

Relevant Concepts, Key Technologies and Typical Application Scenarios of AI + Education

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Abstract. Artificial intelligence (AI) + education has become an indispensable part of China's national strategy with regard to AI. This paper redefines relevant concepts of AI + education, studies the core technology of AI + education, and proposes a four-level systematic framework of AI + education. Besides, this paper probes into the application scenarios, typical models and main technologies of AI + education.

1. Relevant Concepts of AI + Education

As artificial intelligence (AI) is increasingly extensively applied in the field of education, new concepts, e.g. "AI education", "educational AI", "intelligent education", "smart education", "application of AI education" and "intelligent teaching system", have emerged one after another. The concepts are flourishing but a little perplexing, so these concepts urgently need to be clearly defined. Among these concepts, "AI education" means that the education system that teaches AI-related knowledge trains AI professionals or cultivates students' AI literacy by offering AI courses or providing professional education related to AI. "Educational AI", as a combination of AI and discipline, focuses on AI and expresses the knowledge related to pedagogy with AI. As education supported by AI technology, "intelligent education" builds an intelligent learning environment with AI technology as the tool, or plays the technical supportive role of AI in education and teaching with AI as content resources, constructs AI education solutions and development systems to achieve a new interdisciplinary and intelligent educational model. Supported by information technologies such as big data, the Internet of Things, cloud computing, wireless communication and AI, "smart education" is a new educational form and model characterized by interconnection, intelligence, perception and ubiquity. It enables teachers to teach efficiently and allows students to learn individually. "Application of AI education" refers to the application of AI in the field of education. According to the depth of the application of AI technology in education, such application can be divided into three levels, namely shallow application of "computational intelligence + education", intermediate application of "perceptual intelligence + education" and deep application of "cognitive intelligence in specific domains + education". With the help of AI technology, the "intelligent teaching system" allows AI to act as a teacher to carry out teaching through establishing the learner model, domain knowledge model and teaching model ¹.

Based on the above analysis, with learners as the orientation, AI + education is a new educational model and form based on AI technologies such as educational big data, deep learning, machine learning, emotional computing and learning analysis. This educational model establishes an intelligent educational environment of context awareness, ubiquitous interconnection, data integration and



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business collaboration, builds an intelligent team of teachers, realizes differentiated teaching, personalized learning and adaptive learning, so as to promote the reform of talent training mode and teaching methods, improve learners' core literacy and cultivate innovative talents.

2. Key Technologies of AI + Education

Including “two lower levels”, namely machine learning and deep learning, the key technologies of “AI + education” are combined with educational big data to provide algorithm and data guarantee for the application of AI in education. The “three-layer service” structure (speech recognition and emotional computing technology for physical sign service, natural language processing technology for content service, adaptive learning technology for behavior service) realizes personalized learning. On this basis, visual computing, virtual reality, educational robot, wearable technology, intelligent mining and intelligent modeling further lay a technical foundation for the application of AI in education². As the AI technology is constantly developing, it is impossible to exhaust the key technologies needed to apply AI to education. Therefore, it is necessary to establish a systematic model to explain these key technologies.

According to relevant researches on the above concepts, this paper applies the structural expression method to construct the systematic framework of AI + education, as shown in Figure 1.

Level	Technological factors
Application scenarios	For teachers, students and teaching
Learning support systems	Education cloud platform, intelligent campus, intelligent online learning platform and intelligent education analysis system
Core technology platforms	Speech recognition, affective computing, natural language processing, adaptive learning, machine learning, deep learning
Basic supportive platforms	Intellisense system, High performance computing and cloud services, big data infrastructure

Figure 1. Systematic framework of AI + education

Basic supportive platforms. The basic supportive platforms provide the support of basic hardware devices such as servers, terminals, sensors and chips as well as software environments ranging from cloud services to big data analysis system. The typical hardware infrastructure includes: the intelligent sensor which is used to automatically perceive the omni-directional and whole-process information of the learner, the intelligent chip that can cooperate with the sensor to calculate and process the perceptual signals, the AI supercomputing cluster, the big data computing cluster, the specialized AI computing server and so on. The typical software infrastructure consists of an intelligent cloud service system that realizes high-performance computing using the virtualization technology, and the big data analysis system that provides educational big data mining and analysis for the research, development and application of AI + education.

