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ARTIFICIAL INTELLIGENCE AND EDUCATION: CURRENT APPLICATIONS AND FUTURE PERSPECTIVES

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Abstract: Artificial intelligence (AI), designed to imitate certain aspects of human intelligence, is now widely used in many fields ranging from simple machines to complex systems. It has the potential to replace fundamental human cognitive functions and has become a popular area of research. One of the major application areas of AI is education. Since the early 21st century, with the transformation in education, AI technologies have gained rapid momentum in parallel with technological advancements. Indeed, AI is widely used today to improve and personalize learning processes in the field of education. Research shows that AI-driven adaptive learning platforms have significant potential in various areas by enabling personalization, real-time performance tracking, detection of learning difficulties, and offering customized recommendations for learners. Current analyses demonstrate that AI has become increasingly important in education and will continue to serve as a central component of educational systems in the future. In this context, the present study examines the current applications of AI in education and its potential for future development. The study focuses on major applications of AI in education, such as intelligent tutoring systems, expert systems, and dialogue-based instructional systems. The basic components, theoretical principles, advantages, disadvantages, and practical examples of these systems are discussed in detail. Based on these insights, it is anticipated that AI technologies will become even more widespread in education and will form the foundation of future intelligent learning systems.

Keywords: artificial intelligence, AI applications in education, intelligent tutoring systems, expert systems, dialogue-based instructional systems

Introduction

In the 21st century, the rapid advancements in artificial intelligence (AI) technologies have profoundly influenced all aspects of society, making AI an indispensable part of daily life. AI has transformed the ways in which people think, work, and socialize, leading to fundamental changes at both individual and societal levels. Researchers such as Yang and Southgatehave also emphasized that AI-supported technologies are gaining increasing importance in modern society and have become an integral part of everyday life [1].

Today, AI has become an essential component of educational systems. Particularly during the pandemic, the need for digital learning has further highlighted the importance of AI in education. With its potential to personalize learning environments, enhance teaching methods, and make educational processes more effective, AI has attracted the attention of educators, researchers, and policymakers alike. According to Lameras and Arnab, the use of AI in education is being examined across a wide spectrum, ranging from instructional tools to pedagogical models. Similarly, the study by Zhai et al. indicates that publications on AI and education have

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significantly increased in recent years. This trend demonstrates that the influence of AI in education is expanding and is expected to become even more significant in the future [2].

The definition of intelligence has long been a subject of debate in the history of psychology. Wechsler, who developed the Wechsler intelligence tests, defined intelligence as an individual's capacity for rational thinking and purposeful action while interacting with their environment. Toker et al. defined intelligence as the ability of mental structures to change and create new connections through dynamic interaction. This perspective emphasizes that intelligence is not a static entity but rather a continuously developing and evolving process. In contrast, Gardner, through his theory of multiple intelligences, opposed the notion that intelligence should be limited to traditional conceptions of reason, logic, and knowledge. According to Gardner, intelligence is not a single ability but a collection of interrelated mental skills that manifest across different domains. This view extends beyond verbal-linguistic and logical-mathematical intelligence to include musical, visual-spatial, bodily-kinesthetic, interpersonal, naturalistic, and existential types of intelligence.

In conclusion, the definitions of intelligence proposed by Wechsler, Toker, and Gardner address different aspects and dimensions of intelligence. These diverse perspectives demonstrate that intelligence is a complex phenomenon that cannot be confined to a single definition. This complexity also makes defining artificial intelligence a challenging task. Indeed, the multidimensional and intricate nature of intelligence prevents AI from having a singular, comprehensive definition [3].

Although AI has been examined from various perspectives in the literature, it is generally defined as systems that imitate certain features of human intelligence and can perform specific tasks. Hodges defines AI as an effort to reproduce human creativity and generate new situations; Poole et al. describe it as agents that interact with the environment and act toward goals; Minsky refers to AI as the science of building systems that display intelligent behavior autonomously; Friedman et al. define AI as the ability to make inferences and act independently based on data or theory; and Remian conceptualizes it as systems capable of interacting with humans and performing human-like tasks. Regona et al, on the other hand, approach AI within a broader framework encompassing knowledge representation, perception, and action. As can be inferred from these diverse definitions, AI is a multidisciplinary field that aims both to emulate fundamental features of human intelligence and to autonomously perform specific tasks [4].

