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# Investigation of Artificial Intelligence algorithms in education

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**Abstract.** The application of Artificial Intelligence (AI) in education has garnered increasing attention in recent years. This study investigates the primary methods of AI in education, including The Teaching Machine System, Intelligent Tutoring Systems, Intelligent Educational Systems, and the Intelligent College Student Comprehensive Quality Evaluation Model. The Teaching Machine System employs pre-defined rules and algorithms to deliver personalized instruction to students. Intelligent Tutoring Systems use AI algorithms to provide real-time feedback and guidance to students, tailoring the learning experience to address their learning gaps. Intelligent Educational Systems use AI to assist with instructional design, assessment, and delivery, while the Intelligent College Student Comprehensive Quality Evaluation Model is an AI-based system designed to evaluate students' comprehensive quality. Furthermore, this paper provides relevant descriptions and insights into the applications of AI in language and mathematics learning, highlighting the limitations of current AI models in these areas. Despite the advances in AI, challenges still exist, including limitations in processing unstructured data and the need for more effective human-AI interactions. Nonetheless, the potential of AI to enhance the quality and accessibility of education remains promising, and further research is needed to explore its full potential in the field of education.

**Keywords:** Artificial Intelligence, education, machine learning.

## 1. Introduction

Education is a multifaceted process that involves the promotion of knowledge, skills, values, beliefs, and habits among individuals or groups through teaching, training, and research. Artificial intelligence (AI) pertains to intelligent behavior performed by computer systems or machines, including perception, reasoning, learning, decision-making, and creation. The incorporation of AI into the educational domain has the potential to enhance the provision of tailored, effective, and adaptable instructional services. AI can facilitate a diverse range of educational applications, spanning from AI-powered personalized instruction and conversational systems to exploratory courses enabled by AI algorithms for content learning, student writing analytics, intelligent agents in game-based environments, and student-

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supported chatbots. The integration of AI in education has the capability to facilitate student-instructor matching, enabling students to have greater autonomy in directing their own learning experience [1]. The personalized learning environment not only enhances the learning experience, but also motivates and inspires them to learn. It will facilitate the adoption of educational content to meet the needs of students, leading to more personalized learning plans [2]. Artificial intelligence can also assist teachers in instructional design, assessment, and feedback to improve the quality and efficiency of teaching and learning, and embedded systems can support the use of bots as well as chatbots to perform the functions of a teacher or tutor [3]. The significance of AI education lies in its ability to help learners adapt to future societal changes and challenges, enhance their innovation and competitiveness, and promote lifelong learning and self-development.

AI education involves the integration of artificial intelligence (AI) and education, with a history that dates back to the 1940s [4]. The development of AI has gone through various stages, including embryonic, birth, golden, first trough, prosperous, second trough, and third wave, each characterized by specific advancements in the field. Correspondingly, AI education has also experienced similar stages of development. Notably, since the 1920s, there have been several attempts to integrate technology and education, including the development of the first machine for testing, computer-aided teaching systems, expert systems, and adaptive teaching systems. Recent innovations in AI education include the development of the social skills training system MACH by MIT researchers in 2013.

In 1970, Carbonell discusses the process of the application related to AI to the field of Computer Aided Instruction (CAI) [5]. Carbonell proposes a rules-based neural network algorithm to help students identify and correct errors and personalize student learning behaviour. In 1982, Sleeman et al. proposes a framework of intelligent education system based on student model and domain model, which includes modules such as knowledge representation, student model teaching strategy and learning process control, etc. [6]. In 1984, Merrill proposed the concepts of Automated Design (AD) and Automated Operation (AO), namely, the automation of instructional design and the automation of instructional operation. The author believes that the automation of instructional design is to convert teaching principles into computer programs and automatically generate teaching materials and activities suitable for learners' personalized learning situation, while the automation of instructional operation is to convert the teaching process into computer programs to realize the automatic display and organization of teaching contents, as well as the automatic monitoring and feedback of learners' behaviours [7]. In 1992, Brusilovsky put forward the concept of intelligent tutoring system ITEM/IP. This is an intelligent education system based on the Internet and the World Wide Web. The system's core feature is an adaptive learning environment that can automatically generate and recommend personalized learning resources and teaching activities for each learner based on their unique needs and learning styles. The system's learning resources include text, images, video, audio and other forms of materials, and support the autonomous control and self-assessment of the learning process. In addition, ITEM/IP system also offers a series of powerful management and analysis tools, which can track and analyse learners' learning behaviour and learning effect in real time, and provide teachers with more scientific and effective teaching evaluation and auxiliary decision-making [8].

