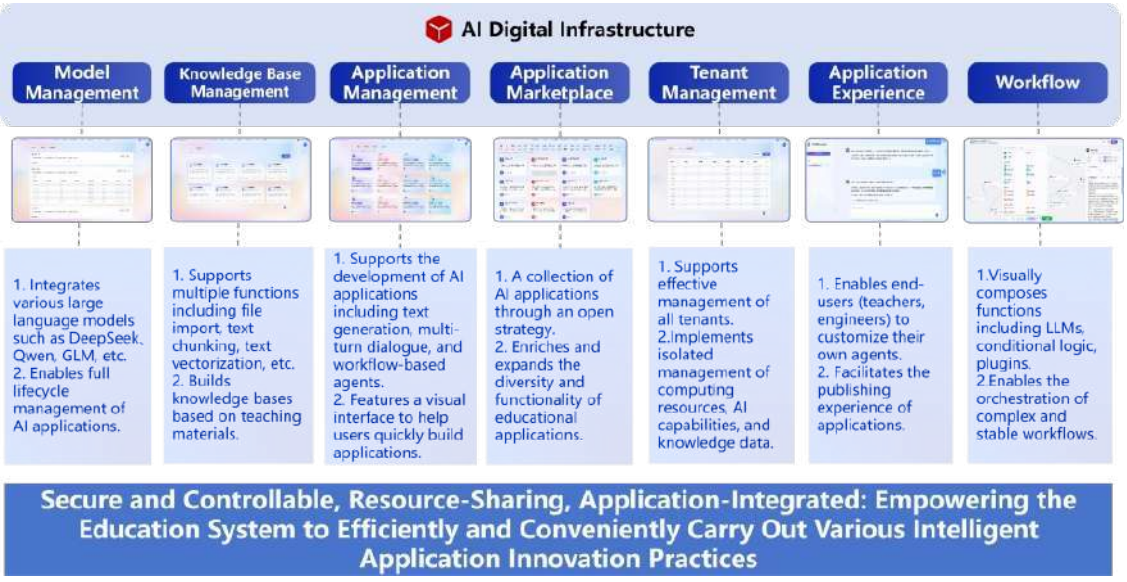

Figure 15 Overview of AI Digital Infrastructure Functions

Figure 16 Intelligent Infrastructure Homepage: Agent Center

Second, a new paradigm of AI-empowered intelligent teaching system for academic education has been established. For students majoring in artificial intelligence, intelligent applications such as AI Learning Companion, AI Scenario Simulation, AI Programming Assistant, and AI Video Learning Navigation have been deployed across 15 core courses, including “Introduction to Artificial Intelligence” and “Introduction to Big Data Technology”. Students have generally reported that these applications effectively support cross-disciplinary autonomous learning. Meanwhile, leveraging the AI infrastructure, the initiative has advanced the intelligentization demonstration of open education courses and developed a Teacher AI Toolkit, deploying applications such as AI lesson preparation, learning companion, knowledge graph, AI-based test question analysis, and intelligent question generation and grading across 58 courses in disciplines including computer science, educational technology, foreign languages, humanities, and economics and management. Through the course “Methods and Art of Public Speaking”, 101 course agents have been developed, driving the shift in assessment from traditional single-score evaluation toward Project-Based Learning (PBL) teaching and process-oriented assessment. The intelligent question generation system has achieved an 80% usability rate for generated questions, and examination assessment efficiency has improved by 50%.

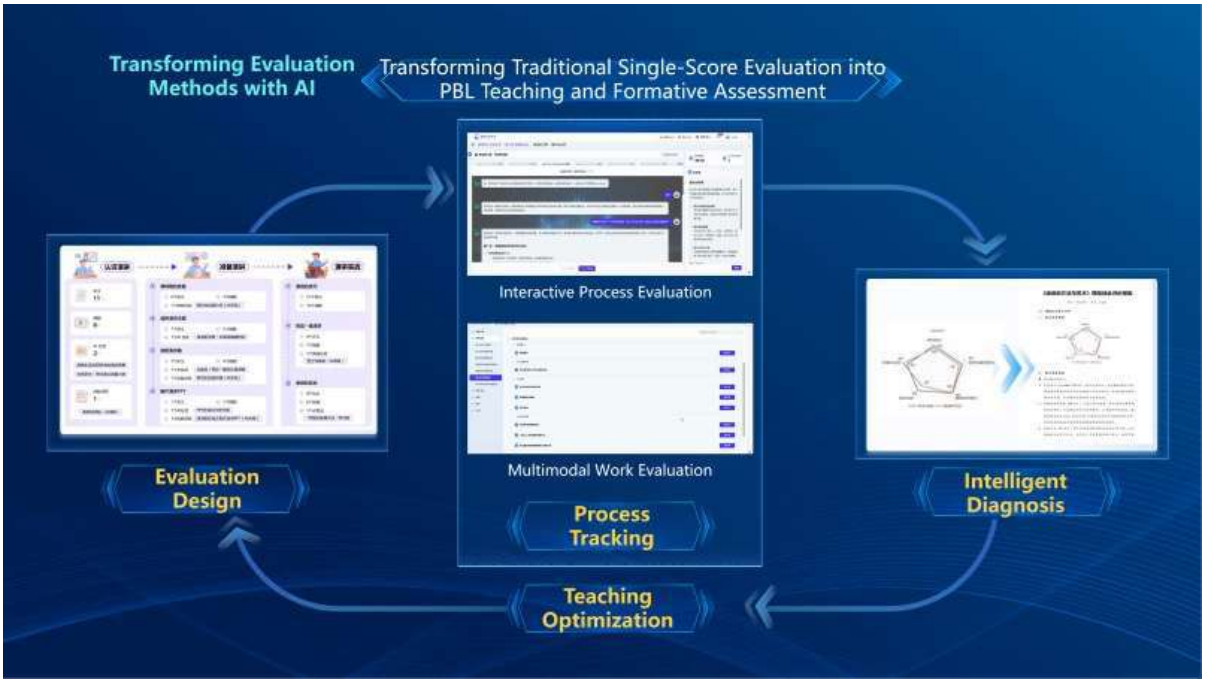

Figure 17 AI-Empowered Assessment Reform

Third, an intelligent learning service system for lifelong learners has been established. A series of intelligent applications have been launched on the lifelong education platform, covering over 4,500 courses, forming a four-in-one intelligent learning service matrix of “guidance-search-graph-assessment”, which has served more than 12 million learner visits cumulatively. Through proactive intelligent learning guidance, intelligent resource search, knowledge graphs, AI testing, and personalized reports, a closed loop of “learning-practice-assessment” has been constructed. Meanwhile, a customized round-the-clock intelligent customer service system has been developed to efficiently respond to the needs of diverse user groups, improving service efficiency and satisfaction, and

providing comprehensive support for lifelong learners' efficient autonomous learning and continuous improvement.

Fourth, a digital education ecosystem characterized by systemic collaboration and co-construction and sharing has been formed. Leveraging the institutional advantages of the "two-level coordination, four-level operation" system, 45 regional branches have been mobilized to advance the deployment and application promotion of the AI infrastructure. A collaborative mechanism of "pilot-summary-scaling" has been established, enabling low-cost reuse and collaborative innovation of intelligent capabilities and applications within the system. A number of innovative cases have been successfully incubated, including the "Generative Teaching-Assessment Integrated Platform" by Qinghai Open University, effectively enhancing teachers' digital intelligence literacy and teaching innovation capacity, and forging a new AI digital education ecosystem that is openly shared and continuously evolving, based on the model of unified intelligent infrastructure and regionally distinctive applications.

Figure 18 Qinghai Open University: Generative Teaching-Assessment Integrated Platform

(2) Replicability: First, the underlying architecture is highly universal, and the deployment model is lightweight. The intelligent infrastructure adopts a layered decoupled, modular design, with core AI capabilities encapsulated as flexibly selectable standardized components. Different educational institutions can rapidly build adapted intelligent applications according to their own needs, achieving "one infrastructure, multi-scenario reuse", which substantially reduces redundant development costs. Second, the solution has undergone scenario validation and demonstrates strong cross-scenario transferability. The model has been successfully validated in two core scenarios-academic education and non-academic education-and can be transferred to diverse educational scenarios such as basic education, vocational education, corporate training, and community education.

Sustainability: First, the solution aligns with the long-term strategic direction of global education development. It addresses the requirements of domestic and international education digitalization and

"AI+" initiatives, and is consistent with the long-term trend toward educational equity and universal access worldwide. Second, it has formed a demand-driven endogenous iterative closed loop. Leveraging the massive and sustained learning demand of lifelong education, an endogenous closed loop of "demand pulling-scenario deployment-iterative optimization-capability upgrading" has been established, coordinating multiple stakeholders to co-build the ecosystem and achieve self-sustaining growth. Third, it possesses comprehensive long-term safeguard capabilities. The solution employs a fully-stack self-controlled technology architecture, complemented by well-established R&D, operations, and training support systems, providing full-chain assurance for the long-term stable operation and continuous upgrading of the solution.

Promotion Potential: At the domestic level, the solution has completed deployment validation within The Open University of China system and can be promoted to universities, vocational colleges, community education institutions, corporate universities, and other entities nationwide, contributing to the building of a learning society. At the global level, the solution addresses common challenges in education worldwide-the difficulty of balancing scaled instruction with personalized services, the high threshold for education digitalization, and the challenge of universal access to quality resources. It can provide differentiated deployment solutions for different countries and regions, offering an actionable Chinese paradigm for universal access to quality education and the development of lifelong education systems worldwide, thus possessing significant value for international dissemination and promotion.

(3) Illustration of a Typical Case:

Case Name: AI-Empowered Teaching Practice in Artificial Intelligence Major Courses

Implementation Period: September 2024 to present

Implementation Location: Experimental College, The Open University of China

Implementation Scale: Serving 300 students majoring in artificial intelligence, covering core courses such as "Introduction to Artificial Intelligence" and "Introduction to Big Data Technology".

Core Outcomes: First, the full-process implementation of AI teaching across 15 core courses over three semesters for the artificial intelligence major has been completed, establishing a human-machine collaborative teaching closed loop encompassing pre-class intelligent lesson preparation, in-class interactive learning guidance, and post-class intelligent grading. Second, authentic student application feedback has been gathered: 75% of students expressed satisfaction with applications such as AI Learning Assistant and Intelligent Study Companion; 36% believed these applications significantly enhanced their learning; over 80% of students were willing to recommend them to classmates, effectively improving autonomous learning outcomes and learning motivation. Third, platform optimization directions have been clarified based on actual usage, identifying improvement areas such as knowledge accuracy, response speed, and knowledge integration and generalization capabilities, while collecting constructive functional requirements such as learning path recommendation. Fourth, practical support has been provided for AI infrastructure iteration and multi-disciplinary promotion, validating application feasibility through real teaching scenarios and forming reusable course implementation experiences and data foundations.

Basic Information of the Institution

As a new type of higher education institution directly under the Ministry of Education, supported by modern information technology and with the mission of promoting lifelong learning, The Open University of China leverages institutional advantages, aggregates system strengths, and focuses on "Four Services" to systematically build a lifelong education network of "Four Platforms and One Support" that covers urban and rural areas nationwide and connects millions of households, digitally empowering lifelong education to serve the building of a learning society and a learning powerhouse. Under the leadership of the Ministry of Education, the university conducts academic and non-academic education, establishing a nationwide operational system comprising 1 headquarters, 45 regional branches, and 3,735 learning centers, with services covering urban and rural areas nationwide. It also provides diversified learning services to all members of society, promoting the vision that "everyone can learn, everywhere can be a place of learning, and learning is possible at any time". In terms of global presence, the university has established 35 overseas learning centers in nearly 30 countries across Asia, Africa, and Oceania, initiated the co-construction of the "Belt and Road" Open Education Development Alliance, established partnerships with nearly 30 overseas institutions, and promoted international exchange and resource sharing in digital education. It received the "Outstanding Institution Award" from the International Council for Open and Distance Education. The university is also a member of the Asian Association of Open Universities (AAOU) and the International Council for Open and Distance Education (ICDE), demonstrating its influence in the field of international distance open education.

