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Large model for education—Overall reference framework

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Contents

Foreword

This document was drafted in accordance with the provisions of World Digital Education Alliance (WDEA) Standardization Committee Operation Procedure.

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This document was proposed by and is under the jurisdiction of the World Digital Education Alliance.

Introduction

Artificial intelligence is currently driving the innovation of science and technology, and profoundly transformin g the progress of educational modernization. UNESCO has released a number of reports and documents to guide global policymakers and educators to explore the application of artificial intelligence in education.

In this context, many governments and relevant institutions have actively taken measures to facilitate the application and development of artificial intelligence in education, successfully organizing important international conferences. With the progress in deep learning, big data, and cloud computing, generative large models have emerged as an innovative paradigm in artificial intelligence, unlocking substantial potential to transform educational practices and enhance learning experiences. Educational AI models, which are specifically customized to meet the needs of education, can effectively enhance the quality and efficiency of education while promoting educational equity and personalization.

However, large models for education also face challenges and risks related to data quality, algorithm security, model interpretability, and ethics. To address these challenges, it is supposed to adhere to principles of human-centricity, cultural adaptability and neutrality that could contribute to the scientific validity, effectiveness, reliability, and sustainability of these models, to establish relevant standards and specifications that could regulate the platforms, tools, data, assessment, interfaces, applications, security, ethics and privacy regarding large model for education; and to build a trustworthy, secure, user-friendly, efficient and human-oriented large model for education, which could better empower education, optimize digital education standard system, promote education digitalization and innovation to ensure high-quality development in education.

This standard, developed by the Standardization Committee of the World Digital Education Alliance, serves as an overall reference of large models for education. It is intended to guide the construction and application of large models for education, and to direct the development of subsequent standards related to large models for education. This standard aims at promoting the healthy development of large models for education, ensuring unified standards and best practices throughout the design, development, implementation, and evaluation processes, accelerating the digital transformation in education, advancing educational equity as well as building a trustworthy educational ecosystem.

Large model for education: overall reference framework

1 Scope

This document establishes the design principles for the large models for education, provides a reference framework for these models, and offers basic descriptions of the infrastructure layer, the data layer, the model layer, the interface layer, the application layer, and the layer concerning security, ethics, privacy, and governance within the framework.

This document is applicable to the design, development, deployment, and application of large models for education within the Alliance.

2 Normative references

The content of the following documents become an integral part of this document through normative references in the text. For those referenced documents with a specified date, only the version corresponding to that date is applicable to this document. For those referenced documents without a specified date, the latest version, including all amendments, is applicable to this document.

ISO/IEC 22989:2022 *Information technology — Artificial intelligence — Artificial intelligence concepts and terminology*

ISO/IEC TR 24368:2022 *Information technology — Artificial intelligence — Overview of ethical and societal concerns*

GB/T 42018-2022 *Information technology — Artificial intelligence — Platform computing resource specification*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

large model for education

The term "large model for education" refers to various AI models of different scales that are designed and developed based on education-related data to serve diverse educational purposes.

Note: The core lies in the adaptation of these models to meet the practical needs of education, such as understanding educational content, generating teaching resources, analyzing learning behaviors, and other relevant aspects.

3.2

foundation model

Foundational model is a general-purpose large AI model, trained through deep learning based on a vast amount of raw data. Foundational models are typically categorized into several types, including

Large Language Model (LLM), Large Vision Model (LVM), Audio Large Language Model (ALLM), and Multi-modal Large Model (MLM).

3.3

domain-specific large model for education

Domain-specific large model for education refers to an educational large model that is designed and developed based on the specific needs of a particular educational field and is capable of reflecting the characteristics of that field.

Note: If categorized by educational stages or types , it can be divided into domain-specific large models for basic education, higher education, vocational education, lifelong education, special education, and other forms of education. If categorized by disciplines, it can be divided into domain-specific large models for different disciplines.

3.4

scenario-based large model for education

A scenario-based large model for education is an educational large model that has been deeply optimized for specific scenarios within a specific domain of education.

Note: The core of this model lies in its specialization for particular scenarios, aiming to meet the needs of specific educational practice contexts, such as classroom interaction, exam tutoring, language learning, etc.

4 Abbreviated terms

AI	Artificial Intelligence
LME	Large Model for Education
LLM	Large Language Model
LVM	Large Vision Model
ALLM	Audio Large Language Model
MLM	Multimodal Large Model
API	Application Programming Interface
CPU	Central Processing Unit
GPU	Graphic Processing Unit
FPGA	Field Programmable Gate Array
NPU	Neural Network Processing Unit
TPU	Tensor Processing Unit

5 Design discipline

5.1 Be systematically layered

The architecture of the entire large model for education adopts a modular hierarchical structure, divided into several layers, with each level potentially having sub-layers. This design aligns with the technical logic of large models and ensures clear structures between layers and sub-layers.

5.2 Be designed based on open architectures

A large model for education adopts open architectures, supporting plug-and-play module design and the integration of various technologies, including the open soft and hard resources, open data, open-source algorithms and models, platform interfaces, and other open applications.

5.3 Be extensible

A flexible architecture is designed to support future functional and scale expansion. This includes support for distributed computing, dynamic resource scheduling, data management and scaling, model scaling and migration, application scenario expansion, and so on.

5.4 Ensure security and ethicality

The entire architecture of the large model for education is secure, with comprehensive security measures in place across all layers, including data security, model security, system security, privacy protection, and compliance.

5.5 Reflect the characteristics of the education sector

The large model for education is designed to align with the principles and characteristics of the education sector. It meets educational needs, adheres to ethical and privacy requirements, fulfills the expectations of education stakeholders, serves various educational entities, and is applicable across diverse educational scenarios such as learning, teaching, assessment, research, and management.

