

How Generative Artificial Intelligence Facilitates the Digital Transformation of Educational Models

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Abstract: Generative artificial intelligence (AI) technology is rapidly developing, bringing profound changes to educational models. This study focuses on how generative AI promotes the digital transformation of educational models, deeply analyzing its technical characteristics and its ability to reshape educational models, and revealing the potential applications of this technology in the field of education. By providing personalized learning paths, optimizing the allocation of teaching resources, and enhancing the interactivity and fun of learning, generative AI significantly improves learning outcomes and teaching quality. However, its application in the digital transformation of educational models also faces challenges such as data privacy protection and technological maturity. In response to these challenges, this study proposes corresponding solutions. Through a review of relevant literature, tracking analysis of frontier developments, and examination of educational practice cases, this study aims to provide a solid theoretical basis and practical guidance for the digital transformation of education, in order to drive the process of educational modernization and contribute to cultivating more talents with innovative abilities.

Keywords: Generative Artificial Intelligence; Education Model; Digital Transformation.

1. Introduction

The rise of generative artificial intelligence technology, relying on the rapid development of deep learning and natural language processing, has brought significant opportunities for change in the field of education [1]. This technology can generate high-quality multimedia content, break geographical restrictions, make it possible for students in remote areas to access high-quality educational resources, and provide customized teaching programs based on students' learning progress and ability to meet the needs of personalized learning. Digital transformation, as a key path to education modernization, aims to promote the balanced distribution of resources, achieve educational equity, and cultivate students' innovative thinking and practical ability [2]. Generative AI plays an important role in this process, and its intelligent

teaching assistance function can reduce the burden of teachers, improve teaching efficiency, and generate personalized learning paths and resources (see Figure 1), stimulate students' learning interest and effectiveness, and provide powerful support for cultivating innovative talents and promoting social progress in the field of education. This study aims to deeply investigate how generative AI promotes the digital transformation of the education model, analyze its technical characteristics, applications in the education field, its role in reshaping the teaching model, and empirically assess its actual effects in the digital transformation of education. The study will focus on challenges such as data privacy protection and technology maturity, and propose corresponding solution strategies, with a view to providing a theoretical basis and practical guidance for the digital transformation of education and promoting the innovative development of education.

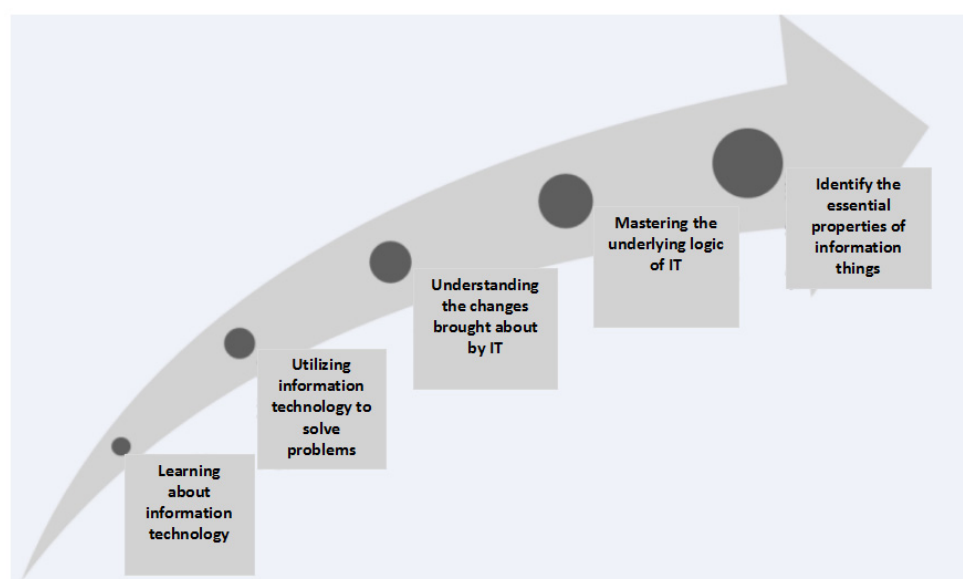


Figure 1. Educational perspective on generative AI utility and opportunity

2. Evolution of Educational Models and Generative AI

2.1. Historical Evolution of Educational Models

The education model has continued to evolve with the progress of the times and technological innovation, gradually shifting from traditional classroom lectures and paper-based textbooks to diversification, personalization and intelligence (see Figure 2). The traditional model emphasizes knowledge instillation, teacher domination, and passive acceptance by students, with the limitations of ignoring individual differences and restricting the cultivation of innovative thinking and abilities. With the rise of the Internet, mobile communications, artificial intelligence technology, the education model has undergone profound changes [3]. Internet technology makes educational resources widely disseminated, breaks the geographical time constraints, and