## 2. Method

### *2.1. Overview of the model*

The key technologies of artificial intelligence education can be traced back to the 1950s. Including natural language processing, speech recognition, etc. Based on these technologies, people have designed The Teaching Machine System and an Intelligent Teaching System. In modern times, key technologies in the field of education include deep learning and intelligent control. This article will introduce some typical application scenarios including intelligent teaching systems and personalized learning process support.

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## 2.2. Models

### 2.2.1. The teaching machine system

Teaching Machines and Programmed Instructions is an article published by B.F. Skinner in 1958 and is considered one of the milestones in computer-aided education and behaviourist education theory. This article mainly introduces Skinner's educational theory and explains how to use computers efficiently to achieve personalized education [9].

This article presents Skinner's teaching theory, which is founded on reflexology. The author argues that teaching should be based on the behavioural responses of students, as their specific behaviours can be either strengthened or weakened through rewards and punishments. To achieve personalized teaching, Skinner suggests utilizing computers that can adjust teaching content and pace in response to students' reactions, needs, and progress. Through programming and automated testing and evaluation, teachers can easily monitor students' progress and provide tailored feedback and guidance. The proposed teaching approach allows for a more efficient and effective way of delivering education, as it enables teachers to intervene promptly and provide students with personalized instruction.

In addition, Skinner also introduced his educational device, the Teaching Machine, which was an early computer-aided education tool that could automatically generate personalized teaching content through punched paper tape. This type of device not only improved learning efficiency but also reduced educational costs, which attracted widespread attention and discussion at that time.

### 2.2.2. Intelligent tutoring systems

In 1982, Burton et al. published a paper. The present paper provides an in-depth analysis of intelligent tutoring systems (ITSs) by firstly defining and highlighting their unique characteristics, which differentiate them from traditional teaching models. ITSs offer personalized learning guidance to students that is tailored to their specific learning needs and progress, thus aligning with the pedagogical approach of "people-oriented" teaching. The paper then proceeds to elaborate on the design and implementation of ITSs, including the analysis of students' knowledge level and learning style, the development of a knowledge representation and reasoning mechanism, and the design of monitoring and feedback mechanisms for the learning process.

Finally, the paper discusses the application prospects of intelligent tutoring systems in the field of education, especially in vocational training, remote education, and personalized learning. The paper points out that intelligent tutoring systems will become an important component of future education, providing students with more efficient, personalized, and comprehensive learning tutoring, promoting the improvement of their learning outcomes and abilities [10].

### 2.2.3. Intelligent educational systems

The advent of open, network-based intelligent education has sparked an increased interest in online learning and the subsequent emergence of network-based intelligent teaching platforms [11]. Kang and colleagues focus their study on intelligent teaching systems (ITS), exploring the utilization of deep learning (DL) networks possessing powerful self-learning capabilities in constructing such systems, as well as future trends and prospects of ITS. The article also delves into an analysis of factors affecting students' learning processes, incorporating elements such as learning styles and study habits into the construction of student models. The article proposes that in an online environment, language teachers should re-evaluate traditional communication media and teaching models through the lens of teaching practices, altering their perceptions and roles, and organically merging modern information tools with traditional language teaching methods. The ultimate goal is to allow computer systems to assume responsibilities related to education and teaching, and to empower computer systems with intelligence in order to partially replace teachers and achieve optimal teaching. The article also explores how key techniques (such as fuzzy evaluation algorithms and neural networks) can be used to extract parameters from online learners' behavioral data and performance information in order to address serious shortcomings in the current online learning systems in terms of adaptation and personalization.