6 Overall reference framework

The reference framework for the Large Model for Education (LME) is structured hierarchically from the bottom up, consisting of five layers: Infrastructure Layer (L1), Data Layer (L2), Model Layer (L3), Interface Layer (L4), and Application Layer (L5). Each layer serves as an essential support for the layer above it, forming a closed-loop logic for the development and application of the large model for education. Additionally, common concerns such as Security, Ethics, and Privacy (D1) and Governance (D2) are considered at each layer, with the two dimensions integrated as core threads throughout the entire LME development and application process. The reference framework is illustrated in Figure 1.

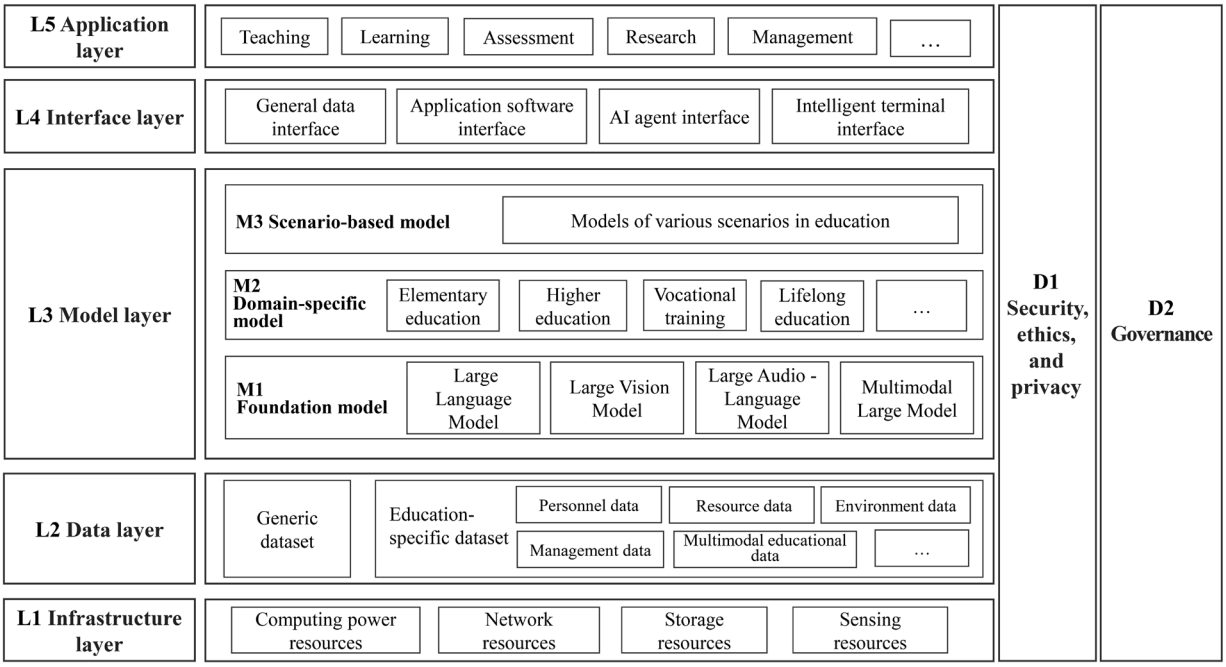

Figure 1 Overall reference framework of the large model for education

The architecture of the Large Model for Education (LME) is specifically divided into the following hierarchical levels and dimensions,

— L1 Infrastructure Layer: The infrastructure resources that support the development of the Large Model for Education typically include computing power resources, storage resources, networking resources, sensing resources, and security resources.

— L2 Data Layer: Provides datasets for training and testing the large model, including generic datasets and education-specific datasets.

— L3 Model Layer: Divided from bottom to top into three sub-layers: the Foundation Model Layer (M1), the Domain Model Layer (M2), and the Scenario Model Layer (M3).

— L4 Interface Layer: Interfaces between the large model and various applications, typically including data interfaces, application software interfaces, agent interfaces, and smart terminal interfaces.

— L5 Application Layer: Various educational applications and services that integrate the capabilities of the large model, enhancing the service satisfaction of different educational needs by leveraging the capabilities of the large model.

— D1 Dimension of Security, Ethics, and Privacy: The requirements related to security, ethics, and privacy that need to be considered in the design, development, and application of the education large model, involving Layers L1 to L5.

— D2 Dimension of Governance: The governance of the elements and dynamic processes within the framework (Layers L1 to L5).

7 Infrastructure Layer

7.1 Overview

The Infrastructure Layer is the bottom layer of the technical architecture, providing fundamental support resources, including computing power resources, network resources, storage resources, sensing resources, and security resources, to ensure the technical implementation of large models.

7.2 Computing power resources

Computing power resources are key infrastructures that support the training and inference of large models, providing the computational capabilities for data processing and algorithm execution, and are typically divided into two forms: self-built and cloud services.

The devices that provide the computational and data processing capabilities required for model training and inference include physical computing devices (such as CPUs, GPUs, FPGAs, NPUs, TPUs) and virtual computing devices. The computing power resources in large models should meet the following basic requirements:

a) They should be able to execute the training or inference of models for at least one modality (such as text, images, or speech);

b) They should support hardware-accelerated AI computing, equipped with distributed training and inference acceleration libraries;

c) They should support hardware-accelerated preprocessing (such as image and video encoding and decoding);

d) They should support key-value pair caching.

7.3 Storage resources

Storage resources are high-performance computing devices used in the development of large models to store models, training data, and inference data.

— Data storage: It is used to store training datasets, preprocessed data, intermediate results, etc.

Example: Storing large-scale educational datasets in a distributed file system for access by training servers.