promotes the development of distance education and online learning; mobile communication technology enhances the convenience of learning, and students can obtain knowledge anytime and anywhere through mobile devices; artificial intelligence technology, especially generative artificial intelligence, generates new content by learning a large amount of data to provide rich resources for education, realizes personalized learning plans and exercise generation, simulates the real teaching scene, and enhances interactivity and competence. Real teaching scenarios, enhance interactivity and interest, and significantly improve the learning effect. Behind the evolution of the education model is the result of changes in social demand for talent and technological progress. Generative artificial intelligence, as a technological frontier, is promoting the education model to personalized, intelligent and efficient direction, in order to adapt to the requirements of the times and cultivate talents with innovative spirit and practical ability [4].

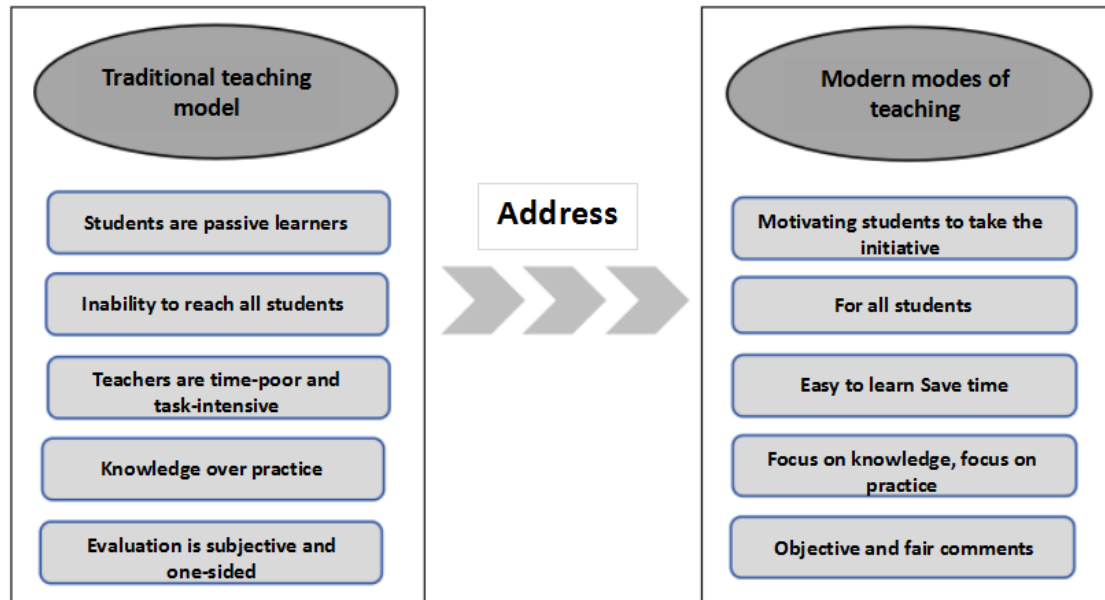


Figure 2. Comparison between traditional and modern education models

2.2. Technical Characterization of Generative AI

As a cutting-edge technology, Artificial Intelligence Generated Content (AIGC) is profoundly affecting multiple fields, especially education. The technology captures the intrinsic laws from a large amount of data through deep learning models, especially neural network architectures, to generate new content, covering a variety of forms, such as text, images, audio, video, etc. (see Fig. 3). AIGC, with its powerful generative capabilities and flexibility, can generate coherent and logical text in text generation, such as the Transformer-based GPT model, which is presented in news, literary creations. In image generation, Generative Adversarial Networks (GANs) generate highly realistic images, providing new ways for art and virtual reality. In the field of education, AIGC provides personalized resources according to students' learning progress and ability, recommending appropriate materials and difficulty, realizing tailor-made teaching and enhancing learning effects; AIGC is used as a teaching aid to reduce teachers' burden, provide immersive learning experience, and enhance interaction and fun. With

technological advances, AIGC will be more widely integrated into education, combined with virtual reality (VR), augmented reality (AR) and other technologies to create rich learning scenarios, but also face challenges such as content authenticity and privacy protection, which need to be solved by multi-party collaboration, in order to promote the modernization and high-quality development of education.