In the field of lifelong education digitalization, The Open University of China continues to promote the deep integration of new-generation information technology with lifelong education, having built the world's largest online education system. In terms of AI-empowered education, it has developed the AI Digital Infrastructure for lifelong education integrating large language models and knowledge graphs, launched intelligent applications such as the Baize Learning Companion and AI Digital Teacher, and established the National Vocational Education Credit Bank, achieving digital rights confirmation and conversion of learning outcomes, systematically advancing education digitalization transformation driven by digital intelligence. The university launched the Lifelong Learning Centre of the Smart Education of China Platform, which has served over 70 million learner visits, aggregating a multi-type, multi-level matrix of quality resources, providing platform support for digital intelligence-empowered large-scale personalized lifelong learning.

The practices of The Open University of China have received high recognition from authoritative domestic and international institutions, demonstrating its outstanding qualifications and promotion value. In 2021, its "One Village, One University Student" program was awarded the King Hamad Bin Isa Al Khalifa Prize, the highest award in education informatization conferred by UNESCO. In 2025, cases submitted by the university, including "Smart Education Empowering Lifelong Learning: Construction and Application Practice of The Open University of China's Data Infrastructure", were successfully selected as outstanding cases at the Global Smart Education Conference. Furthermore, cases focusing on the deep integration of AI and teaching, such as "Construction of AI-Empowered New Paradigm Online Learning Environment", received the First Prize in the Digital Education Innovation Achievement Award from the China Educational Technology Association in 2025, forming a replicable and promotable Chinese solution for digital education empowering lifelong learning.

Case 96

American Open University: A case of AI-enhanced instructional content development in Nigeria

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Introduction

The global course of higher education is currently charting a watershed moment defined by the intersection of instructional development and advanced artificial intelligence. In West Africa, higher education is navigating a transformative era where the integration of artificial intelligence (AI) is redefining how we operate open and distance learning (ODL), and in particular, Nigeria. As carefully put forward by Moore (2025), the rise of AI is significantly enhancing operational efficiency by augmenting human involvement in routine instructional tasks. This case study assesses the American Open University (AOU) Global Campus in Ibadan, Oyo state, as a primary example of how the instructional process and the purposeful integration of artificial intelligence (AI) can redefine the parameters of open and distance learning. By moving past the static delivery models that have historically described distance education in Nigeria, American Open University has implemented an AI-augmented instructional learning system that prioritises learner engagement, skill acquisition, and professional empowerment.

Case Background

The American Open University (AOU) is a newly established open and distance learning institution in Oyo State, Nigeria. Its vision is to be a game changing educational institution with learning outcomes that prepare students for the future of work in a constantly shifting global digital economy. Unlike traditional institutions that often struggle with the lag between academic theory and industry application, American Open University adheres to a competency-based model that emphasizes verifiable skills and global competitiveness.

One of the primary challenges for open universities such as the National Open University of Nigeria (NOUN) in Nigeria has been the persistent reliance on “PDF-ization” of course content. We describe the “PDF-ization” of course content as the digital release of static course materials that lack interactivity and engagement. Distance education in Nigeria has historically faced "the hills, the wills, and the skills" obstacles, including inadequate infrastructure and delays in the distribution of course materials. Before AI intervention, a significant gap existed in personalisation; Moore (2025) argues that conventional frameworks often struggle with the scalability and personalisation required for modern learners. While NOUN has been instrumental in democratising access to higher education for over 5,000 students, its administrative operations have been hindered by poor funding, inadequate infrastructure, and the slow distribution of course materials. The process of developing self-instructional materials in these institutions is often lengthy and complicated, and it involves a transition for subject matter experts from conventional face-to-face teaching to a distance learning "house style".

These institutional obstacles, categorized as "hills, wills, and skills" challenges, have historically led to a lack of student motivation in the learning process of Nigerian Open and Distance education students.

At the core of the American Open University instructional strategy is the EDGE instructional leadership framework. This student-centered model informs the design and delivery of every academic program and ensures that students actively participate in their learning process, and not merely passive recipients of information. The EDGE is designed around four progressive pillars that make up the American Open University educational experience.

Table 1 Four pillars of EDGE framework

Pillar	Focus area	Pedagogical mechanism
Educate	knowledge foundation	focusing on the "what" of learning by providing essential theoretical and practical knowledge aligned with workplace needs.
Develop	personal growth	shaping students into well-rounded professionals with the competencies and ethical frameworks required by their career paths.
Grow	real-world application	bridging the gap between theory and practice through projects, internships, and direct industry engagement.
Empower	career advancement	providing the tools, mentorship, and professional networks necessary for long-term career success and positive global impact.

This EDGE framework requires that instructional content be highly interactive and responsive to engage the learner and make them an agent in their learning process. Achieving this standard manually for a large and diverse learner population was identified as a significant operational burden, and this makes the integration of AI a strategic necessity to ensure that content development could meet the "reposition, reskill, and reinvent" mandate of the university.

Implementation Process

AI-enhanced content development process at the American Open University Global Campus is defined by a structured, triple-tool workflow that integrates the video generation capability of Synthesia AI, cognitive capabilities of Google Gemini, with the instructional design precision of Articulate Rise 360. This combination allows for a rapid transition from raw knowledge to immersive and engaging learning experiences.

The AI-enhanced instructional content development in American Open University Global Campus, Ibadan, is a systematic instructional design process through the application of generative artificial intelligence (GenAI) and interactive e-learning technologies. This is directly embedded in the theoretical foundation of constructivism which, according to Purushottam Balaso Pawar (2023), refers to an active process in which people are creating knowledge, depending on their previous experience and interactions with the surrounding environment. Pawar also discovered that AI-enhanced learning can be placed in this framework because it encourages individualized learning and leads to active interactions. The institution ensures these personalized experiences by moving away the stagnant documents to multimedia rich modules to support the needs of individual students.

Its development cycle starts with planning stage in which Google Gemini is used as a cognitive support tool. Muhammad Imran and Norah Almusharraf (2024) published the article stating that the most recent multimodal AI tool is Gemini, which can address and execute several tasks simultaneously, such as processing data of text, pictures, audio, and video. These features are employed by designers to generalize dense contents and get underlying themes. It is also observed that Gemini can help in identification of diverse answers and help in learning innovations (Imran and Almusharraf, 2024). It assists in preparing simple learning objectives and making complicated ideas easier to understand at this stage. The authors discovered that AI could serve as a virtual language tutor, where low-stakes, adaptive support can be given to international students and they can apply it to enhance their communication (Tom Farrelly and Nick Baker, 2023). But Farrelly and Baker (2023) also reported that these tools are effective, but institutions should be sensitive to the so-called hallucinations - credible but untrue information - and the current biases in the AI models.

Gemini is used as an Inspiration Hub when storyboarding and the structure is already set. Davinia Hernandez-Leo and Yannis Dimitriadis (2024) discovered that GenAI could be used to accelerate the human-centred creative design process through stimulating the brainstorming process and aiding in crystallizing the visualised solutions. The stage results in the creation of production with Articulate Rise 360 that produces mobile-first and responsive lessons. The developers of Rise 360 make use of special blocks called Accordion block and Process block used to provide a concise explanation and step-by-step guidance respectively. To guarantee a progressive advance, they use "Divider blocks," which involve student interaction prior to their advance. This is in line with Self-Regulated Learning (SRL), which Roger Azevedo and Sanna Jarvela (2024) discovered is an agentic process in which learners strategically engage in learning.

To deliver videos of high quality in specialized visual way, the institution adopts Articulate Storyline 360 to produce high-quality educational videos. In a bid to make it more human, they also use Synthesia in their course creation by using synthetic virtual instructors. Michail Giannakos et al. (2024) discovered that this interactive learning video using synthetic instructors can provide high-quality learning content to large numbers of learners. Storyline also supports making of exercises that are drag and drop.

Such modules serve as Intelligent Tutoring Systems, which Pawar (2023) discovered to be the primary elements of transformative education assisting with real-time feedback and personal content delivery. Last modules are also sent out as SCORM conforming files to monitor learning analytics.

All courses are strictly vetted by instructional designers before ultimate implementation. According to Farrelly and Baker (2023), AI literacy and ethics should be the main factors that can guarantee fair access and favorable results to every student. Imran and Almusharraf (2024) further argued that algorithms must be monitored rigorously to ascertain that algorithms are devoid of any biases that may undermine some groups. This human-in-the-loop model will make sure that although AI will do the data processing and speed, human experts will give the judgment, creativity, and ethical control required to make students successful.

An overview of the three tools and timeline of usage in the instructional development process.

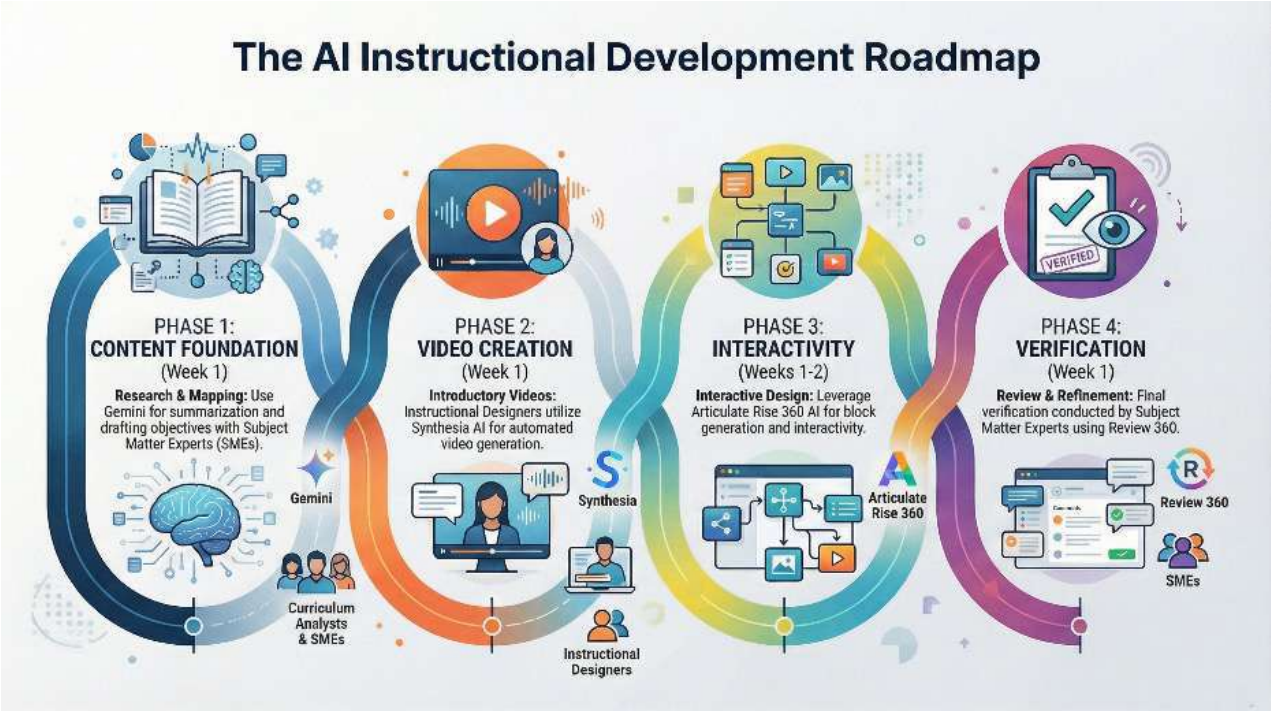

Figure 1 Gotten from American Open University Global Campus instructional design team.