— Model storage: It is used to store the weights of trained models, checkpoints, and inference models.
Example: Storing trained models in object storage for loading by inference servers.

The storage resources shall meet the following quality requirements:

a) Distributed storage and access of datasets shall be supported, with a redundancy backup mechanism implemented;

b) Standard file system interfaces shall be supported;

c) Requirements for storage bandwidth;

d) In-memory computing shall be supported where appropriate;

e) Storage pools shall be creatable using storage servers or hard disks as units. The storage pools shall be capable of identifying and managing different types of storage media, such as solid-state drives and hard disks.

7.4 Network resources

The network services that support the development and application of large models should enable high-speed data transmission and communication. Network resources refer to the hardware facilities for data transmission and communication, including servers, switches, routers, and other network devices. These resources can provide a high-speed and stable network environment for the computational power of large models and effectively support data transmission. The key elements include:

a) Support for high-speed network communication protocols;

b) Packet forwarding rate;

c) Support for load balancing;

d) Support for reliable networking solutions;

e) Support for server clustering;

f) Support for mapping between physical switches and logical switches to achieve link redundancy, ensuring that the failure of a single physical switch does not affect the execution of training and inference tasks.

7.5 Sensing resources

The infrastructure and equipment that provide sensing data for large models. The use of sensing resources should comply with the regulations on safety, ethics, and privacy and obtain the corresponding authorization.

Sensing resources include, but are not limited to:

a) Sensor devices: such as temperature sensors, humidity sensors, light sensors, pressure sensors, accelerometers, etc.;

b) Wearable devices: such as smartwatches, smart glasses, etc.;

c) Visual data acquisition devices: such as cameras;

d) Audio data acquisition devices: such as microphones;

e) Virtual reality, augmented reality, and mixed reality devices;

f) Holographic devices: such as holographic server equipment, holographic projection equipment, holographic display equipment.

8 Data Layer

8.1 Overview

The data layer includes datasets for pre - training, fine - tuning, inference, and prediction of the large models for education, which can be divided into two categories: general - purpose datasets and education - specific datasets.

8.2 Generic dataset

Generic dataset usually refers to a broad and diverse collection of data used for training and evaluating foundational models. It typically covers multiple domains, tasks, and modalities, in order to help models acquire general understanding and reasoning capabilities.

— Open-source data: Publicly available data that cover a variety of modes, including text, images, audio, and video.

— Search data: Content obtained through search engines, such as web pages, documents, and question-and-answer entries.

— Web data: Multimodal data obtained from publicly accessible Internet resources, including content from social media, news, and forum.

— Literature data: Structured or unstructured text data, such as academic papers, technical reports, and patent documents.

8.3 Education-specific dataset

Education-specific dataset refers to the existing dataset used in education as well as the new dataset generated during the educational practice. It is used to train large models in the field of education and large models for educational scenarios.

From the perspective of an educational business categorization, education-specific data can typically be divided into personnel data, resource data, environment data, management data, and multimodal educational data.

a) Personnel data. It mainly includes basic information represented by demographics, covering student data, teacher data, and administrator data.

    1) Teacher data: It stipulates the basic information and elements of teachers, including basic information of teachers, information on the organization of teaching activities, and information on the evaluation of teaching effectiveness. Teacher data can be used to train large models to assess teaching methods and classroom interaction effects in teaching scenarios.

2) Student data: It defines the information model and elements of students, including their identity identification, academic progress, learning style, learning ability, level of knowledge mastery, and learning preferences. Student data can be used to train models to recommend personalized learning paths for students in learning scenarios and to predict academic performance in evaluation scenarios.

3) Administrator data: It defines the information model and elements of administrators, including their basic information, management behavior information, and system maintenance behavior information. Administrator data can be used to optimize the allocation of educational resources and system design in management scenarios.

b) Resource data. It covers all the teaching, learning, and research resources created or accumulated in the educational process, including stored educational content resources and various learning support resources.

1) Educational Content Resources: They specify the foundational materials and learning content used for teaching. They include course modules (such as knowledge graphs, learning progression descriptions, etc.), subject-specific information, and instructional design. These resources help teachers and students construct and understand the basic knowledge, ideological methods, and inquiry-based practices of a subject. Textbooks and curriculum data are useful for training large models to design appropriate course schedules and content recommendations in educational settings.

2) Assessment and Practice Resources: They specify the learning resources used to test students' learning outcomes. They can evaluate students' knowledge acquisition, including homework and practice exercises, as well as test papers. Test and assessment data reflect the development status of students' core literacy, which help large models to evaluate students' knowledge in real-time in evaluation scenarios and recommend further learning content.

3) Learning Support Resources: They specify various learning materials and resources that support students' independent learning, including audio resources, books, papers, and teaching literature. In learning scenarios, models can recommend personalized learning content to learners based on subject resource data and design efficient learning environments and interactive models.

4) Practice and Learning Resources: They specify study tours, social practice, bases, tools, works, etc.

c) Environment data. It refers to all facilities, equipment, platforms, and other factors that influence the learning outcomes in the educational process. It includes both physical environment data and virtual environment data, which can help large models understand and optimize the impact of different learning environments on students and teachers.

1) Physical environment data: This covers all data related to the actual physical spaces and equipment used in educational activities, including classroom equipment, laboratory facilities, and library resources. Physical environment data can be used to train large models to design more suitable classroom layouts and equipment configurations in teaching scenarios. In learning scenarios, it can also help analyze students' performance in different

physical environments and recommend appropriate learning environments based on the analysis.