2.3. Impact of Generative AI on Educational Models

Generative Artificial Intelligence (AIGC) is gradually reshaping the field of education, which, with advanced algorithms and big data analysis, realizes the personalized customization of educational content, diversification of teaching methods, precision of learning paths, and scientific evaluation system. AIGC technology can dynamically generate appropriate learning materials according to the learning progress and comprehension ability of students, such as Coursera and edX intelligent education platforms, which recommend the most suitable course content and difficulty through machine learning algorithms. AIGC technology can

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through machine learning algorithms, which effectively improves the learning efficiency and stimulates students' motivation to learn.

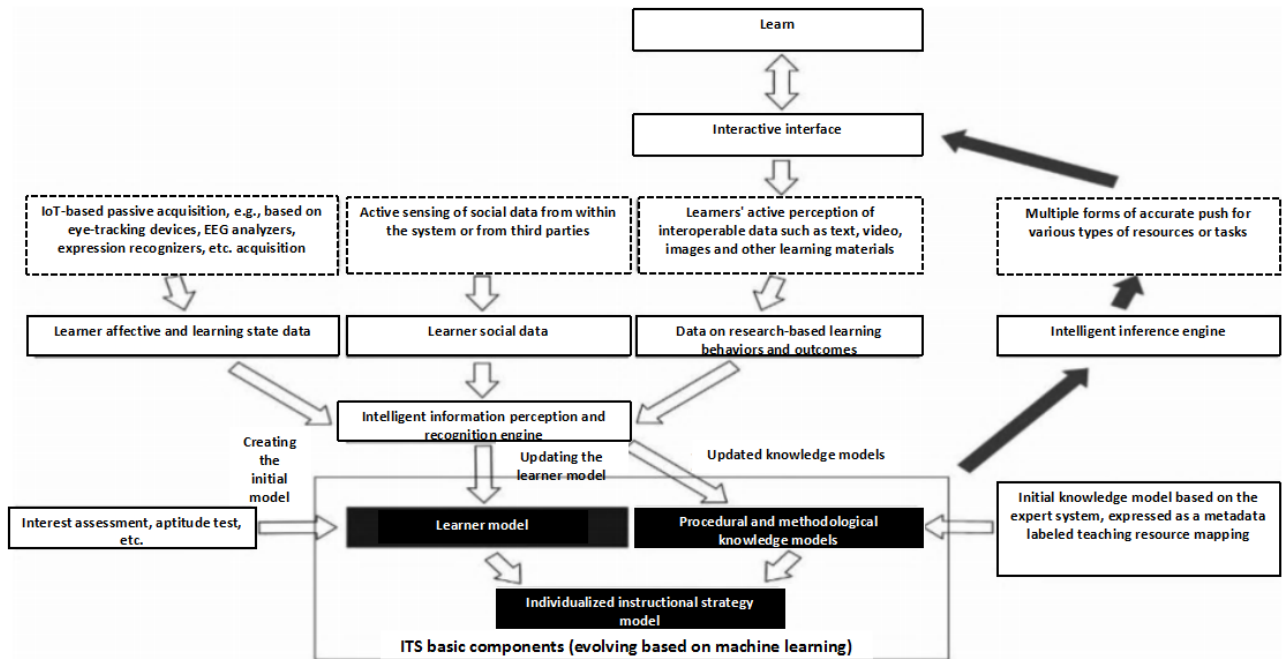


Figure 3. Working principle diagram of AIGC teaching system

AIGC technology empowers interactive and game-based learning, utilizing Virtual Reality (VR) and Augmented Reality (AR) technology to build immersive learning environments, complemented by chatbots and natural language processing technology. Chatbots and natural language processing technologies provide instant tutoring, breaking the limitations of time and space [5]. In terms of learning paths, AIGC customizes learning paths for students through in-depth analysis of their learning habits, interests, and abilities, which not only improves the learning effect, but also cultivates their independent learning and problem solving abilities. In terms of evaluation system, AIGC realizes objective and comprehensive assessment of students' learning outcomes with the help of big data analysis, focusing on

thinking ability, innovation ability and practical ability, which provides teachers and parents with accurate feedback and guidance (see Figure 4). Taking Homework together as an example, the platform uses AI technology to provide students with personalized learning resources and exercises, adjust the learning plan and difficulty in real time, and generate personalized learning reports, helping students and parents clearly grasp the learning situation and optimize learning strategies. It can be seen that AIGC is profoundly influencing the education model, promoting the development of education in the direction of personalization, diversification and scientific development, and laying a solid foundation for the cultivation of innovative talents.