Innovation Highlights

The core innovation at the American Open University lies in the transition from "content-driven instruction" to "experience-driven mastery." As stated by Javed (2024), the future of education lies in collaborative frameworks where AI acts as a "co-pilot" to augment human educators. AOU Global's approach is distinctive because it bridges the "brain" (Google Gemini's reasoning) with the "authoring ecosystem" (Articulate 360). This synergy ensures that the curriculum is not just a collection of facts but an interactive learning path that includes adaptive feedback. The model

incorporates what Bozkurt et al. (2024) describe as a collective responsibility to ensure AI alignment with human values. By integrating the "Intelligent-TPACK" framework, AOU instructional designers use their Technological, Pedagogical, and Content Knowledge to ethically guide AI tools. This ensures that machine efficiency is always tempered by human judgment, empathy, and cultural context. Traditional curriculum development is static and slow to update. American Open University has introduced what we described as "instructional agility" through its AI-native workflow. This level of responsiveness is distinctive in the African higher education landscape and ensures that students are learning information that is current and practically relevant.

Effectiveness Proof

Internal data from the 2024-2025 instructional content development cycles shows a radical reduction in production time across all phases of the instructional lifecycle. The qualitative impact on staff morale and institutional culture has been equally profound. A structured interview was held to obtain the impact of artificial intelligence on instructional content development. By leveraging the Rise 360 AI Assistant and Google Gemini, the institution has reported the following improvements:

Table 2 Improvements after leveraging AI tools

Production metric	Traditional workflow	AI-enhanced workflow	Improvement factor
Initial course outline drafting	2-3 Weeks	1-2 Days	-10x Faster
Formative assessment creation	20-30 Hours	1-2 Hours	-15x Faster
Multimedia localization	2 Months	1-2 Weeks	-8x Faster
Module updates/ changes	1 Week	30 Minutes	-14x Faster

These gains allow the university to maintain a high volume of high-quality content without increasing the size of the development team, solving the "skills and hills" obstacles that have previously limited Open and Distance Learning expansion in Nigeria.

Promotion Plan

To ensure the long-term sustainability and scalability of this model across Nigeria and Africa, this study proposes a phased approach that allows other institutions to transition from static models to AI-enhanced instructional design without overwhelming their existing infrastructures.

1. Phase 1 (Capacity building): Nigerian and African universities should prioritize "AI Literacy" for

both students and staff. This involves organizing workshops that focus on prompt engineering, the ethical use of AI, and the integration of the TPACK framework into daily teaching.

2. Phase 2 (Infrastructure development): Institutions should move away from expensive on-premise hardware and instead invest in "mobile-first" and "cloud-based" authoring tools like Articulate 360.

3. Phase 3 (Governance and policy): The establishment of an AI education policy framework that addresses pedagogical, governance, and operational dimensions is essential. This ensures that AI integration is "human-centered," transparent, and accountable.

Conclusion

The case study of the American Open University Global Campus demonstrates that AI-enhanced instructional content development is no longer a luxury but a fundamental requirement for a future-ready education system in Nigeria. Through adherence to the EDGE framework and integrating tools like Google Gemini and Articulate 360, American Open University has created a blueprint for institutional design that bridges the gap between static learning experiences and interactivity.

This model also shows that the instructional content challenge can be overcome through the augmentation of human judgment with machine efficiency. The transformation of distance learning from the static "PDF" to an interactive, AI-enhanced format represents a significant leap towards providing high-quality interactive learning and education that empowers the next generation of learners to compete on the global stage. To secure By embracing its responsibility and prioritising Artificial Intelligence literacy, the Nigerian higher education system can better prepare for the future of global digital education.

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Case 97

Research on the Application of AI Agents in Mental Health Work

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Background

The growing prevalence of mental health issues among adolescents globally poses significant challenges to basic education in China. According to the World Health Organization, approximately one in five adolescents experiences mental distress. In China, mental health services in primary and secondary schools face critical pain points: a severe shortage of specialized psychological counselors, over-reliance on static and single-dimensional assessment tools, and a lack of systematic, evidence-based intervention strategies. These limitations often lead to delayed identification and ineffective support for students in need.

Concurrently, rapid advances in artificial intelligence (AI)—particularly in natural language processing, affective computing, and multimodal data analysis—offer new avenues to transform mental health education. The National Education Modernization Plan 2035 and the Education Strengthening Nation Construction Plan (2024–2035) explicitly call for deep integration of intelligent technologies with teaching and learning to accelerate digital transformation in education.

In response, Longhua District initiated a pilot project to explore how AI agents could be harnessed to address these challenges. The primary objectives were: (1) to develop intelligent tools for curriculum design, interactive learning, and psychological assessment; (2) to establish a dynamic, data-driven early-warning mechanism for mental health risks; (3) to provide personalized support for students, teachers, and parents; and (4) to create a collaborative ecosystem involving schools, families, and communities. This case study documents the implementation and outcomes of this initiative, aiming to provide a replicable framework for AI-enhanced mental health education.

Case Implementation Status

The implementation in Longhua District centers on the development and deployment of a suite of AI-powered tools designed to systematically enhance mental health education. Key technological components include an intelligent curriculum design system, multimodal interactive teaching tools, and a data-driven assessment framework.

1. Intelligent Psychological Curriculum Design System: A Precision Matching Mechanism Based on Needs Analysis

An AI agent-powered curriculum design system has been developed to enable scientifically grounded personalization through three stages: (1) Multi-source data collection: integrating school-based psychological assessment systems and classroom behavior analysis modules to build a foundational database covering cognitive, emotional, and social dimensions; (2) Grade-level adaptation mechanism: based on the stage-specific objectives outlined in the Guidelines for Mental Health Education in Primary and Secondary Schools, the system intelligently generates targeted activities—for example, attention-training exercises and achievement-journaling tasks for elementary students (crucial for attention development and self-concept formation), and peer-conflict simulations and stress-management inquiry modules for secondary students (sensitive to peer relationships and academic pressure); (3) Human-machine collaborative optimization: a knowledge graph establishes semantic links between school-based resource libraries and national guidelines, allowing teachers to make personalized adjustments within the structured curriculum framework recommended by the system.

2. Multimodal Interactive Teaching Tools for Mental Health Curriculum

To enhance the appeal and depth of mental health lessons, teachers have introduced the "Stress Relief Planet" application. Through its interactive assessment functions, students gain better awareness of their own psychological states during participation. Additionally, the "AI Psychological Companion" module embedded in "Stress Relief Planet" engages students in dialogue, not only increasing their interest in learning but also encouraging sustained exploration of personal development. This integration of advanced technology with traditional educational methods aims to create an engaging and educationally meaningful psychological classroom environment.

3. Intelligent Curriculum Quality Assessment System in AI-Enhanced Educational Settings

Recognizing the limitations of traditional curriculum evaluation—which often relies heavily on scale-based scores and is prone to subjectivity—teachers utilize the "Stress Relief Planet" program to track dynamic changes in students' mental health status, providing evidence for assessing classroom effectiveness. By analyzing the frequency and duration of student interactions with different modules of the program, teachers gain precise insights into students' psychological needs, enabling targeted adjustments to curriculum design. Furthermore, AI technology assists teachers in conducting in-depth self-analysis of their classroom performance, offering personalized suggestions for improvement, thereby helping teachers continuously refine their instructional strategies to enhance overall teaching quality.

Case Innovation and Breakthroughs

1. Main Innovation Content

Human-Machine Collaborative Model for Mental Health Education: Unlike traditional one-size-fits-all approaches, this case pioneers a hybrid support ecosystem where AI agents complement human expertise. The system does not replace counselors but augments their capacity by automating routine assessments, providing real-time insights, and suggesting evidence-based interventions. This shifts the paradigm from reactive crisis management to proactive, personalized mental health promotion.

Integration of Multiple AI Capabilities: The case uniquely combines natural language understanding, affective computing, knowledge graphs, and multimodal data fusion within a single cohesive platform. This enables seamless transitions from curriculum delivery to risk detection to family engagement, creating a continuous support loop.

Dynamic, Context-Aware Risk Assessment: Moving beyond periodic paper-based surveys, the system continuously analyzes student interactions (dialogue sentiment, response latency, word choice) to build dynamic psychological profiles. This allows for earlier identification of emerging issues and reduces the stigma associated with formal testing.

Whole-Community Approach: By involving teachers, parents, and even students themselves in the feedback loop, the project fosters a shared responsibility for mental health. The AI Family Assistant, in particular, bridges the gap between school and home, ensuring that support is consistent and coordinated.

2. Technology Breakthrough Content

Affective Dialogue Generation: The AI Psychological Companion employs fine-tuned large language models capable of empathetic, context-aware conversation. It can detect subtle emotional cues (e.g., frustration masked as sarcasm) and adjust its tone accordingly. This is achieved through a combination of sentiment lexicons, transformer-based classifiers, and reinforcement learning from human feedback.

Multimodal Early-Warning Algorithm: The platform integrates data streams that were previously siloed (text, behavior, physiology). A deep neural network fuses these inputs to predict risk levels with higher accuracy than any single modality. For instance, combining dialogue sentiment with changes in response latency improves detection of depressive symptoms.

Knowledge Graph for Curriculum Personalization: A domain-specific knowledge graph links educational standards, developmental psychology principles, and local resources. An AI planner uses graph traversal algorithms to generate optimal learning pathways for each class or individual student, ensuring alignment with both national guidelines and local needs.

Privacy-Preserving Data Analytics: To address ethical concerns, the system employs differential privacy techniques and on-device processing where possible. Student data is anonymized and aggregated before analysis, and parents/students can opt out of specific data collection.

3. Application Practice Breakthrough Content

Scalable Implementation in a Real-World Setting: The pilot in Longhua District demonstrates that AI-enhanced mental health services can be deployed across a diverse range of schools (urban, suburban, with varying resource levels). The system's modular design allows schools to adopt components incrementally based on their readiness.

Positive Impact on Student Engagement: Preliminary feedback indicates that students are more willing to interact with the AI companion than with human counselors initially, viewing it as a non-judgmental listener. Over time, some students have become more open to seeking face-to-face help. This "gateway" effect is a significant breakthrough in destigmatizing mental health support.

Empowerment of Non-Specialists: Teachers and parents, who are not mental health experts, now have actionable insights and guidance at their fingertips. The AI tools translate complex psychological data

into plain-language recommendations, enabling them to play a more effective role in the support network.

Demonstration of AI's Role in Teacher Well-Being: The self-care module for teachers is a novel application. By proactively nudging teachers to attend to their own mental health, the project acknowledges the emotional labor involved in education and helps prevent burnout.

4. Intellectual Property Status

The core technological components of this case—including the AI Psychological Companion, "Stress Relief Planet" , and "Smart Mental Health" platform—are developed by iFLYTEK Co., Ltd.