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#### *2.2.4. Intelligent college student comprehensive quality evaluation model*

The utilization of artificial intelligence and deep learning has the potential to predict students' future learning performance based on their historical learning data and to recommend suitable content, thus significantly enhancing their learning efficiency. Li and colleagues concentrate their study on enhancing college students' growth and development through artificial intelligence and deep learning [12]. Firstly, a personalized learning resource recommendation model was constructed on an online education platform using deep neural networks (DNN), which was experimentally validated. Secondly, a new comprehensive quality evaluation index system was established in school management based on the traditional complete quality evaluation method. The authors combined the thorough fuzzy evaluation (FCE) method with the back propagation neural network (BPNN) model to create a comprehensive quality evaluation model for college students. Through experiments comparing the comprehensive quality evaluation scores obtained from this model with actual scores, the authors concluded that the model could offer improved personalized recommendations for college students when the number of learners is 50, and the number of learning resources is 180 in the constructed personalized learning resource recommendation model.

## 3. Application and discussion

### *3.1. AI assisted language learning*

Joshua Underwood's study on the use of AI to assist primary age English as a Foreign Language (EFL) students to learn language in class highlights the potential of AI to facilitate language learning [13]. The study found that students who used AI assistants in group work were more likely to speak English and engage in self-correction and reformulation. Moreover, the students displayed a joyful and playful attitude towards learning, persistently attempting to get the AI assistants to do what they wanted them to do. These findings suggest that AI can provide an effective means of engaging students in language learning, promoting self-directed learning and enhancing the learning experience.

Despite the potential benefits of using AI in student language education, there are also some limitations to its effectiveness. One such limitation is the difficulty in capturing and understanding the nuances of human language, which can make it challenging for AI to provide accurate feedback on language use. Additionally, AI systems may lack the empathy and emotional intelligence of human teachers, which can impact the ability to develop positive teacher-student relationships and provide individualized support. Another limitation is the potential for AI to reinforce existing biases and perpetuate inequalities, particularly if the underlying data used to train the system is biased. Therefore, while AI has the potential to enhance language learning in students, it is crucial to consider its limitations and ensure that it is used in an ethical and responsible manner.

### *3.2. AI math learning*

AI has the potential to transform math education by providing personalized learning experiences, facilitating real-time feedback, and automating assessment. For example, AI-powered math apps can adapt to students' individual needs and learning styles, provide immediate feedback on problem-solving, and track progress over time. Additionally, AI can be used to create virtual math tutors that can engage students in personalized one-on-one interactions, enhancing their understanding of mathematical concepts.

However, the use of AI in math education also presents some challenges and limitations. One such challenge is the need for high-quality data to train AI models, which can be difficult to obtain in educational settings. Additionally, the lack of human interaction may limit students' ability to develop problem-solving skills and collaborate with peers, which are important aspects of math education.

## 4. Conclusion

In conclusion, the application of AI in education has demonstrated promising results, with various methods such as The Teaching Machine System, Intelligent Tutoring Systems, Intelligent Educational

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Systems, and the Intelligent College Student Comprehensive Quality Evaluation Model showing potential for enhancing the quality and accessibility of education. However, despite the advances in AI, limitations in processing unstructured data and the need for more effective human-AI interactions remain major challenges in the field. Additionally, while AI has shown potential in language and mathematics learning, its applications in other subjects require further exploration. Future research should focus on developing more sophisticated and versatile AI models that can effectively process and analyse unstructured data, as well as on designing more effective human-AI interactions to improve the overall learning experience. By addressing these challenges, the full potential of AI in education can be realized, enabling more personalized and effective learning experiences for students.

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