Fundamental components of intelligent tutoring systems

Intelligent Tutoring Systems (ITS) possess a complex structure and consist of four fundamental components. These components are as follows:

1. **Domain model:** This model represents the knowledge base of the subject matter that the system is designed to teach. It includes information such as the content of the subject, learning objectives, relationships among concepts, and common student errors [5].
2. **Student model:** This model represents the system's understanding of the learner's knowledge and skills. It contains data related to the learner's past performance, response latency, problem-solving strategies, errors, and level of motivation.
3. **Tutoring model:** This model defines the pedagogical approaches and instructional strategies used by the system to teach the learner. It encompasses elements such as teaching approaches, learning theories, cognitive load management, and feedback mechanisms.

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4. **User interface model:** This model illustrates how the system interacts with the learner. It involves the design of the user interface, the presentation of instructional content, and the communication processes between the learner and the system [6].

The first example of intelligent tutoring systems: SCHOLAR

One of the earliest examples of intelligent tutoring systems is SCHOLAR. This system employs a pedagogical approach based on the principles of Socratic dialogue. Utilizing artificial intelligence techniques, SCHOLAR constructs a semantic network that allows it to respond individually to students' answers. Through this mechanism, a natural dialogue environment is established between the learner and the system, enabling the student to actively engage in the learning process.

The fundamental features of SCHOLAR include the use of Socratic dialogue, knowledge representation based on a semantic network, and student modeling through AI techniques. These innovative characteristics positioned SCHOLAR as a pioneering system in the field of intelligent tutoring systems and served as an inspiration for many subsequent developments in this area [7].

Mathia: Artificial intelligence–supported personalized mathematics education

Mathia (formerly known as Cognitive Tutor) is a platform that provides AI-supported personalized mathematics education for K–12 students, developed based on research conducted at Carnegie Mellon University. The system monitors students' progress- including their achievements and conceptual misunderstandings-while they work through carefully structured mathematical tasks, and guides them along individualized learning paths. In this way, Mathia functions as a personal coach, offering each student a customized learning experience.

One of Mathia's most significant features is its ability to provide automated feedback that not only explains why a student solved a problem incorrectly, but also how it can be solved correctly. This feedback helps learners learn from their mistakes and gain a deeper understanding of mathematical concepts.

Carnegie Learning asserts that Mathia is most effective when used as part of a blended learning approach that integrates both print and digital resources. This approach encourages students to learn individually as well as collaboratively in groups [8].

Assistments: An intelligent tutoring system supporting personalized learning

Assistments is a contemporary example of an instructional Intelligent Tutoring System (ITS) developed at Worcester Polytechnic Institute, employing an approach broadly similar to that of Mathia. Assistments focuses on addressing a fundamental issue of ITSs-namely, the varying pace at which students progress. This disparity can lead to increasingly diverse achievement levels within a single classroom, thereby complicating the teacher's instructional process.

Assistments is designed to mitigate this problem by allowing students to work independently at home in the evenings to catch up on lessons. Through this mechanism, students with different learning speeds are able to follow a common trajectory of progress within the classroom environment [9].

Although there is no conclusive evidence regarding the effectiveness of either Mathia or Assistments, there is strong empirical support suggesting their positive impact on learning outcomes.

Alta: A personalized learning experience for higher education students

Alta is an example of an Intelligent Tutoring System (ITS) developed by Knewton, designed specifically for higher education students. It provides a personalized learning experience across

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various subjects such as mathematics, economics, chemistry, and statistics. Like many other ITSs, the core operation of Alta involves acting as a one-on-one instructor while the student works on an assignment-offering personalized instruction, assessment, feedback, and instant correction. Through this mechanism, students can optimize their learning process and acquire knowledge in the most effective way.