Promotion Value and Risks

1.Application Prospects and Achievements

The Longhua District model has been piloted in primary and secondary schools within the district, reaching a significant number of students and teachers. The early-warning platform has successfully identified students with previously unrecognized mental health risks, enabling timely interventions. Preliminary feedback from participating schools indicates positive reception of the AI tools. The system's modular design makes it adaptable to other regions, offering potential for broader adoption in basic education settings facing similar challenges in mental health service delivery.

2. Social and Economic Value

Social Value: By enhancing early detection and intervention capabilities, the system contributes to reducing the long-term impact of mental health issues on students' academic achievement, social relationships, and overall well-being. It promotes educational equity by providing access to technology-enhanced mental health support across schools with varying resource levels.

Economic Value: Automation of routine assessments and initial triage helps optimize the allocation of scarce mental health professionals, allowing them to focus on more complex cases. This increased efficiency in workforce utilization has potential cost-saving implications for public education and health systems if scaled more broadly.

3.Demonstration and Leading Role

This case provides a concrete, evidence-informed framework for integrating AI technologies into mental health services within basic education. Its emphasis on human-machine collaboration, ethical data use, and multi-stakeholder engagement offers a reference point for other regions exploring similar innovations. The systematic approach to curriculum design, dynamic monitoring, and family involvement demonstrates a pathway for leveraging intelligent technologies to address pressing challenges in student mental health.

4. Potential Risks

Technical Risks: Dependence on AI models carries inherent risks of errors in risk assessment (false positives/negatives). Continuous monitoring, validation, and human oversight are essential to maintain reliability. System security and data integrity must be ensured to prevent service

disruptions.

Ethical Risks: The collection and analysis of sensitive student data raise privacy concerns. Robust data governance frameworks, transparency in data usage, and informed consent mechanisms are necessary but require ongoing vigilance. There is also a risk of over-reliance on automated recommendations without sufficient professional judgment.

Equity Risks: Disparities in technological infrastructure between schools could lead to uneven implementation and benefits, potentially widening existing gaps.

Social Risks: Student perceptions of AI interactions as surveillance rather than support could create unintended stigma. Clear communication about the supportive purpose of the system is essential to maintain trust.

Other Relevant Information

1. Case Award Status

None to date. The project is currently in its pilot phase; awards may be applied for after full evaluation.

2. Third-Party Evaluation

Expert Appraisals of the "Smart Mental Health" Platform and its Core Assessment Tools: Two independent expert panels evaluated the "Smart Mental Health" platform and the "Mental Health Diagnostic Test for Primary and Secondary Students" (MHT) integrated within it. Both appraisals confirmed that the scales demonstrate good reliability and validity, with norms revised using large, nationally representative samples to ensure timeliness and precision. The platform comprehensively assesses student mental health covering all themes of national guidelines, and its user-friendly, automated features enhance school mental health work efficiency.

Collaborative Development with Beijing Anding Hospital: The AI multimodal screening module was developed in collaboration with the team of Dr. Wang Gang, Director of Beijing Anding Hospital. Trained on over 3,000 expert-diagnosed cases, the AI screening achieves significantly improved accuracy compared to traditional psychological scales.

Preliminary User Feedback: Teachers and counselors report that the AI tools facilitate monitoring of student well-being and provide valuable insights, with early-warning alerts being particularly appreciated.

3. Case-related images.

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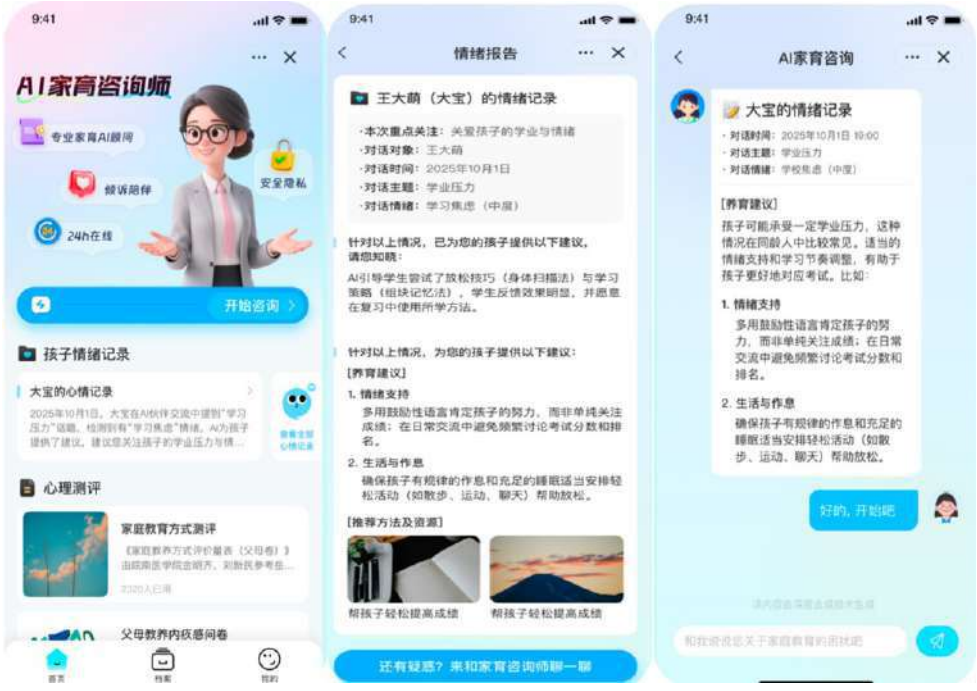
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情绪报告
王大萌（大宝）的情绪记录
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·对话对象：王大萌
·对话时间：2025年10月1日
·对话主题：学业压力
·对话情绪：学习焦虑（中度）
针对以上情况，已为您的孩子提供以下建议，请您知晓：
AI引导学生尝试了放松技巧（身体扫描法）与学习策略（组块记忆法），学生反馈效果明显，并愿意在复习中使用所学方法。
针对以上情况，为您的孩子提供以下建议：
[养育建议]
1. 情绪支持
多用鼓励性语言肯定孩子的努力，而非单纯关注成绩：在日常交流中避免频繁讨论考试分数和排名。
2. 生活与作息
确保孩子有规律的作息和充足的睡眠适当安排轻松活动（如散步、运动、聊天）帮助放松。
[推荐方法及资源]
帮孩子轻松提高成绩
帮孩子轻松提高成绩
还有疑惑？来和家育咨询师聊一聊
AI家育咨询
大宝的情绪记录
·对话时间：2025年10月1日 19:00
·对话主题：学业压力
·对话情绪：学校焦虑（中度）
[养育建议]
孩子可能承受一定学业压力，这种情况在同龄人中比较常见。适当的情绪支持和学习节奏调整，有助于孩子更好地对应考试。比如：
1. 情绪支持
多用鼓励性语言肯定孩子的努力，而非单纯关注成绩：在日常交流中避免频繁讨论考试分数和排名。
2. 生活与作息
确保孩子有规律的作息和充足的睡眠适当安排轻松活动（如散步、运动、聊天）帮助放松。
好的，开始吧

9:41 AM
进入聊愈室
换装
声音
Hi，我是吉塔，你的心理伙伴，和小星一样是减压星球的原住民。
现在经营着一家玻璃房花店，里面种植热带的蔷类植物，旺盛绽放的鲜花。看我很喜欢大家看到花店时幸福的感觉。我会在花店定期开展社区活动，居民们可以相互分享生活、手作、点心。如果谁遇到了困难，还会相互支持对方，大家会平等的交流，不会相互评价对方。如果你也想分享生活，获得支持，也欢迎你来找我哦！
最近发生了一件特别好玩的事情。
我们应该如何定义"完美"呢？
平时做题都会，但一到考试好像就不会了。

Case 98

eCognitia: The Agentic AI Operating System for End-to-End Research and Content Development

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Solution Introduction

1. Function Overview

eCognitia is a cloud-native Research Operating System (ROS) designed to digitize, coordinate, and improve the full academic and applied research lifecycle. It is integrated with eProfexus, an autonomous agentic AI engine for instructional design and content development. Together, the solution supports both research management and high-quality educational content production within one intelligent platform.

The solution addresses two major educational pain points.

a. Postgraduate research processes are often fragmented, manual, and difficult to monitor, leading to delays in proposal development, weak coordination between students and supervisors, and limited institutional visibility into research progress and outputs.

b. Content development for online and digital learning is highly labour-intensive, time- consuming, and costly, especially where instructional design depends on multiple human review stages and growing demand for new courses and learning materials.

To address these challenges, eCognitia is built around two integrated pillars.

a. The Research Pillar (Modules 1–8) digitizes the research journey from concept development to final outputs. It includes an Intelligence Engine for AI orchestration, an AI Proposal Builder, supervision and workflow tools, and a Semantic Literature Generator that uses Retrieval-Augmented Generation (RAG) to ground outputs in verified academic sources. This supports structured research guidance, stronger academic quality, improved supervision efficiency, and better institutional oversight.

b. The Agentic Content Development Pillar (Module 9: eProfexus) automates the instructional design workflow. It ingests raw source materials such as PDFs, books, policies, and notes, then uses a chain of specialized AI agents to generate complete course modules, learning activities, and assessments. The workflow follows: Ingestor → Analyst → Outline → Content → Activity → Assessment → Reviewer → Formatter. The system supports more than 17 academic domains and applies domain-aware learning design patterns to improve relevance and quality.

The core value of the solution is that it provides a scalable, responsible, and human- supervised AI platform that reduces workload, shortens development time, improves consistency, and strengthens both research productivity and digital learning delivery. It enables institutions to move from fragmented manual processes to an integrated, data-driven, and quality-assured model that is efficient, inclusive, and replicable across different educational contexts.

2. Technical Highlights and Innovations

a. Semantic Knowledge Retrieval (RAG): The system employs Retrieval Augmented Generation (RAG) using PostgreSQL with pgvector alongside a Python-based FAISS microservice. This enables high- speed semantic search across institutional repositories, ensuring that AI-generated outputs are grounded in credible academic sources.

b. Live DOI Resolution: Integration with the CrossRef API enables real-time citation validation, effectively eliminating inaccuracies and preventing AI generated bibliographic errors.

c. Scalable Agentic Architecture: Built on Laravel 11, Cognitia adopts a modular, high-concurrency architecture that supports scalability and adaptability to diverse institutional requirements and technological environments.

d. Institutional Governance Dashboard: A high-level administrative interface designed for institutional leadership (e.g., Vice-Chancellors), providing insights into research productivity, compliance tracking, and detailed monitoring of AI token usage.

e. Agentic Pipeline Architecture (eProfexus): An 8-agent chain; Ingestor, Analyst, Outline, Content, Activity, Assessment, Reviewer, Formatter; replicates the full professional workflow of an instructional designer. Each agent is a focused, single- responsibility FastAPI endpoint. The Reviewer Agent computes a Bloom's alignment score before any content proceeds to publication, ensuring pedagogical integrity is machine-verified.