Core technology platforms. Integrating a series of AI technologies that drive the education system towards “intelligence”, the core technology platforms act as the core technological engine in the entire intelligent education system. With the natural language processing technology, the potentially ambiguous natural language can be transformed into some kind of unambiguous internal representation that can be understood by the computer. In this way, people can communicate with computers with natural languages without having to spend abundant time and energy learning computer languages that do not conform to human language habits. Adaptive learning allows computers to adjust the presentation of educational materials according to the learning demands of learners, e.g. learners' feedback on problems, their tasks and experience, which ensures that students can learn at their own pace. Machine learning and deep learning refers to the process of processing, sorting and transforming the original data into information through an interconnected hierarchical network of artificially simulated neurons, that is, conversion from data to intelligence. Speech recognition is the technology that enables the machine to transform speech signals into corresponding texts or commands through recognition and comprehension. Emotional computing is to establish an “emotional model” by gaining

the physiological and behavioral characteristic signals caused by human emotions through various sensors, thereby creating a kind of computing system that can not only perceive, identify and understand human emotions, but also make intelligent, sensitive and friendly response to human emotion³.

Learning support systems. Learning support systems, as the supporting environment and tool to implement AI teaching, serve as a significant foundation and supporting condition for the application of AI + education and teaching. Through the construction of educational cloud platform, we can realize the convergence, intercommunication and sharing of educational resources and data information; by building an intelligent campus, we can provide an open, interactive and collaborative intelligent campus service platform for schools, and offer an intelligent, three-dimensional and comprehensive teaching platform for teachers and students to conduct differentiated teaching and personalized learning; through establishing an intelligent online learning platform and an intelligent education analysis system, we can provide intelligent and ubiquitous learning services and data-based educational decision-making services.

Application scenarios. The application of AI technology in education is an inevitable path to give full play to the value of AI technology and construct a new educational model. Based on the key AI technologies and intelligent learning support system, AI + education achieves the intelligent application of education and teaching in all scenarios. These application scenarios include teacher-oriented AI applications (teaching-assisted applications such as intelligent lesson preparation, intelligent teaching, intelligent homework assignment, intelligent teaching and research etc.), student-oriented AI applications (learning-enhanced applications like learning path planning, learning resource recommendation, adaptive learning etc.) and teaching-oriented AI applications (examination evaluations such as intelligent test paper composition, intelligent invigilation, intelligent evaluation and intelligent examination analysis; management service applications such as intelligent course scheduling, intelligent class plates, intelligent security, intelligent equipment management, home-school intercommunication and regional big data management; physical and mental care applications such as physical health management, psychological diagnosis and rehabilitation, tutoring and special education).

3. Typical Application Scenarios of AI + Education

3.1. AI Technology and Its Application Scenarios

As the core of AI + education system, AI technology plays a critical role. There have been typical practical cases in the current application of AI + education.

Computational intelligence, perceptual intelligence and cognitive intelligence are not only three important phases in the development of AI, but also represents three different application levels of AI in education. Based on structured and unstructured data processing and analysis, computational intelligence is mainly used to solve complicated computing problems. With the ability to deal with auditory, visual and tactile perception and acquire environmental information, perceptual intelligence realizes the natural interaction between human and machine. Equipped with certain cognitive reasoning ability, cognitive intelligence enables the machine to learn, think and make correct decisions like humans⁴. With different development stages and technical requirements, the three types of AI technologies show different characteristics in the research, development and practical applications of products. The technological threshold for enterprises to research and develop AI products changes from a relatively low one to a high one, and then to a significant high technological threshold. Because of this, the currently available mainstream intelligent education products are still educational and teaching AI products based on computational intelligence and perceptual intelligence technologies. There is a small number of products that reflect cognitive intelligence, and these products are often limited to specific scenarios or fields. As indicated by the application level of AI technologies embodied in the products, the application of AI based on computational intelligence is only integrated with the educational scenario at a shallow level, the application of AI based on perceptual intelligence is combined with the

educational scenario at a medium level, and the application based on cognitive intelligence is deeply united with the educational scenario, which is also the further development direction of AI + education⁵.