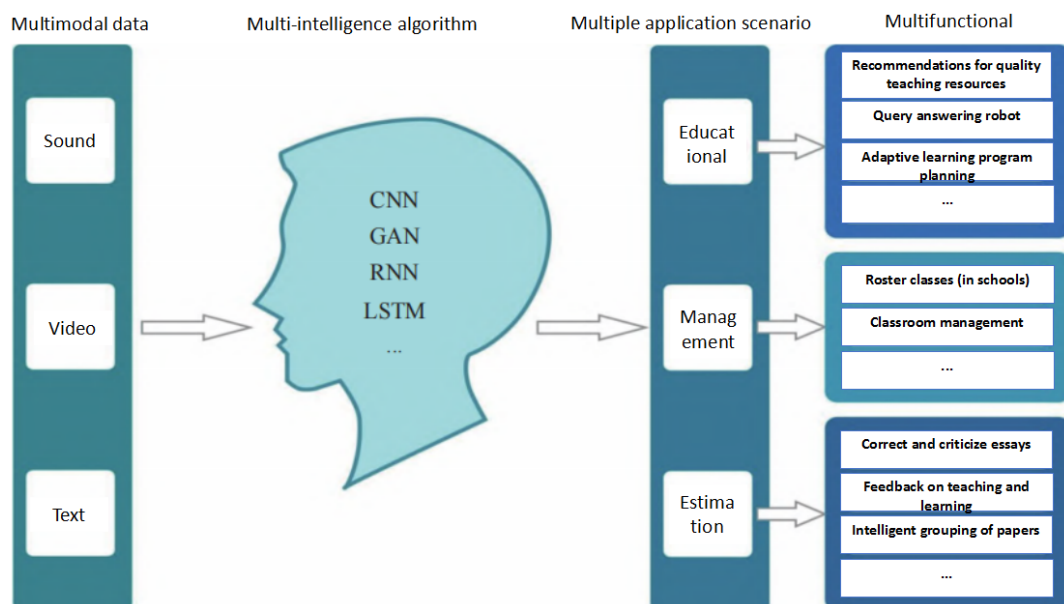


Figure 4. AIGC Education Brain Framework Diagram

3. Generative Artificial Intelligence Reshapes the Underlying Logic of Education

3.1. Brain Science and the Transformation of Education

Brain science, as a cutting-edge discipline that probes deeply into the structure and function of the brain, has revealed the plasticity of neuronal connection strength in its core theory of long-time horizon enhancement (LTP), which provides a scientific basis for the mechanism of learning and memory, and emphasizes the importance of repetitive practice and deep processing in the consolidation of knowledge. In educational practice, brain science guides educators to focus on the depth of learning, advocates active processing of information, and emphasizes the role of emotional factors in promoting learning effectiveness. At the same time, the rise of generative artificial intelligence (AIGC) technology has brought about the challenge of the "Google effect" in education, i.e., students tend to acquire information quickly rather than memorize it in depth. creative generation, bringing innovation to education. Intelligent tutoring systems can dynamically adjust the content and difficulty of teaching according to students' learning progress and preferences, realizing personalized teaching and effectively compensating for shallow learning problems. The integration of technology requires educators to balance the roles of technology-assisted and human teachers, and to pay attention to the impact of technology on students' social and emotional development. Brain science provides the theoretical basis for educational change, while the integration of AIGC technology opens up new paths for strengthening the depth of learning, realizing personalized teaching, and innovating educational methods. Educators need to continue to explore the effective integration of brain science and AIGC technology, with the aim of promoting the overall development of students and cultivating innovative talents to meet future needs.