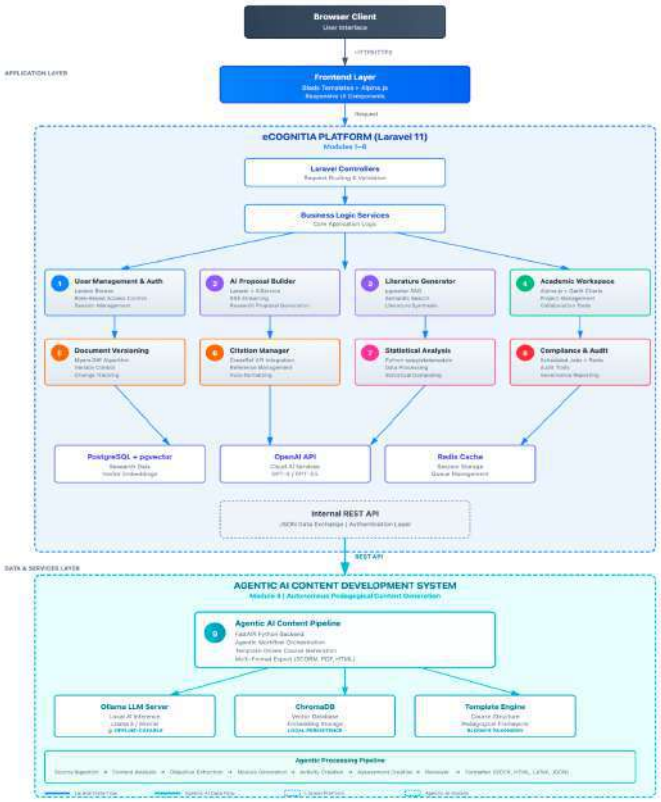

Figure 1 Structure of the platform

Application Scenarios

1. Application Environment and Implementation

eCognitia is optimized for a fully online, distance-learning environment, specifically tailored for the Open University of Kenya. It is designed to function seamlessly across both desktop and mobile devices, ensuring accessibility for users across diverse geographical locations.

The platform targets four main categories of users:

a. Students and Early Career Researchers: These users need structured guidance in research methodology, literature synthesis, academic writing, and the responsible use of AI to improve the quality of their research outputs.

b. Academic Supervisors: These users require efficient oversight of multiple research portfolios, including tools for monitoring progress, reviewing drafts, providing timely feedback, and safeguarding academic quality and integrity.

c. University Leadership and Administrators: This category includes academic managers, deans, heads of departments, and other administrators who need data-driven insights into institutional research output, supervision progress, content development workflows, and overall performance for planning and decision-making.

d. Faculty, Instructional Designers, and Quality Assurance Teams: These users are involved in course and content development and need support in creating, reviewing, aligning, and improving academic materials for online delivery in a way that is efficient, scalable, and guided by responsible human oversight.

2. Examples of Typical Application Scenarios

a. Scenario A: Thesis Development Pipeline A postgraduate student begins their research journey by defining a topic. Cognitia's AI Proposal Builder assists by suggesting primary and secondary objectives. The student then generates a literature review that is automatically cross referenced with the university's semantic knowledge base, ensuring comprehensive and relevant content.

b. Scenario B: Collaborative Supervision at Scale the Dean of School utilizes the Academic Workspace to monitor a cohort of 50 PhD candidates. She can track version histories, word-count progress, and milestone achievements for each student, intervene when necessary, and approve drafts with automated audit logs for accountability.

c. Scenario B: Rapid Agentic Course Synthesis at Scale the School of Science and Technology needs to launch an 'Azure Fundamentals (AZ-900)' course within a two-week window for a new cohort of 200 students. Traditionally, this requires months of manual content writing. Instead, the Instructional Designer uploads the Azure source textbooks and selects a pre-defined OUK Course Template in eCognitia. The 8-agent pipeline executes sequentially:

i. Ingestor Agent: Chunks and embeds the 500-page textbook in under 3 minutes.

ii. Analyst Agent: Enriches Course Learning Outcomes (CLOs) and produces a generation plan.

iii. Outline Agent: Flags a topic coverage gap in Module 3 with ELOs, prompting the designer to upload an additional whitepaper.

iv. Content Agent: Writes 9 full lessons grounded entirely in the uploaded sources.

v. Activity Agent: Generates a hands-on Azure lab exercise for each technical lesson.

vi. Assessment Agent: Creates randomised STACK based quizzes aligned to each lesson's CLOs

vii. Reviewer Agent: Computes Bloom's alignment score of 95% the course is cleared for publication.
viii. Formatter Agent: Outputs an OUK branded LaTeX, HTML course card and a DOCX document ready for the lecturer's final review.

3. Impact and Case Evidence

(1) Implementation Results, Evaluation Data, or Practical Experience

Baseline findings indicate that OUK is still at a pre-implementation stage in the use of AI for research and content development. Current practice shows that course content development remains largely manual and human-led, involving subject experts, instructional designers, reviewers, and quality assurance teams. On average, development of one course module takes approximately 10 days, making the process time-intensive, costly, and difficult to scale as student numbers and programme offerings expand.

The baseline also shows that the use of AI in research and academic work is still limited, fragmented, and largely experimental. Where AI tools are used, they are mainly applied for support functions such as literature search, idea refinement, language improvement, and productivity enhancement rather than autonomous knowledge generation. This has highlighted the importance of strengthening institutional capacity for the controlled, ethical, and responsible use of AI in ways that enhance research quality, protect academic integrity, and improve outputs without compromising human oversight.

OUK already has a functioning digital learning ecosystem and an established content development workflow, providing a strong foundation for the introduction of more advanced AI-supported processes. Practical experience from current operations shows that there is significant opportunity to use AI to reduce content development cycle time, improve efficiency, support research productivity, and strengthen scalability. At the same time, the baseline confirms the need for a carefully governed approach that places emphasis on quality assurance, human review, data protection, and responsible AI use.

These findings justify the proposed intervention: an Agentic AI-supported Content Development and Research Support Module that will complement, rather than replace, human expertise. The anticipated value lies in faster turnaround, lower resource dependency, improved consistency, and enhanced support for both academic content production and research outputs. However, the costs of implementation, integration, and capacity building remain significant, making external grant support essential for successful deployment.

(2) Replicability, Sustainability, and Promotion Potential

eCognitia is built on an open and modular architecture using Laravel, FastAPI, PostgreSQL, Alpine.js, PHP, and Python, making it highly replicable across other national online universities and higher education institutions globally. Its sustainability model leverages institutional token management alongside a scalable, cloud-native deployment, ensuring long-term viability and ease of adaptation.

The sustainability model operates on three pillars:

a. Agentic AI; Ollama-hosted LLMs ensure eProfexus remains functional regardless of changes to external AI providers' pricing or terms of service;

b. Institutional token budgets with configurable per-user monthly ceilings prevent open-ended AI expenditure;

c. Horizontal cloud scalability accommodates enrollment growth without infrastructure redesign.

The Zero-Trust Privacy Model: with sensitive course data stored on-disk in ChromaDB and never transmitted to external cloud providers - future-proofs the platform against evolving data protection regulations including the Kenya Data Protection Act and GDPR.

(3) Illustration of a Typical Case

eCognitia is currently at a prototype functional stage, with core modules operational and undergoing active testing within the implementation team. The system is functional, with both the research and agentic content development pipelines in place, but remains in a controlled validation phase.

The project is massive in scope and inherently costly, involving cloud infrastructure, AI orchestration, data pipelines, and domain-specific model integration. For this reason, structured funding is required to support development, packaging, scaling, and full institutional deployment. At this stage, emphasis is on internal testing, system refinement, and implementation readiness, rather than large-scale rollout.

Comparable developments reinforce this direction. For example, Arthur AI, as noted by Bill Faruki, demonstrates how AI-powered education systems can scale rapidly and operate at relatively low cost once fully deployed. This highlights the importance of early-stage investment to achieve scalable, adaptive, and intelligent learning ecosystems such as eCognitia.

(4) Exhibition Materials

If selected for presentation, eCognitia can be demonstrated through a live interactive dashboard. Conceptual high-fidelity renderings are available to showcase:

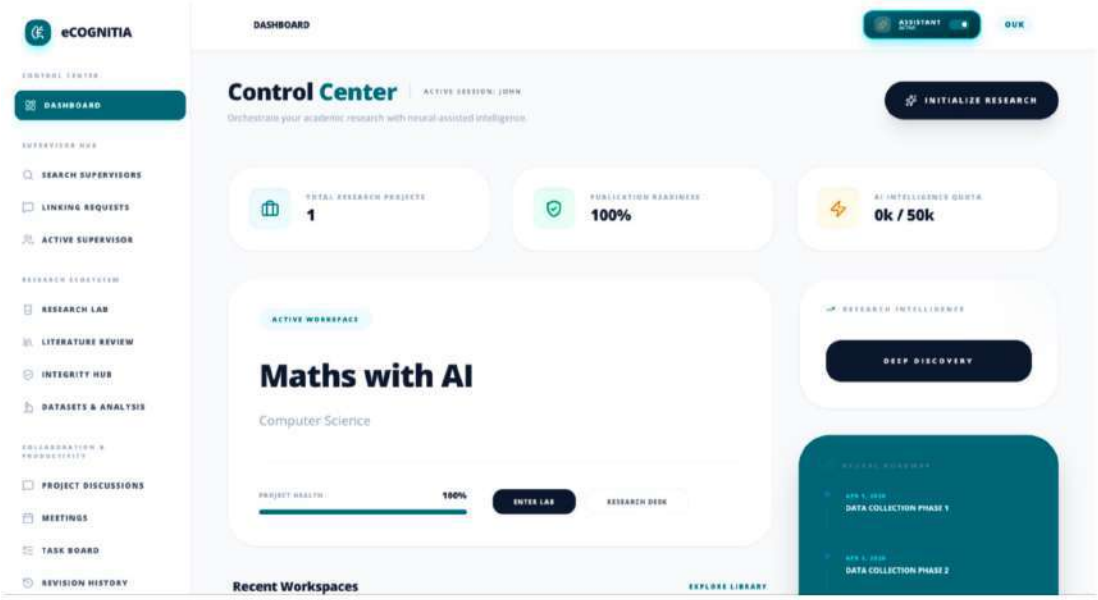

Figure 2 Student side overview/Dashboard page

More Diagrams here:
https://drive.google.com/drive/folders/1IPTKfjdpNHKz0fqeYKq5yjsfWpqTpSCs?usp=sharing

4.Basic Information of the Institution

(1) Institution Introduction

The Open University of Kenya (OUK) is Kenya's first fully online specialised public university, established to expand equitable access to quality higher education through open, flexible, and technology-enabled learning.

Awarded its Charter on 3 August 2023 and headquartered at Konza Technopolis, OUK delivers teaching, research, innovation, and professional development through a digital-first model serving school leavers, working adults, lifelong learners, and underserved populations.

OUK offers undergraduate, postgraduate diploma, master's, doctoral, and professional development programmes in areas including Data Science, Artificial Intelligence, Cyber Security and Digital Forensics, Learning Design and Technology, Business, Education, Agriculture, and Computing. Its rapid programme expansion reflects strong responsiveness to labour market needs and digital transformation priorities.

By combining flexible admissions, online delivery, digital learner support, and modular learning, OUK provides an inclusive, scalable, and replicable model for widening access to higher education and lifelong skills development in Kenya and beyond.

OUK has also built global visibility through international partnerships and networks, including the Commonwealth of Learning, a formal collaboration with IGNOU in India, UNISA in South Africa, Arizona State University and academic collaboration with institutions of higher learning locally and globally. Its leadership has also represented Kenya in global digital education forums, including the USAID Global Education Conference in Washington, DC and the DETA 2025 Conference in Mauritius. OUK has also been invited to join the African Council for Distance Education (ACDE), further affirming its emerging continental role in open and digital learning.

(2) Experience and Qualifications in Digital Education

OUK's core strength lies in designing and operating an integrated digital education ecosystem from the ground up. Through myOUK for student services and SOMAS for teaching and learning, supported by digital library and repository services, the university delivers online admissions, learning, assessment, learner support, and academic administration at scale. This makes OUK a practical model of end-to-end digital higher education. Its additional strengths include flexible programme design, industry-responsive curricula, strong digital learner support, policy readiness, and the capacity to build strategic partnerships around emerging technologies and scalable innovation.