2) Virtual environment data: It specifies the data within virtual learning environments that support online learning interactions and virtual experiment operations, including online learning platforms and virtual laboratories. Virtual environment data helps to optimize the online learning experience and virtual experiment operations in research scenarios.

d) Management data. It refers to all data involved in management, administration, decision-making, and statistics within the education system, covering key areas such as school management information and administrative management information.

1) School management data: It defines all data related to the operation and management of a school, including data on curriculum design, faculty allocation, and arrangement of school activities. Management data can be used to train large models to optimize educational resources, evaluate policies, and formulate school operation strategies in management scenarios.

2) Administrative management data: It defines the data involved in the daily administrative operations of a school or educational institution, including data on administrative affairs, financial budgeting, and school policies. Administrative management data can be used in evaluation scenarios to assess the administrative work of a school, provide decision-making support, and ensure the proper implementation and evaluation of policy effectiveness.

e) Multimodal educational data. It refers to the data collected through various sensory means that are related to educational activities. These data reflect the learning process of students and store the physiological, psychological, and behavioral data of both teachers and students. These three types of data should meet the requirements of security, ethics, and privacy.

1) Physiological data: Data related to the physiological states of teachers and students collected through various types of sensors, including brainwaves, eye movements, heart rate, blood pressure, learning state, and attention distribution. Physiological data helps the large model assess students' concentration and learning stress in learning scenarios, thereby providing personalized learning suggestions.

2) Psychological data: Refers to data analyzed and recorded from the emotional, affective, and cognitive states of teachers and students, including interactive dialogues, emotional perception, facial expressions, and self - assessment reports from questionnaires. Psychological data can be used to train large models to assess the emotional changes of teachers or students in teaching scenarios, thereby adjusting teaching strategies or learning tasks.

3) Behavioral data: Refers to the specific behavioral data exhibited by teachers and students during the learning or teaching process, including body movements, operations, facial expressions, speech, intonation, speaking rate, and classroom interactions. In evaluation scenarios, these data can help assess students' learning attitudes and classroom performance, as well as teachers' teaching effectiveness, providing multi - dimensional support for teaching evaluation.

Educational-specific data plays a vital supporting role in the five major educational scenarios of teaching, learning, evaluation, research, and management. The synergistic effect of various types of data provides comprehensive support in the training of large educational models, laying a solid foundation for intelligent and personalized decision - making in all aspects of education.

9 Model layer

9.1 Overview

The model layer is the part responsible for the core functionality of the large model. It covers key technical elements from the underlying algorithms to the upper - layer applications, including the design, training, optimization, and application of the model. It consists of three sub - layers: the foundation model layer, the domain - specific model layer, and the scenario - specific model layer.

9.2 Foundation model

Foundation model is the foundation of the large educational model, providing general service capabilities for the large educational model. It typically includes the following models: Large Language Model (LLM), Large Vision Model (LVM), Large Audio - Language Model (ALLM), and Multimodal Large Model (MLM). The specific details are as follows.

a) LLM: A type of natural language processing model based on deep learning. LLMs can understand, generate, and process human language through large - scale training data and a vast number of parameters. Their core value lies in achieving efficient understanding and generation of human language through pre - training and fine - tuning, thereby promoting the widespread application of artificial intelligence in the field of natural language processing. The functions they provide include, but are not limited to:

    1) Natural Language Understanding: Text classification, entity recognition, relation extraction, and semantic comprehension.

    2) Natural Language Generation: Text generation, summarization, translation, and dialogue creation.

    3) Question - Answering and Information Retrieval: Open - domain question - answering, closed - domain question - answering, and information search.

    4) Text Completion and Editing: Text completion, text rewriting, and grammar correction.

    5) Reasoning and Logical Analysis: Logical reasoning, mathematical calculation, and common - sense inference.

    6) Personalization and Context - Awareness: Personalized generation and context - aware responses.

    7) Multilingual Support: Multilingual comprehension, multilingual generation, and cross - language translation.

    8) Task Planning and Tool Invocation: Task decomposition and tool calling.

9) Creative Capability: Creative writing and design assistance.

b) LVM: A type of large - scale visual processing model built based on deep learning technology, which is capable of extracting useful features and information from visual data such as images and videos. These models are typically trained using vast amounts of data and complex algorithms to simulate the working principles of the human visual system. The functions it provides include, but are not limited to:

1) Perception and Understanding: Image classification and recognition, object detection and segmentation, scene understanding, image quality assessment, video analysis and understanding.

2) Generation and Synthesis: Image generation, style transfer and editing, super - resolution reconstruction, video generation and synthesis.

3) Cross - modal Capability: Inter - understanding of images and text, multimodal reasoning, cross - modal generation.

c) ALLM: A type of large - scale audio processing model built on deep learning technology, which is capable of extracting useful features and information from audio data, including speech, music, and environmental sounds. These models are typically trained using vast amounts of audio data and complex algorithms to simulate the working principles of the human auditory and vocal systems, as well as musical expression capabilities. The functions they provide include, but are not limited to:

1) Perception and Understanding: Speech recognition, emotion analysis, audio event detection, audio classification.

2) Generation and Synthesis: Speech synthesis, music and song generation, audio enhancement, voice imitation, noise suppression.

3) Cross - modal Capability: Inter - understanding of speech and text, synchronized analysis of audio and video, cross - modal audio - video generation.

d) MLM: A type of large - scale pre - trained model based on a deep learning architecture, which is capable of processing and analyzing two or more different modalities of data, such as text, images, audio, video, sensor data. By learning the inter - relationships across modalities and integrating information from different modalities, it enhances the model's performance in various complex tasks, such as visual question - answering, multimodal dialogue, cross - modal retrieval, and image - caption generation. The functions it provides include, but are not limited to:

1) Multimodal Data Understanding: Perception and feature extraction, cross - modal association comprehension.