3.2. Knowledge and Innovation in Education

The evolution of the concept of knowledge has gradually shifted from a static, fixed and unchanging understanding of entities to a dynamic, constructive perspective, a shift that has profoundly affected educational models and teaching practices. The traditional view of knowledge focuses on the objective existence and transmission of knowledge, while the modern view of knowledge emphasizes the contextual, individual constructive and social interaction of knowledge, prompting the transformation of education from the transmission of knowledge to the cultivation of knowledge creation and application ability. The rise of generative artificial intelligence (AIGC) provides a new path for the representation, encoding, computation, and creation of knowledge. AIGC simulates human creative thinking through deep learning algorithms, efficiently processes information and generates novel content, such as text, images, music, etc., which facilitates the dynamic updating and personalized presentation of educational content. In education practice, AIGC technology significantly improves teaching effect, such as intelligent education platform generating personalized learning paths based on students' learning data, assisting writing tools to stimulate students' creative inspirations in literary creation teaching, and intelligently

identifying knowledge blind spots to provide targeted exercises in mathematics learning. the integration of AIGC technology not only enriches teaching methods, but also promotes students' active learning and cultivation of innovative thinking, and promotes education from knowledge imparting to creative thinking. It promotes the transformation of education from knowledge transfer to knowledge innovation and application. Educators need to constantly update the concept of education, make full use of the advantages of AIGC technology, design student-centered teaching activities, and at the same time pay attention to the impact of technology on students' cognitive, affective, and social skills, so as to ensure that the integration of technology into education, promote the overall development of students, and provide a broad space for educational innovation.

3.3. Metacognition in Education

Metacognition in education, as educators' and learners' in-depth knowledge and reflection on the educational process itself, is the key to improving the quality of education and learning efficiency. It not only prompts educators and learners to comprehensively examine the learning objectives, strategies, processes and results, but also emphasizes the monitoring and regulation of self-cognitive activities. With the rapid development of generative AI, this technology generates diversified learning resources and personalized learning paths by simulating human thinking, which puts higher demands on the metacognitive abilities of educators and learners. At the same time, its instant feedback and personalized recommendation function promotes the cultivation of learners' independent learning ability and pushes educators to rethink teaching design and evaluation methods. The application of generative AI, such as the intelligent education platform that generates personalized learning paths based on students' learning data and interests, not only enriches learning resources, but also realizes the personalization and intelligence of the learning process, provides students with an immersive learning experience, and promotes the in-depth understanding and application of knowledge. In the face of this change, educators need to actively explore the application potential of generative AI in education, build an intelligent education ecosystem, promote personalized learning, facilitate deep learning, strengthen metacognitive ability training, and explore a new type of evaluation system to accurately reflect learner outcomes and abilities. The integration of metacognition and generative AI in education is leading the future education model to move towards greater intelligence and personalization, and educators should actively adapt to this trend to achieve the sustainable improvement of education quality and the comprehensive development of learners through innovative strategies.

4. Applications of Generative Artificial Intelligence in Digital Transformation of Educational Models

4.1. Application in Project-based Learning (PBL)

Project-based learning (PBL), while emphasizing practice and inquiry, is often limited by uneven distribution of

teaching resources, subjectivity in design and evaluation, and low student participation, and is in urgent need of digital transformation [7]. Generative AI provides core support for PBL through intelligent technology to optimize instructional design, evaluation and implementation. It uses natural language processing to analyze students' interests and recommend personalized project topics, and introduces resources such as virtual labs and online collaboration platforms to enhance project attractiveness and participation. It realizes objective and comprehensive evaluation of project results through data analysis technology to improve evaluation accuracy, efficiency and fairness. During the implementation process, generative artificial intelligence provides real-time feedback and guidance, and combines VR and AR technologies to create an immersive learning

experience and deepen students' understanding of the project content [8]. Taking the "future classroom" as an example, students from the Experimental Middle School in Xinhe County, Hebei Province, have made significant progress in information technology through this platform and performed well in the NOC competition (see Table 1), demonstrating the potential of generative AI in narrowing the "digital divide" between urban and rural education and promoting resource equalization. This demonstrates the potential of generative AI in narrowing the "digital divide" between urban and rural education and promoting resource equalization. These practices show that generative AI effectively solves the PBL dilemma, promotes its digital transformation, and provides a solid guarantee for the cultivation of innovative talents.