OUK's innovation profile is strengthened by strategic partnerships and successful projects with strong demonstration value. These include the Huawei ICT Academy with Huawei Kenya and Equity Group Foundation, an ICDL digital literacy partnership, BCS Technology supporting AI training and innovation pathways, and participation in the EU co-funded Erasmus+ PROSPER Project, where OUK contributes to digital collaboration and quality monitoring. OUK was also awarded support under the USAID Transforming Higher Education Activity, reflecting international confidence in its institutional capacity, even though the wider programme context was later affected by USAID closure processes.

OUK also participated in the KIEP-SKIES Rapid Tech Skills Program, a World Bank-funded, multi-university initiative, demonstrating OUK's capacity to deliver digital skills programmes. In addition, OUK's digital learning systems were showcased through the Education Sector Case Studies at the CIO100 Symposium and Awards 2025.Together, these experiences position OUK as a credible, innovation-driven institution with solutions that are inclusive, scalable, partnership-based, and adaptable across global contexts well aligned with the vision and collaborative spirit of the WDEA.

Case 99

Calculating Campus Greenery Ratio: An AI and Beidou Collaborative Image Quantification Exploration

The Aerospace City School of RDFZ, Beijing, China

Background

Current primary and secondary education exhibits structural deficiencies in the integration of ecological civilization education and artificial intelligence education. Ecological education predominantly remains at the level of knowledge transmission, lacking systematic cultivation of students' ecological cognitive abilities and quantitative analysis skills for environmental issues. AI education, meanwhile, is often confined to theoretical introductions or extracurricular club activities, failing to embed authentically within real-world problem contexts, thereby preventing students from developing the core competency of "solving practical problems with AI." Furthermore, interdisciplinary curriculum integration remains weak, and the cultivation of quantitative analytical thinking is insufficient. When confronted with comprehensive ecological issues such as "campus greenery ratio," students lack scientific modeling capabilities and technical support.

This case addresses the aforementioned pedagogical pain points by constructing an interdisciplinary project-based learning framework driven by the core task of "Calculating Campus Greenery Ratio." It systematically integrates AI image quantitative analysis and Beidou navigation technology to explore a feasible pathway for integrating AI and ecological education. By embedding AI technologies into the process of solving authentic ecological problems, this case aims to facilitate a paradigm shift from knowledge acquisition to competency transfer, demonstrating clear practical relevance and technological innovation value.

Case Implementation Status

This case adopts project-based learning as the core teaching strategy, integrating two courses: Information Technology (2 class hours) and General Technology (2 class hours). The implementation relies on three core technological tools—AI programming plugins, educational large language models,

and Beidou navigation modules—to construct a closed-loop teaching process comprising “problem identification, technological intervention, data integration, and outcome generation.”

1. Technology Application Measures and Solutions

·AI Programming Plugin (Fittencode + VSCode): Used for quantitative image analysis to achieve pixel-level region extraction and area calculation. Under teacher guidance, students utilize AI-generated code or independently write scripts to identify green regions and calculate areas across various images, including Jastrow illusion images, leaf images, multi-temporal remote sensing images of Saihanba, and campus aerial photographs.

·Educational Large Language Model (InnoSpark): Supports students in independently investigating algorithms for spherical distance calculation, aiding their understanding of longitude-latitude coordinate conversion and geospatial modeling methods. This fosters interdisciplinary knowledge integration and the development of autonomous learning capabilities.

·Beidou Navigation Module: Utilized for collecting longitude and latitude data of key campus locations. Combined with the Haversine formula, it enables high-precision calculation of the actual campus building area, providing the fundamental scale data necessary for calculating the greenery ratio.

2. Implementation Steps and Timeline

Phase I: Pre-Course Preparation (Preliminary Stage)

Multi-scenario preparatory activities (Fig1) establish students’ initial understanding of ecology and AI, laying an experiential foundation for subsequent project-based learning. These include an AI Technology Festival (AIGC creation), a field study in Inner Mongolia (ecological investigation of the Kubuqi Desert), and labor education (gourd planting and pyrography).

Figure 1 Multi-scenario preparatory activities

Phase II: Information Technology Course (2 Class Hours)

Session 1: From Jastrow Illusion to Saihanba Remote Sensing – AI-Assisted Quantitative Image Analysis

The Jastrow illusion image (Fig2) serves as an instructional hook, triggering cognitive conflict regarding area comparison and guiding students to consider the logic behind computer-based quantitative image analysis. The teacher leads students in reviewing RGB color encoding and pixel concepts, transforming the area problem into a pixel quantity problem. Students use Fittencode to calculate the pixel areas of two annular sectors, verifying the scientific nature of the visual illusion.

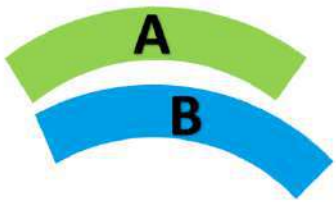

Figure 2 Jastrow Illusion (Determine the size of the green and blue areas)

Subsequently, the concepts of “color threshold” and “binarization” are introduced, using leaf images to demonstrate methods for extracting irregular regions (Fig3). The task escalates to analyzing four temporal remote sensing images of Saihanba (1982, 1998, 2008, 2018). Students calculate vegetation coverage, perceiving the effects of ecological governance through data changes, while contextualizing the Saihanba spirit within historical background (Fig4).

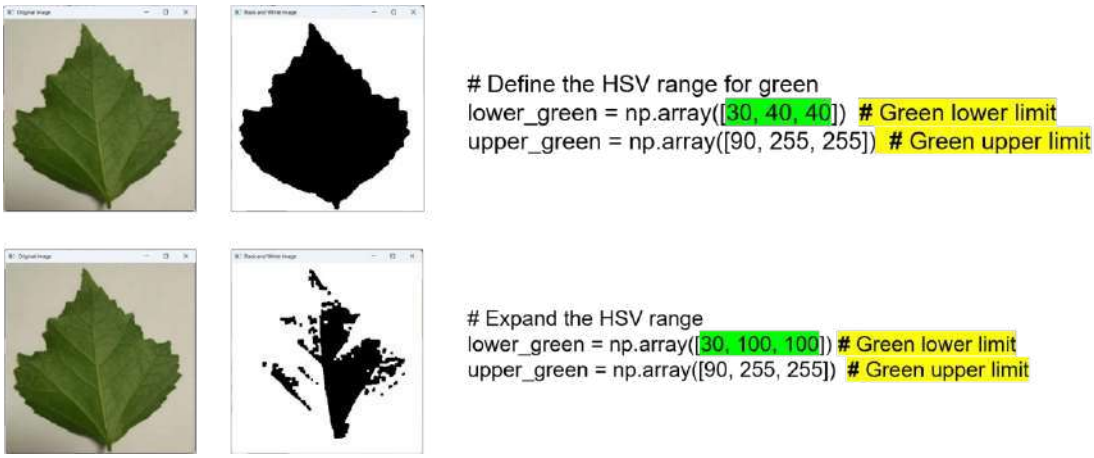

Figure 3 Leaf extraction areas under different green thresholds

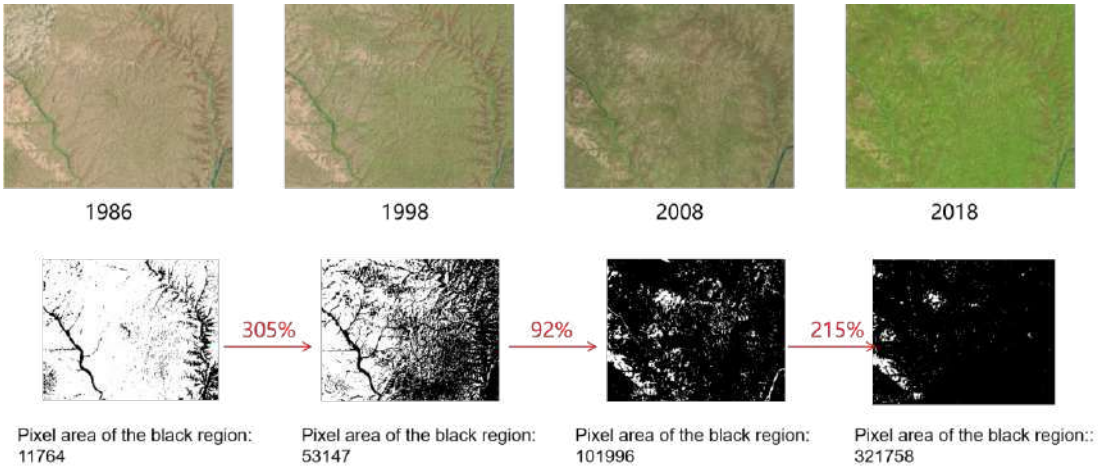

Figure 4 Changes in the green coverage of Saihanba

Session 2: Method Transfer and Campus Application

Students are guided to transfer the pixel-based area calculation method to campus aerial images (Fig5). They discuss technical pathways for acquiring scale information, and the Beidou navigation module is introduced as a precision measurement tool, preparing for the subsequent General Technology course.

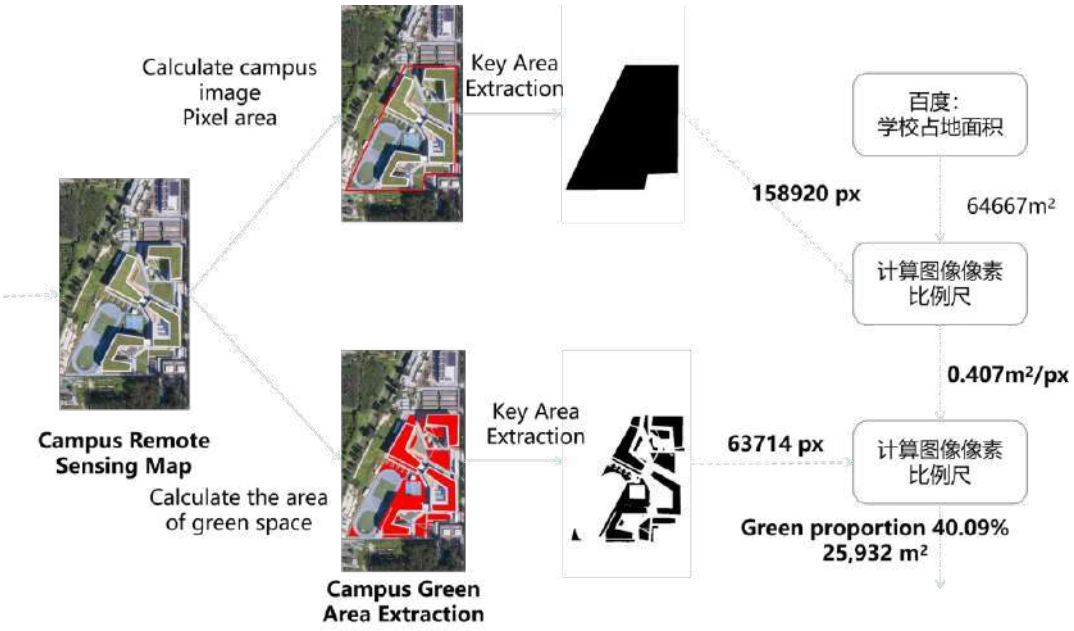

Figure 5 Calculation of Campus Green Space Ratio

Phase III: General Technology Course (2 Class Hours)

Students use the Beidou navigation module to collect longitude and latitude data of campus boundaries and key points (Table1). Leveraging the educational large language model, they research spherical distance algorithms to calculate the actual campus building area. By integrating the measured area with pixel area data from aerial images, students ultimately compute the campus greenery ratio and present their project outcomes.