2) Multimodal Data Generation: Text generation, image generation, and cross - modal generation.

3) Multimodal Reasoning and Decision - making: Commonsense reasoning, logical reasoning, emotional reasoning.

4) Multimodal Knowledge Integration and Transfer: Knowledge integration and knowledge transfer.

5) Multimodal Interaction and Adaptation: Human - computer interaction and environmental adaptation.

9.3 Domain-specific model

The domain - specific model has typical characteristics of a specific educational field and deeply integrates professional knowledge of education. In terms of functionality, it is integrated and supports the needs of all aspects including teaching, learning, evaluation, research, and management.

The functions provided by the domain - specific model include, but are not limited to:

a) Personalized Learning Support: Recommending learning resources based on students' needs, providing personalized learning pathways and progress tracking.

b) Intelligent Teaching Assistance: Supporting automated lesson planning, enhancing classroom interaction, and providing feedback on homework correction.

c) Educational Content Generation: Automatically generating textbooks, test questions, virtual teaching assistants, etc.

d) Educational Data Analysis: Analyzing student performance, evaluating teaching effectiveness, and predicting educational trends.

e) Educational Management Optimization: Optimizing resource allocation and course scheduling, and supporting educational decision - making and policy - making.

f) Virtual Learning Environment: Building virtual classrooms, laboratories, and tutors to support remote and blended learning.

g) Language Learning and Translation: Providing intelligent language - learning tools and real - time multilingual translation.

h) Support for Special Education: Providing personalized interventions and assistive tools for students with special needs.

i) Teacher Development Support: Provides support services for teacher training and professional development.

9.4 Scenario-based model

Scenario Model: A more specific model than the domain model, the scenario model is a large - scale model that is deeply optimized for specific scenarios within the education field to meet the needs of particular educational scenarios.

Educational scenarios can be divided into five types: teaching, learning, assessment, research, and management, each of which includes several specific scenarios.

a) Applications of large - scale models in teaching scenarios may include lesson planning for teachers, classroom management, teaching analysis, student situation analysis, homework management, question - answering tutoring, course design, teaching assistance, and cross - disciplinary thematic learning - assisted design.

b) Applications of large - scale models in learning scenarios may include AI - based learning companions, language - learning assistants, gamified learning, situational learning, and intelligent tutoring systems.

c) Applications of large - scale models in assessment scenarios may include automatic homework grading, comprehensive quality evaluation, student assessment, and assistance in academic assessment.

d) Applications of large - scale models in research scenarios may include intelligent teacher professional development, intelligent management of educational research and teaching, intelligent research experiments, and intelligent research assistants.

e) Applications of large - scale models in educational management scenarios may include intelligent management of student information, intelligent campus security monitoring, and intelligent academic affairs management.

10 Interface layer

10.1 Overview

The interface layer is the connection layer between the layers of large - scale educational model and applications. When a specific teaching application calls the large - scale model, the interface layer is responsible for data transfer between the application layer and the large - scale model layer. The interface layer of the large - scale educational model focuses on the rules and details of interface invocation and does not involve specific application - layer functions and implementations. The interface design of the large - scale educational model should follow these principles.

a) Standardization: Adherence to general technical specifications (such as RESTful API, JSON/XML data formats).

b) Security: Support for data transmission encryption, user privacy protection, and access control.

c) Scalability: Modular design, supporting future functional expansion and version iteration.

d) Compatibility: Adaptation to multiple platforms (Web, mobile, desktop applications) and heterogeneous systems (databases, cloud services).

The interface layer mainly includes general data interfaces, application software interfaces, intelligent agent interfaces, and intelligent terminal interfaces, which are described in detail as follows.

10.2 General data interface

The general data interface is an interface that provides universal data services for accessing large models. To promote the efficient integration and data interconnection between large - scale educational models and educational systems (such as learning platforms, academic affairs management systems, educational tools, etc.), a set of standardized and universal data interfaces needs to be defined, without involving specific business logic or user interaction.

The general data interface has the following functional requirements, including but not limited to:

a) Data Input and Output

   1) Support for multiple data formats (such as JSON, XML, CSV, etc.).

   2) Provision of a standardized data structure to facilitate data exchange between different systems.

b) Data Preprocessing: Functions such as data cleaning, analysis, and tokenization.

c) Data Storage and Transmission: Support for efficient data storage and transmission protocols (such as HTTP/HTTPS, WebSocket).

d) Data Security: Data encryption and anonymization processing.

e) Metadata Management: Provision of metadata such as data source, type, and timestamp.

10.3 Application software interface

As a core component for interaction between large models for education and external systems or applications, the application software interface (API) requires meticulous planning for the implementation of functions and business logic. Through API interfaces, large models for education can achieve seamless integration with systems such as teaching platforms, learning tools, and knowledge bases, thereby providing a range of functions including intelligent Q&A, personalized learning, and teaching assessment.

The following functional requirements are included but not limited to:

a) Core Function Invocation:

   1) Natural Language Processing: Question - answering, translation, essay correction, etc.

   2) Image Processing: Handwriting recognition, formula recognition, etc.

   3) Speech Processing: Speech recognition, speech synthesis, etc.

b) Personalized Learning Support: Learning data analysis, adaptive learning pathways, knowledge point recommendations.

c) Teaching Management Functions: Classroom management, homework correction, virtual teaching assistants.

d) User Interaction and Feedback: User evaluation, interaction log recording.

e) Performance Monitoring and Optimization: Model performance monitoring, optimization suggestions.