The main technical features of computational intelligence are the application of machine learning algorithms and ideas, the ability of fast computing and persistent storage, and the ability to quickly read, process and analyze structured or semi-structured data. Computational intelligence is typically applied to online learning systems. Encapsulated and developed by the collaborative filtering algorithm based on KNN (data mining classification technology), computational intelligence serves as the recommendation engine of learning resources. The technical characteristics of perceptual intelligence are the ability to deal with auditory, visual and tactile environmental information with the help of speech, image and gesture recognition technologies, and to realize the natural interaction between human and machine through voice and visual technologies. Typically applied to oral English evaluation systems, perceptual intelligence combines the scoring rules with the general oral pronunciation, recognition and text rewriting technologies to function as an oral English evaluation engine. Cognitive intelligence equips the machine with certain cognitive reasoning ability, and enables it to learn, think and make correct decisions like human beings. Currently, the development of domain-specific cognitive intelligence is prioritized. Cognitive intelligence is usually combined with domain-specific knowledge systems, with the models customized or new algorithms developed according to business requirements. Cognitive intelligence is typically applied to personalized homework systems. Cognitive intelligence generates disciplinary knowledge graphs based on experts' experiential learning, forms the user profiles by collecting data about students' learning behaviors, and works as a personalized reasoning engine according to the user profiles and knowledge graphs².

3.2. Analysis of Application Scenarios of AI + Education

According to the application practice of AI + education in China, this paper studies the application scenarios, typical models and main technologies of AI + education (Table 1).

Table 1. Analysis of application scenarios of AI + education

Application scenarios	Typical application	Main technologies
Teaching scenarios	Intelligent speech assisted teaching	The speech recognition system developed based on the speech recognition technology, supports human-computer language interactive learning.
	Intelligent teaching system (student analysis service)	Help teachers to adjust teaching strategies through analyzing students' learning states and emotional attitudes by capturing and recognizing students' facial expressions and postures in real time in classroom teaching using emotional computing technology.
Management scenarios	Intelligent teaching system (decision support service)	Analyze all kinds of educational data produced by teaching and educational management activities using machine learning and deep learning technologies, extract useful information, induce and discover knowledge, and assist management decision-making ¹ .
	Teaching expert system (decision support service)	Solve complex decision-making problems by processing the expression, storage and search of knowledge with the knowledge representation technology.
Learning scenarios	Teaching robot	The teaching robot assists in answering questions, helps students in learning, and assists teachers in completing auxiliary or repetitive work in classroom

		teaching.
	Intelligent teaching system (intelligent recommendation service)	Make full use of learning resources to assist personalized teaching and learning using data mining and intelligent computing technologies.
	Photographing search; Answering questions online	It enables users to search and retrieve information they need by taking photos with the help of technologies combining image recognition, deep learning and content search.
	VR simulation teaching	Provide an immersive learning environment with VR and machine learning technologies.
Examination scenarios	Intelligent speech assisted system	Supported by the natural language processing technology, this system answers questions with natural language, and conducts oral language assessment and computer-aided language teaching.
	Intelligent paper correcting system	This system judges the examination results using image recognition, character recognition, big data analysis and knowledge modeling technologies ² .

4. Conclusion

Currently, both theoretical research and practical application of AI + education are in the initial development phase, and there are many problems in the clear definition of the concept of AI + education concept, the design of core technology platforms and application innovation. Therefore, this study tries to carry out analysis from three perspectives, namely relevant concept, key technologies and typical application scenarios, so as to promote the innovative development of AI + education.

References:

- [1] Liu Bangqi, Wang Yafei. Intelligent Education: System Framework, Core Technology Platform Construction and Implementation Strategy[J]. China Educational Technology. 2019 (10): 23-30.
- [2] Gao Tingting, Guo Jiong. Research Review on the Application of Artificial Intelligence in Education[J]. Modern Educational Technology. 2019 (1): 11-17.
- [3] Yan Xiaomei, Gao Bojun et al. Development Trend of Intelligent Technology Change Education: A Summary of the Fourth US China Smart Education Conference[J]. China Educational Technology. 2019, (7):31-37.
- [4] Zhang Jinbao, Ji Lingyan. Artificial Intelligence Enhanced Education or Education for Development of Intelligence——An Analysis on Connotation and Target of Intelligent Education in the Age of Artificial Intelligence[J]. Modern Distance Education Research. 2018, (2):14-23.
- [5] Song Lingqing, Xu Lin. The Logical Starting Point and Boundary of Artificial Intelligence in Education Application —Taking Knowledge Learning as an Example[J]. China Educational Technology. 2019,(6):14-20.