Table 1 Latitude and longitude detection values of key campus points (partial excerpt)

Longitude	Latitude	Longitude	Latitude
116.265313	40.067825	116.264223	40.069831
116.264975	40.067743	116.264305	40.069675
116.264762	40.06757	116.264490	40.069737
116.264557	40.06741	116.264795	40.069508
116.264613	40.068002	116.264977	40.069298
116.265728	40.068817	116.264998	40.068722
116.264157	40.069102	116.265033	40.068722

Case Innovation and Breakthroughs

1. Main Innovation Content

·Task-Driven Interdisciplinary Teaching Paradigm Restructuring: This case uses the authentic task "Calculating Campus Greenery Ratio" as a vehicle to break down disciplinary barriers, organically integrating knowledge from Information Technology, General Technology, Ecology, Mathematics, and Geography. Compared to traditional discipline-segmented instruction, it constructs a real problem-oriented project-based learning framework, facilitating a paradigm shift from knowledge transmission to competency development.

·Cognitive Conflict-Driven Inquiry-Based Teaching Logic: Using the Jastrow illusion as a pedagogical starting point, the case leverages visual misdirection to create cognitive conflict and stimulate student inquiry. Students navigate a complete inquiry pathway encompassing "phenomenon observation, prior knowledge review, technological validation, model transfer, and real-world application." This pedagogical logic strengthens students' understanding of AI technology's value while embodying the cultivation of scientific inquiry spirit and critical thinking.

·Fusion Cultivation of Technological Literacy and Ecological Civilization Values: The case naturally integrates ecological civilization education into technical instruction. Through quantitative comparisons of Saihanba remote sensing data, students intuitively grasp the ecological transformation from "desert to forest," understanding the historical significance and spiritual value of ecological civilization construction. This organic integration of technical learning and value orientation reflects education's pursuit of balance between technological rationality and humanistic care.

2. Technology Breakthrough Content

This case systematically integrates AI image quantitative analysis with Beidou navigation positioning technology within a primary/secondary school teaching context for the first time. AI technology significantly lowers the operational barrier to image processing and data analysis, allowing students to focus on modeling and solving ecological problems. The Beidou navigation module provides high-precision field measurement capabilities, effectively addressing the scale acquisition inaccuracies inherent in remote sensing images. Their synergy establishes a complete technological chain encompassing "macro remote sensing, micro field measurement, and data integration," forming a replicable and transferable "AI + Beidou" educational technology integration paradigm. This integration represents a meaningful advancement in applying domestic autonomous technologies to foundational education, demonstrating the feasibility of embedding advanced technologies within real-world teaching scenarios.

3. Application Practice Breakthrough Content

The case achieves a breakthrough in moving AI education from theoretical instruction or isolated club activities to genuine interdisciplinary application. Students not only learn operational skills but also apply AI to solve tangible ecological problems—calculating the campus greenery ratio—thereby forming a closed loop of "problem – technology – application." This practice directly addresses the persistent issue in basic education of the disconnect between learning and application. Furthermore, by utilizing domestic AI models and Beidou navigation systems, the case provides a replicable model for other schools and regions aiming to integrate autonomous technologies into their curricula, advancing the digital transformation of domestic basic education.

4. Intellectual Property Status

The case materials, including curriculum design, teaching plans, code examples, and datasets (e.g., Saihanba remote sensing images, campus aerial images), are jointly developed by the teaching team at Beijing National Day School Aerospace City. The intellectual property rights are collectively owned by the school. The curriculum outcomes have been published through academic conferences (GCCCE 2025), school video channels, and various teaching awards, demonstrating a controlled yet open approach to knowledge dissemination.

Promotion Value and Risks

1. Application Prospects and Achievements

This case is currently implemented at Beijing National Day School Aerospace City, with the curriculum embedded within the standard Information Technology and General Technology courses. The implementation model includes pre-course preparation activities, a two-session IT component, and a two-session General Technology component, forming a complete project-based learning cycle. The case materials—including lesson plans, student activity sheets, code examples, and datasets—have been systematized, forming a replicable resource package suitable for promotion.

2. Social and Economic Value

Socially, the case enhances students' ecological awareness and digital literacy, cultivating interdisciplinary talents aligned with national digital and green development strategies. Economically, it demonstrates an efficient, replicable "AI + ecological education" solution using domestic technologies, reducing reliance on expensive commercial software or external training resources, thereby improving resource utilization efficiency in education.

3. Demonstrative and Leading Role

This case pioneers the integration of AI and Beidou technologies within foundational education, establishing a replicable "AI + ecological education" model. It exemplifies how advanced technologies can be embedded into authentic teaching scenarios to drive instructional reform, providing a practical reference for other schools and regions in constructing interdisciplinary curricula. Its emphasis on domestic technologies also underscores the importance of technological autonomy and security in education.

4. Potential Risks

Technical Risks: AI-generated results may exhibit randomness and unpredictability; image analysis accuracy can be affected by image resolution and threshold settings. Risk mitigation involves strengthening student training in tool operation, emphasizing the importance of precise prompts, and introducing the concept of iterative result validation.

Ethical Risks: Students' reliance on AI for problem-solving may weaken their independent critical thinking. It is essential to cultivate AI literacy, guiding students to understand AI as a tool whose output requires human judgment and validation, ensuring proper use of AI technology.

Other Relevant Information

1. Case Award Status:

Award Time	Award Name	Awarding Institution
2024	Research Lesson “AI-Assisted Image Processing”	Beijing College of Education, Faculty of Information Technology Education
2024	Second Prize, Haidian District Labor Education Excellent Lesson Collection and Selection	Haidian District Education Commission
2024	Third Prize, Haidian District Primary and Secondary School Interdisciplinary Theme Learning Typical Cases	Haidian District Education Commission
2025	Long Paper Accepted, Teacher Forum, 29th Global Chinese Conference on Computers in Education (GCCCE 2025)	GCCCE Organizing Committee
2025	Outstanding Cases of Smart Education	Ministry of Education Research Base for Educational Informatization Strategy
2025	Second Prize in the Primary and Secondary School Teachers Category of the 8th Global Future Education Design Competition	Beijing Normal University National Engineering Research Center for Intelligent Technology and Application in Internet Education

2. Third-Party Evaluation

Expert Review (GCCCE 2025): The course “From Jastrow Illusion to Saihanba Remote Sensing – AI-Assisted Quantitative Image Analysis” was selected for the Teacher Forum as a long paper, receiving unanimous positive feedback from experts who commended its interdisciplinary design and integration of AI technology with ecological education.

Public Opinion: The results of the “Beidou Navigation Mapping Campus Map” course were published on the school’s official video channel, receiving widespread attention and positive feedback from parents and the broader community.

Case 100

Exploration and Research on AI-empowered Teaching Practice of Technology and Engineering for Upper Grades in Primary Schools

Liu Wanying [1], Chen Lei [2], Liu Yi [3], Deng Xinyang [4]

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[2] Institute of Educational Science, Chaoyang District, Beijing
[3] Dijing Branch of Beijing Chenjinglun High School
[4] Chuiyangliu Central Primary School, Chaoyang District, Beijing

Background

China's Education Modernization 2035 clearly proposes to "use artificial intelligence to promote the reform of education and teaching and build intelligent campuses". The strategy of "early cultivation of top innovative talents" also emphasizes the need to foster students' innovative awareness and practical abilities from the basic education stage[1]. The Compulsory Education Science Curriculum Standard (2022 Edition) requires helping students understand the value of technological application and form initial engineering thinking through practical activities[2].

Investigations and research have revealed the following problems in the current technology and engineering education in primary schools: first, the fragmented teaching model, which is mostly dominated by single manual activities and lacks systematic design; second, the superficial application of AI tools, which are mostly used as information query tools and not deeply integrated into the whole process of design, practice and evaluation; third, the imperfect evaluation system, which focuses on result evaluation and neglects the process-oriented development of students' innovative thinking[3]. Against this background, exploring the AI-empowered teaching path of technology and engineering has become the key to breaking through teaching predicaments and fulfilling the goal of early cultivation of top innovative talents.

Case Implementation Status

1. Design and Implementation of AI-empowered Thematic Activities of Technology and Engineering (January 2024 - December 2025)

In accordance with the cognitive characteristics of students in Grades 4 to 6 and the curriculum requirements, 11 thematic activities covering four fields of circuit design, mechanical models, health programs and energy utilization were designed and implemented, and the application methods of AI tools were specified in the practice of each theme, as shown in Table 1.

Table 1 Design of AI-empowered Technology and Engineering Thematic Activities for Upper Grades in Primary Schools

Grade	Theme Name	AI Tool Application	Core Competency Cultivation
4	Simulated Installation of Lighting Circuits	AI virtual experiment software (e.g., NB Physics Experiment AI Version), Doubao (for inquiring circuit principles)	Understanding of circuit principles, AI virtual operation ability
4	Making a Home Security Alarm	ERNIE Bot (for design scheme reference), Seewo Screen Cast AI interactive function (for design display)	Structural design ability, AI-assisted scheme optimization ability
4	Making a Small Musical Instrument	Deepseek (for inquiring acoustic principles), AI appearance design tools (for generating appearance suggestions)	Application of acoustic principles, AI-assisted creative design ability
5	Making a Simple Mechanical Model	Tongyi Qianwen (for explaining mechanical principles), AI simulation software (for simulating mechanical operation)	Understanding of mechanical principles, AI simulation experiment ability
5	Making a Simple Electric Heating Cutter	Doubao (for inquiring electrothermal principles), AI safety operation guidance system (for prompting safety norms)	Application of energy conversion, AI-assisted safety practice ability
5	Formulating a Healthy Drinking Water Plan	AI database for digital human lectures (for generating health knowledge), AI data analysis tools (for analyzing drinking water data)	Data collection and analysis ability, AI-based health knowledge acquisition ability
6	Developing a Hydropower Generation Model	ERNIE Bot (for design idea reference), AI efficiency evaluation tools (for evaluating power generation efficiency)	Principles of energy utilization, AI-assisted engineering design ability
6	Exploring the Mystery of Saimianhong	Starch analysis software (for analyzing experimental data), Doubao (for explaining experimental phenomena)	Experimental data collection ability, AI data analysis ability
4-5	The Magical Ambulance	Tencent Meeting AI collaboration function (for online collaboration guidance), AI creative generation tools (for generating modification suggestions)	Interdisciplinary application ability, AI-assisted online collaboration ability
4-5	Architectural Model Design of a Beautiful Home	WeCom AI sharing platform (for sharing design schemes), AI structural stability evaluation tools (for evaluating models)	Spatial design ability, AI-based structural evaluation ability

2. Development of Supporting Teaching Aids for AI-empowered Technology and Engineering Thematic Activities

To solve the problems such as the difficulty in understanding abstract concepts and the restrictions on practical operation in technology and engineering teaching, four types of AI-integrated teaching aids were developed, as shown in Table 2, realizing the effective combination of AI virtual simulation and physical operation.