10.4 AI agent interface

The intelligent agent of the large model for education is an intelligent proxy based on the large - scale model. It can independently complete specific educational tasks, such as answering questions, tutoring, and assessment. The intelligence and autonomy of the interaction need to be considered, and technologies such as reinforcement learning and multimodal perception are usually required. To support the efficient development and integration of intelligent agents, a set of standardized agent interfaces needs to be defined to provide access interfaces for the agents. External agents refer to systems or entities based on other intelligent models. The current large model for education can interact with one or more external agents to complete complex educational tasks. The interaction between the large - model layer and external agents is completed through the large - model interface layer.

The agent interface has the following functions, including but not limited to:

a) Task Understanding and Distribution: Parsing the user's input task request and distributing it to the corresponding agent module.

b) Knowledge Retrieval and Reasoning: Retrieving relevant information from the knowledge base or large model, and performing reasoning and generation.

c) Interaction Generation and Feedback: Generating interactive content (such as text, speech, image) based on the task results, and providing feedback.

d) Task Status and Monitoring: Real - time monitoring of the task status of the agent, supporting operations such as task pause and restart.

e) Agent Capability Expansion: Supporting developers to customize the agent's capabilities (such as adding new task types, optimizing interaction logic).

10.5 Intelligent terminal interface

The interface requirements between large models for education and intelligent terminals (such as mobile devices, tablet computers, and smart educational hardware) cover interface design principles, communication protocols, data formats, security standards, and performance indicators. These requirements need to take into account the compatibility and real-time performance of terminal devices, and usually need to balance the computational capabilities on the device - side and the invocation of cloud - based resources.

The interface has the following functions, including but not limited to:

a) Multimodal Data Interaction: Support for input and output of text, images, audio, and video.

b) Edge - Cloud Collaboration: Support for collaborative operation between edge - side computing and cloud - side computing.

c) Personalized Learning Support: Learning data analysis and adaptive learning path generation.

d) Real - time Interaction Function: Real-time feedback in the classroom, speech recognition and synthesis.

e) Device Management: Device status monitoring and resource scheduling.

11 Application layer

11.1 Overview

The educational value of large - scale models is mainly reflected in the application layer. Based on the types of activities in the education field, the applications of large models for education can be divided into five major application scenarios: teaching, learning, evaluation, research, and management.

11.2 Teaching

Provide intelligent teaching support for teachers around course creation, pre - class, in - class, and post - class teaching activities, such as intelligent lesson plan generation, teaching resource recommendation, classroom interaction support, and conduction of virtual teaching, to enhance teaching efficiency and quality. The teaching application scenarios include the following three types.

a) Pre-class Preparation. The scenarios in which teachers use AI to complete work during the pre - class preparation stage include, but are not limited to:

   1) Teaching Method Preparation: Q&A on teaching strategies.

   2) Student Situation Preparation: Data analysis of student situations, Q&A on strategies for student situations, and release of preview tasks.

   3) Teaching Material Preparation: Creation of lesson plans, teaching materials, guided learning plans, supporting teaching case study materials, project - based teaching design, large - unit teaching design, cross - disciplinary thematic teaching design, comprehensive practical activity creation, and intelligent slicing recommendation of lesson plan and teaching material resources.

   4) Material Preparation: Creation of videos, audio, images, charts, mind maps, and test papers, as well as intelligent slicing recommendations for video, audio, image, and test paper resources.

b) Classroom Activities. The scenarios in which teachers use AI to complete work during the classroom teaching stage include, but are not limited to:

   1) Teacher - led Teaching: Design and creation of teaching activities, design and creation of knowledge presentation, analysis of the quality of teacher - student interaction.

2) Student - centered Learning: Inquiry - based activities, experimental activities, practical training activities, role - playing, oral dialogues, speeches and recitations, multimedia presentations, multimodal presentations, knowledge contests, classroom debates, etc.

c) Post - class Tasks. The scenarios in which teachers use AI to complete work during the post - class stage include, but are not limited to:

1) Consolidation of Teaching: Assignment of homework, recommendation of micro - lessons.

2) Reflection on Teaching: Review of teaching videos, creation of teaching logs, tools for reflecting on teaching.

3) Question - answering and Tutoring: Planning of learning paths and subject - based Q&A tools.

11.3 Learning

Provide personalized learning support for students to enhance learning effectiveness and interest, such as personalized learning paths, intelligent Q&A and tutoring, and the analysis of learning behaviors. The learning application scenarios include the following two types.

a) Group Learning. This involves AI - based learning application scenarios with multiple people, including but not limited to:

1) Teacher - Student Interaction: Such as communication and answering assistants, tools for creating simulated roles and scenarios, and tools for stimulating creation and discussion.

2) Peer - to - Peer Interaction: Such as tools that add fun and competition.

b) Independent Learning. This only involves AI - based learning application scenarios for individual learners, including but not limited to:

1) Learning Planning: Such as course learning planning, planning for key and difficult points, and recommendations for learning strategies.

2) Resource Recommendation: Such as recommendations for test questions, videos, audio, and articles.

3) Learning Companion: Such as oral practice companions and psychological companions.

4) Auxiliary Learning and Q&A: Such as knowledge review, course preview, reading assistants, writing assistants, and subject - based question - answering.

5) Knowledge Q&A: Such as subject - based knowledge Q&A, extended subject - based knowledge Q&A, and popular science Q&A.

6) Learning Supervision: Such as habit - building Q&A and learning progress tracking reports.

11.4 Assessment

Provide intelligent assessment functions to support comprehensive and objective evaluation of learning outcomes, such as automatic homework grading, exam analysis and feedback, comprehensive quality evaluation, and process - based learning evaluation. The AI application scenarios include the following types.

a) Test - Paper Composition. This only involves application scenarios in AI - based test - paper composition, including but not limited to:

   1) Test - Item Design: Assisting in generating detailed test - item outlines.