Table 1. Students' performance in the NOC competition at Xinhe County Experimental Middle School, Hebei, China

year	Total number of participating students	Number of students advancing to the rematch	Finalist awards	Award level
2022	101	16	1 student won an award	National third prize

4.2. Application in Personalized Teaching

Personalized teaching, as a learner-centered education paradigm, focuses on customizing teaching content and methods to meet the individual needs, interests and abilities of each student, aiming to improve learning effectiveness and satisfaction through flexible teaching strategies. In the current educational context, its importance has become more and more significant, and it can effectively stimulate learning interest, promote comprehensive development, and realize tailor-made teaching. The rise of generative artificial intelligence (AIGC) technology has provided strong technical support for personalized teaching, and AIGC uses deep learning and natural language processing technology to analyze students' learning behaviors, interests, and abilities, intelligently customize learning paths, and collect multi-dimensional data (e.g., basic information, learning history, and test scores) to build student profiles, predict learning trends, and accurately push video tutorials, AIGC supports real-time interactive feedback, which helps teachers to grasp students' learning situation, provide personalized guidance, enhance learning motivation, and promote effective communication between teachers and students. the integration of AIGC technology makes the implementation of personalized teaching more accurate, creates a more high-quality and efficient learning environment for students, and foretells its broad application prospects in the field of personalized teaching.

4.3. Application in the Construction of the Intelligent Education Platform

As the pinnacle of education informatization, the intelligent education platform deeply integrates cutting-edge technologies such as cloud computing, big data and generative artificial intelligence (AIGC), aiming to construct an all-around education ecosystem integrating teaching, management and service, so as to comprehensively improve the quality of education and teaching efficiency. In the construction of this platform, AIGC technology has come to the forefront, and its central position cannot be ignored. Empowered by deep learning and natural language processing, AIGC is able to automatically generate teaching content,

accurately assess learning effectiveness, and provide personalized learning suggestions, greatly expanding the functional boundaries of the platform. Taking intelligent course recommendation as an example, AIGC accurately matches course resources based on students' learning history, interest preferences and ability level; in the intelligent tutoring session, AIGC plays the role of a "virtual teacher", instantly answering students' questions and giving immediate feedback; AIGC also realizes intelligent homework correction, accurately identifying errors and providing improvement strategies. AIGC also realizes intelligent homework correction, accurately identifying errors and providing improvement strategies. Internationally renowned online education platforms such as Coursera and edX have skillfully used AIGC technology to build an intelligent teaching system, which can dynamically adjust the content and difficulty of teaching based on students' learning behavior and performance data, ensuring that each student can get a tailor-made learning experience. AIGC technology also facilitates the intelligent integration and accurate delivery of learning resources to meet the increasingly diversified learning needs of students. AIGC technology also facilitates the intelligent integration and precise delivery of learning resources to meet the increasingly diversified learning needs of students. It can be seen that AIGC has become an indispensable force in the construction of smart education platforms. By providing personalized learning support, optimizing the allocation of teaching resources and enhancing the efficiency of teaching management, AIGC is leading smart education platforms to a higher level, with unlimited application prospects in the future.

5. Conclusion

Generative Artificial Intelligence (AIGC), as a cutting-edge innovation in education technology, is deeply driving the digital transformation of the education model. In educational practice, AIGC, with deep learning and natural language processing technologies, realizes automatic generation of teaching content, accurate assessment of learning effectiveness and customization of personalized learning paths, which significantly improves the matching

degree of learning resources and learning efficiency, such as the intelligent course recommendation system, which accurately recommends course resources based on students' histories, interests and abilities. However, the application of AIGC in education also faces challenges such as data privacy and security, uneven distribution of educational resources, technology maturity and stability, and teachers' acceptance of new technologies. It is necessary to establish a strict data protection mechanism, increase investment in education to promote a balanced layout of technology, and strengthen technology research and development and iteration, as well as improve teachers' ability to apply technology. Looking ahead, as technology continues to advance, AIGC will be more deeply integrated into the education ecosystem and promote a comprehensive revolution in the education model. AIGC will help reform the education evaluation system, comprehensively assess the comprehensive quality of students through big data and machine learning technology, provide a scientific basis for education decision-making, and lead education in the direction of intelligence, personalization and efficiency. AIGC will help reform the education evaluation system, provide a scientific basis for education decision-making through big data and machine learning technology, and lead education in the direction of intelligence, personalization and efficiency.

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