Table 2 Development of AI-integrated Supporting Teaching Aids for Technology and Engineering Teaching in Upper Grades of Primary Schools

Grade	Teaching Aid Name	Function	AI Integration Method
4	Security Alarm Door Lock Model	Simulating the structure of home door locks and testing the sensitivity of the alarm	Real-time analysis of alarm sensitivity data through the AI scheme evaluation system and generation of improvement suggestions
4	Simulated Experimental Model of Tympanic Membrane and Ossicles	Simulating the sound propagation process and helping understand the functions of auditory organs	Comparing the differences in sound propagation between physical models and AI simulation with the combination of AI virtual experiment software, and AI explaining the principles
5	Energy Conversion Simulated Experimental Teaching Aid	Showing the conversion process of electrical energy, thermal energy and mechanical energy	Collecting energy conversion data through AI sensors, and AI generating data charts and analyzing conversion efficiency
5	Experimental Teaching Aid for Studying the Falling Time of Objects with Different Weights	Exploring the relationship between the falling time of objects and their mass and shape	Recording falling time with AI timing APP (e.g., Phyphox AI Version), and AI automatically calculating the average value and analyzing the rules

3. Summarizing and Formulating Core AI Teaching Strategies

3.1 Three-dimensional Driving Strategy of Situation-Problem-AI

Stimulating interest with real situations, driving inquiry with complex problems, providing support with AI tools, and constructing a teaching closed loop of situation creation, problem posing, AI-assisted inquiry and achievement generation[4]. The specific implementation steps are as follows:

(1) Situation Creation

Combined with students' life experience, create real and interesting situations such as family hidden danger investigation and community environmental protection problem solving to stimulate the desire for inquiry[5].

(2) Problem Posing

Transform situations into explorative technology and engineering problems, such as how to design a home security alarm and how to make an environmentally friendly garbage sorting device, so as to clarify the inquiry objectives.

(3) AI-assisted Inquiry

Provide AI tools to support students' inquiry process, such as verifying conjectures with virtual experiment software, obtaining scheme suggestions with AI design assistants, and optimizing achievements with intelligent evaluation tools.

(4) Achievement Generation

Guide students to materialize inquiry results into physical works or design schemes, and display and share them through online platforms to cultivate a sense of accomplishment and innovative awareness.

3.2 Interdisciplinary Integration and AI Collaboration Strategy

Break disciplinary boundaries, integrate multidisciplinary knowledge such as science, mathematics, technology and art, and use AI tools to realize the integrated application of interdisciplinary knowledge[6]. The specific paths are as follows:

(1) Knowledge Integration

Integrate multidisciplinary knowledge points into theme design. For example, formulating a healthy drinking water plan needs to integrate the knowledge of science (simulated experiment design methods), mathematics (drinking water volume calculation), information technology (data collection and analysis) and Chinese (scheme writing).

(2) AI Collaborative Support

AI tools support the application of interdisciplinary knowledge throughout the whole process. For example, Doubao helps students sort out the scientific selection of simulated experiment materials, Excel plug-ins assist in calculating daily drinking water volume, and the digital human lecture database provides materials for scheme display.

(3) Interdisciplinary Presentation of Achievements

Encourage students to present achievements in diverse forms such as reports, models and short videos. AI tools support the design, production and dissemination of achievements, such as generating short video scripts with AI.

3.3 Personalized and Differentiated Cultivation Strategy

In view of the differences in students' cognitive levels and interest strengths, AI tools are used to provide personalized support to meet the innovative needs of top students. The specific measures are as follows:

(1) Personalized Learning Paths

AI recommends learning content according to students' previous performance such as test scores and work ratings. For example, students with weak foundations focus on virtual experiment practice, while top students focus on complex project design.

(2) Differentiated Task Design

Design tasks of different difficulty levels in the same thematic activity. For example, in the activity of making small musical instruments, the basic task is to make a simple flute, and the advanced task is to make an electronic musical instrument whose pitch can be controlled by programming. AI tools provide targeted support for different tasks, such as recommending programming software for advanced tasks.

(3) Personalized Feedback

AI evaluation tools provide personalized improvement suggestions according to the characteristics of students' works. For example, students with strong innovative ability are suggested to increase the functional diversity of their works, and students with weak practical ability are suggested to optimize the production steps to reduce the difficulty.

Case Innovation and Breakthroughs

1. Constructing an AI-empowered Curriculum System of Technology and Engineering

Combined with the cognitive laws of upper-grade primary school students and curriculum requirements, a systematic AI-empowered technology and engineering thematic activity system for Grades 4 to 6 was designed, forming a curriculum system with grade progression, clear objectives and in-depth AI integration, which solves the problem of teaching fragmentation.

2. Refining the Three-dimensional and Four-stage AI Teaching Strategy

From the three dimensions of AI tool application, teaching activity design and students' competency cultivation, a four-stage AI teaching strategy of perception, inquiry, practice and innovation was refined, providing teachers with operable teaching guidelines.

3. Improving the AI-assisted Evaluation System

A three-dimensional evaluation system of AI process recording + teacher evaluation + student peer evaluation was constructed. AI tools are used to record students' learning process and quantify competency development, realizing accurate and personalized evaluation.

Promotion Value and Risks

1. Improvement of Students' Technology and Engineering Competencies

1.1 Results of AI Process-oriented Evaluation

AI tools were used to record students' performance in 11 thematic activities, and scores were given from four dimensions: AI-assisted scheme design, AI-assisted practical operation, AI-assisted problem solving and AI-assisted innovation and optimization. The average score of the experimental class increased from 62 points in the initial stage to 88 points in the final stage, while that of the control class without AI-empowered teaching increased from 60 points to 68 points, showing a significant difference.

1.2 Results of Summative Evaluation

At the end of the research, 85% of the students in the experimental class could independently use AI tools to complete complex engineering design and production, and 70% of the students' optimization schemes were recognized by AI. In the control class, only 30% of the students could independently complete complex production and 15% could put forward optimization schemes, indicating that the experimental class performed significantly better.

1.3 Cultivation of Iterative Optimization Thinking

In engineering innovation practice, students gradually learned to improve schemes through test feedback. For example, in the activity of making a home security alarm, the alarm function designed by students for the first time failed to realize the door-opening alarm function. After many adjustments to the circuit connection and switch design, the demand of alarming when the door is opened and not alarming when the door is closed was finally realized, reflecting the logic from trial and error to optimization in engineering thinking.

2. Improvement of Teachers' Educational, Teaching and Research Competencies

2.1 Published Achievements

A monograph entitled Primary School Science Teaching Based on Technology and Engineering was published for the curriculum of this case. In addition, 31 relevant practical papers or cases on technology and engineering such as A Brief Discussion on Several Understandings of Primary School Science and Technology and Engineering Practical Teaching and Maker Activities Promote the Achievement of Core Concepts of Technology and Engineering for Students were published in journals or books, and 64 papers won awards.

2.2 Awards for Relevant Lesson Cases, Curricula and Designs

32 awards were won for cases and lesson cases at or above the district level, 22 awards for teaching design and homework design, 51 awards for curriculum resources, 67 research lessons and excellent lessons were offered, and 14 awards for activity schemes were obtained.

2.3 Research Project Achievements

Time	Project Name	Issuing Organization
July 2025 - Present	Research on the Design and Implementation of Interdisciplinary Thematic Learning in Primary School Science for Engineering Thinking Cultivation	Office of the Beijing Municipal Education Science Planning Leading Group
July 2022 - March 2025	Practice Research on Teaching Strategies of Technology and Engineering Curriculum in Science Subject during After-school Service Time for Upper Grades in Primary Schools	Academic Committee of Beijing Society of Education
January 2024 - September 2025	Research on the Design Strategies and Implementation of Unit Homework of Technology and Engineering for Upper Grades in Primary School Science Subject	Office of the Chaoyang District Education Science Planning Leading Group
April 2025 - Present	Desin and Practice of Interdisciplinary Thematic Project-based Learning Based on Technology and Engineering	Advanced Innovation Center for Future Education, Beijing Normal University

3. Achievement Promotion and Influence

The curriculum of this case has been introduced in 28 national, municipal and district-level teacher training sessions or teaching material seminars, and the achievements have been shared and exchanged on 22 national and municipal platforms. Among them, a special report entitled Science Education in Technology and Engineering Practice was delivered at the 2025 Annual Conference of the

Science Teacher Alliance of the Consortium for Science and Engineering Technology Education in Basic Education of Beijing Normal University. Meanwhile, in cooperation with the Beijing Association for Science and Technology, a popular science video Hydropower Generation Model was recorded for the Beijing Science Center and applied as a resource in the after-school service time of many primary schools in Beijing.

4. Promotability

This case has realized the in-depth integration of artificial intelligence and technology and engineering education by constructing an AI-empowered technology and engineering curriculum system for upper grades in primary schools, refining the three-dimensional and four-stage AI teaching strategy and improving the AI-assisted evaluation system. Practical research shows that AI empowerment can help improve students' engineering thinking, innovative ability and problem-solving ability, providing a practical path for the early cultivation of top innovative talents. At the same time, the typical cases, AI-integrated teaching aids and strategies formed in this paper can provide practical guidance for primary school science teachers, promote the transformation of primary school technology and engineering education from scattered practice to an AI-empowered systematic curriculum, and contribute to the digital transformation of education and the cultivation of top innovative talents.

Other Relevant Information

1. Case Award Status:

Include the award time	Award name	Awarding institution
2026.1.25	Second Prize in the Collection Activity of Typical Videos for "AI + Basic Education" Application Scenarios	National Engineering Research Center for Internet Education Intelligent Technology and Application, Beijing Normal University
2026.1	Second Prize in the First Collection Activity of International Interdisciplinary Project-Based Learning Cases and Integrated Curricula in Chaoyang District	Institute of Educational Science, Chaoyang District, Beijing
2026.1	First Prize in the First Collection Activity of International Interdisciplinary Project-Based Learning Cases and Integrated Curricula in Chaoyang District	Institute of Educational Science, Chaoyang District, Beijing
2025.9	Special Prize in the Excellent Teaching Lesson Case Track of the National Excellent Lesson Case Competition and Typical Case Collection Activity	Advanced Innovation Center for Future Education, Beijing Normal University

2025.4	Third Prize in the National Excellent Case Collection Activity for 2024 Research on Future Learning in Basic Education	Shanghai Future Learning and Research Development Center
2025.5	Project-based Learning Achievement Case (Expert Evaluated)	Beijing Society of Education, Training Center of Beijing Academy of Educational Sciences
2025.5	Delivered the special report *Science Education in Technology and Engineering Practice* at the annual conference of the Science Teacher Alliance of Beijing Normal University's Basic Education Science and Engineering Technology Education Subject Consortium, with excellent presentation effects	Department of Basic Education Development and Management, Beijing Normal University
2025.11	The paper *Practical Research on AI Application in Technology and Engineering Education for Upper Grades of Primary Schools* was included in the conference proceedings and an on-site special speech was delivered	Professional Committee of Information Technology Education in Primary and Secondary Schools of the Chinese Society of Education

This case collection brings together real-world innovations across K-12, higher education, vocational training, and lifelong learning. Using a scenario-driven approach, each case addresses key challenges in teaching, learning, assessment, research, and governance. From pain points to scalable solutions, the cases show how AI moves beyond a technical tool to become a core driver of educational change. Designed for educators and policymakers, this is an essential public product of the WDEA, supporting SDG4 by offering replicable pathways toward more personalized, intelligent, and equitable education for all.

Selected cases cover key scenarios as follows:

- Enable Immersive & Practical Learning
- Innovate Classroom Instruction
- Personalize Teaching & Learning
- Optimize Management & Services
- Transform Assessment & Evaluation
- Pioneer New Frontiers in Education
- AI-powered Scientific Research
- AI-enabled Lifelong Learning

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