   2) Material Collection: Collecting subject - specific test - item materials.

   3) Test - Item Generation: Assisting in generating test items.

   4) Unified Test - Paper Composition: Assisting in the scientific composition of test papers.

b) Intelligent Examination. This only involves AI - based examination scenarios, including but not limited to:

   1) Examination Room Organization: Assisting in the organization of examination rooms.

   2) Examination Supervision: Assisting in the supervision of examinations.

c) Post - Exam Grading. This only involves application scenarios in AI - based grading, including but not limited to:

   1) Oral Question Assessment: Scoring for Chinese oral questions, scoring for English oral questions.

   2) Written Question Assessment: Scoring for objective questions, scoring for humanities - based subjective questions, scoring for science - based subjective questions, scoring for English compositions, scoring for Chinese compositions.

d) Abnormal Grading Handling. This only involves application scenarios in AI - based grading for abnormal cases, including but not limited to:

   1) Scoring - related: Monitoring for large score differences, monitoring for inconsistent scoring criteria.

   2) Answer - related: Detection of similar answer sheets, detection of copying within the same answer sheet, detection of blank answer sheets, detection of incorrect answer positions.

e) Student Assessment. This only involves application scenarios in AI - based student assessment, including but not limited to:

   1) Diagnostic Assessment: Grading of oral performance, grading of compositions, grading of objective questions, grading of various types subjective questions.

2) Formative Assessment: Pre - class student profiling, pre - class learning situation report, in - class learning evaluation, AI - based evaluation of laboratory operations in physics, chemistry, and biology, evaluation of practical project investigations.

3) Summative Assessment: Generation of student comments, student homework reports, individual student learning situation reports, class - wide learning situation reports, evaluation of student competencies.

f) Teacher Assessment. This only involves application scenarios in AI - based teacher assessment, including but not limited to:

1) Teaching Performance Evaluation: Assessment of classroom teaching quality, evaluation of teaching objectives and content, evaluation of teaching methods and strategies, evaluation of classroom management and organization, evaluation of teaching expression and communication, and evaluation of teaching innovation capabilities.

2) Professional Ethics and Conduct Evaluation: Evaluation of teaching attitudes and integrity.

3) Performance Evaluation: Consideration of the teaching workload and responsibilities undertaken by teachers.

4) Professional Development Evaluation: Assessment of educational research capabilities, classroom management abilities, self - development and improvement, team - working skills, and home - school communication abilities.

g) School Assessment. This only involves application scenarios in AI - based school assessment, including but not limited to:

1) Teaching Quality: Evaluation of teaching quality and effectiveness.

2) School Management: Evaluation of school management and operations.

3) Moral Education: Evaluation of moral education work.

4) School Resources: Evaluation of school resource facilities.

5) Home - School Work: Evaluation of social satisfaction and home - school cooperation.

h) Regional Educational Assessment. This only involves application scenarios in AI - based regional educational assessment, including but not limited to:

1) Evaluation of Educational Quality: Analysis of academic performance and comprehensive quality of students, analysis of curriculum and teaching quality, evaluation of educational innovation and characteristics.

2) Evaluation of Educational Management Quality: Assessment of regional educational management level, analysis and evaluation of regional educational resources, evaluation of regional educational policies and implementation.

11.5 Research

Provide data support and analytical tools for educational research to conduct scientific research, such as the development of training courses, intelligent and precise teaching and research, and research topic assistants, etc. The specific application scenarios include, but are not limited to:

a) Course Development and Research. This only involves application scenarios in AI - based course development and research, including but not limited to:

   1) Special Topic Course Learning: Recommendations for development courses.

   2) Development Course Creation: Support for the creation of development courses.

b) Subject - based Teaching and Research. This only involves application scenarios in AI - based subject - based teaching and research, including but not limited to:

   1) Intelligent and Precise Teaching and Research: Precise support for teacher professional development, precise assistance for educational research, precise integration of interdisciplinary teaching and research, and precise guidance for teaching reflection.

   2) Observation of Teaching Activities: Empowerment of listening and evaluating classes, guidance for teaching competitions.

   3) Application of Subject - based Teaching and Research Tools: Subject - specific teaching and research tools, application of educational technology tools, creation of micro - lessons.

c) Scientific Research

   1) Research Projects: Topic research, research project application assistant, research project assistant.

   2) Writing Assistant: Literature search and recommendation, literature review, thesis writing, research report writing and optimization.

11.6 Management

Provide educational managers with intelligent management tools and enhance management efficiency, such as intelligent course scheduling, resource allocation optimization, and student performance monitoring and early warning, the following specific application scenarios are included but not limited to:

a) Class Management. This only involves application scenarios in AI - based class management, including but not limited to:

   1) Student Performance Management: Automated attendance analysis, student behavior monitoring, and student emotion detection.

   2) Learning Management: Homework and grade management, personalized learning situation analysis.

3) Activity Management: Creation of cultural and sports activities, and themed class meetings.

b) Academic Affairs Management. This only involves application scenarios in AI - based academic affairs management, including but not limited to:

1) Admissions Management: Intelligent analysis of admissions data, intelligent assistance in the admissions process.

2) Course Scheduling and Selection: Intelligent course scheduling, intelligent course selection.

3) Educational Data Analysis and Teaching Improvement: Analysis of educational data to inform teaching improvements.

4) Faculty and Student Information Management: Management of faculty information, management of student information.

5) Student Career Services: Guidance on self - awareness and career exploration, guidance on academic planning and development, guidance on career planning, and guidance on employment services.

c) Home - School Management. This only involves the application scenarios of AI - based home - school management, including but not limited to:

1) Educational Consulting and Guidance Services: Guidance on college application, planning for academic advancement pathways, guidance on subject - specific learning methods, and training on family education methods.

2) Home - School Communication and Evaluation: Communication channels and information dissemination, effectiveness of communication and feedback mechanisms.

d) Teacher Management. This only involves the application scenarios of AI - based teacher management, including but not limited to:

1) Team Building: Teacher development and management of teaching operations.

2) Comprehensive Support and Incentives: Comprehensive support and incentives.

e) Campus Management. This only involves application scenarios in campus management, including but not limited to:

1) Campus Services: AI - based chatbot intelligent Q&A, AI - powered campus security monitoring and early warning, campus energy consumption monitoring and green campus construction.

2) Safety Education: Simulation - based teaching for fire safety, traffic safety, natural disasters, public health, other safety - related topics, and on - site first aid.

12 Security, ethics, and privacy

12.1 Overview

The entire framework of the large model for education includes requirements for security, ethics, and privacy. The large - model system and its stakeholders should take into account issues related to security, ethics, and privacy.

12.2 Security

In the design, development, and application of large models for education, comprehensive security safeguards must be considered. These mainly include the following aspects:

a) Cybersecurity: Effective cybersecurity measures must be provided for the development and application of the models.

b) Data Security: The models must comply with intellectual property rights, ensure the security of commercial and personal data, and prevent the leakage, tampering, destruction and misuse of personal information and trade secrets.

c) Model Security: To prevent illegal acquisition and leakage of model parameters, structures and training data, and to have the ability to resist model attacks.

d) Content Security: The content generated by the models must be accurate and error-free, and must not have potential negative impacts on users' physical and mental well - being, or the network ecosystem.

e) Safety Management: A safety management system must be established for model development and application, and the implementation of this system must be ensured.

12.3 Ethics and privacy

In the design, development, and application of large models for education, ethical and privacy issues must be comprehensively considered. These mainly include the following aspects:

a) Data Privacy Protection: Data anonymity and data masking, the principle of data minimization, and secure data storage and transmission.

b) Algorithmic Fairness and Transparency: Algorithmic bias, model transparencyand interpretability.

c) User Rights and Informed Consent: The principle of informed consent, user rights to data access and control, and transparent privacy policies.

d) Technological Ethics and Social Impact: Educational equity, social responsibility, and long-term impact assessment.

e) Ethical Risks and Accountability: Identification and prevention of ethical risks, clarification of accountability, and the establishment of ethical review mechanisms.

13 Governance

13.1 Overview

The governance of large models for education involves multiple aspects, including technology, application, ethics, and policy. The goal of governing large models for education is to ensure that they align with human educational goals, legal and regulatory requirements, ethical principles, privacy protection, and the sustainable development of human society. Through a scientific governance framework and effective implementation strategies, large models for education can significantly enhance educational quality, promoting educational equity, and driving educational innovation, all while ensuring the safety, compliance, and sustainable development of the underlying technology.

13.2 Governance elements

Governance activities occur in the entire process of large models for education, from development and deployment to application and iteration. These activities encompass multiple layers, including foundational resources, datasets at the data layer, algorithms at the model layer, various interfaces at the interface layer, and diverse application scenarios at the application layer. Governance should cover at least the following seven dimensions.

a) Basic Resource Governance: This involves computing resources, storage resources, network resources and sensing resources.

   1) Computing Resources: Enhance efficiency, reduce costs, improve performance, and strengthen reliability, security, and sustainability.

   2) Storage Resources: Manage data, model parameters, and related intermediate results efficiently to achieve a balance between performance, cost, security, and scalability.

   3) Network Resources: Optimize data transmission, communication efficiency, and network architecture to support the efficient operation of distributed training and reasoning services, ensuring stability, security, and cost control.

   4) Sensor Resources: Collect, process, and coordinate the management of sensor data efficiently to optimize data quality, real-time performance, and resource utilization.

b) Data Governance: This involves data collection, data quality, and privacy protection.

   1) Data Quality: Identify data sources and scope of application, establish mechanisms for data cleansing, labeling, and validation to ensure data accuracy;

   2) Privacy Protection: Utilize encryption, anonymization, and differential privacy technologies to protect user privacy.

c) Model Governance: This involves algorithmic fairness, model transparency, and performance monitoring.

   1) Algorithmic Fairness: Ensure the diversity and representativeness of training data to avoid algorithmic bias.

2) Model Transparency: Provide interpretability for model decisions to enhance user trust.

3) Performance Monitoring: Evaluate model performance regularly to ensure that it meets the expected goals.

d) Security Governance: This involves data security, system security, and emergency response.

1) Data Security: Implement data encryption and access controls to prevent data leakage;

2) System Security: Deploy firewalls, intrusion detection mechanisms, and other security measures to guard against network attacks;

3) Emergency Response: Establish a security incident response mechanism to quickly address potential threats.

e) Ethical Governance: This involves user consent, algorithmic accountability, and assessment of social impact.

1) User Consent: Clearly inform users and obtain their consent before collecting and using data;

2) Algorithmic Responsibility: Clarify the responsibility for algorithmic decision-making to prevent misuse;

3) Social Impact Assessment: Evaluate the potential impact of model applications on society and educational equity.

f) Compliance Governance: This involves legal and regulatory compliance, industry standards, and third-party audits.

1) Industry Standards: Conforming to established standards and norms in the fields of artificial intelligence and education.

2) Third-Party Audits: Introducing independent institutions to conduct compliance audits on the models and the systems.

g) Operational Governance: This involves resource management, version control, and user support.

1) Resource Management: Optimize the use of computing, storage, and network resources to reduce costs.

2) Version Control: Manage model versions to ensure the traceability throughout the iteration process.

3) User Support: Provide user training and technical support to enhance the user experience.

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