The pedagogical model of Alta is grounded in Item Response Theory (IRT), which allows each question to be analyzed in terms of both its difficulty level and its ability to represent key underlying concepts. This enables Alta to deliver questions that match the learner's optimal level of difficulty, thus creating the most effective learning environment.

Additionally, Alta adopts a mastery-based learning approach, wherein students are expected to achieve mastery of prior learning objectives before progressing to new ones. The Alta model assumes that if a student has mastered one of two related learning goals-based on the knowledge graph of the domain model-there is a high likelihood that the student has also mastered the other. Consequently, Alta provides a personalized roadmap that guides students toward the most efficient path for academic progression [10].

Cognii: An intelligent learning system offering a personalized learning experience

Cognii is an AI-based intelligent learning and assessment system that can be integrated into all online learning environments. This system provides personalized educational opportunities by taking into account learners' individual differences. Cognii supports personalized learning by offering one-on-one instruction until mastery, open-ended question assessments through natural language processing (NLP) technology, instant feedback, and automated evaluation of student performance that closely resembles human grading. This process enhances students' awareness of their own learning and encourages them to take a more active role in their educational experience [11].

Jill Watson: An intelligent tutoring system providing 24/7 support

Jill Watson is an AI-based intelligent tutoring system capable of responding instantly and continuously-24 hours a day, 7 days a week-to students' course-related questions. Developed in 2016 at Georgia Tech, Jill was first implemented in the online discussion forum of a graduate-level computer science course. Working alongside a team of human teaching assistants, the system responded to students' questions, thereby supplementing traditional instructional methods [12].

Moreover, Jill Watson offers several advantages compared to conventional teaching approaches. The system provides students with round-the-clock access, making the learning process more flexible and accessible. In addition, Jill Watson delivers fast and accurate responses, helping learners optimize their time and effort throughout the learning process.

Fishtree: A platform providing teachers with personalized lessons and assignments

Fishtree is an application that enables teachers to design adaptive lessons and assign personalized homework to students. The platform was founded in 2012 by Nealon and Jim Butler, along with their former colleague Jim Butler, as the first Learning Relationship Management (LRM) platform.

The core feature of Fishtree lies in its ability to recommend resources tailored to each individual student. By analyzing the information contained within a student's profile and their previous interactions with the platform, Fishtree identifies the most appropriate materials that align with the learner's personal needs and skill level.

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Through this mechanism, Fishtree provides teachers with the opportunity to create personalized lessons and assignments, ensuring that each student learns in the most effective and individualized manner possible [13].

Conclusion

As emphasized by Goel et al, with the rapid progression of the Fourth Industrial Revolution (Industry 4.0), profound transformations are occurring in education, as in many other fields. The technological advancements brought by Industry 4.0 have enabled the restructuring of educational systems and the enhancement of learning processes. Moreover, the technological opportunities offered by Industry 4.0 provide new solutions where traditional educational approaches fall short. Indeed, the increasing global population has confronted educational systems with a growing diversity of learners. This situation forces teachers to deliver the same curriculum to students who differ widely in learning pace, interests, and abilities.

Traditional educational methods often fail to provide students with sufficient personalized feedback and to identify their strengths and weaknesses.. This shortcoming reduces the efficiency of learning processes and prevents students from realizing their full potential. In the search for solutions to these problems, the use of computer-assisted learning systems has come to the forefront. These systems, in which computers take on the role of instructors, offer students personalized learning experiences that allow them to learn at their own pace and in alignment with their interests.

With the advancement of AI technologies, these systems have become even more intelligent-capable of analyzing students' learning processes in real time and providing them with individualized recommendations. Furthermore, the influence of AI in education continues to grow, as confirmed by various international initiatives. Organizations such as the International Society for Technology in Education (ISTE), the United Nations Educational, Scientific and Cultural Organization (UNESCO), and the European Commission are working to redefine AI education within the framework of the latest educational standards and design principles, aiming to enhance digital literacy. These developments demonstrate that the integration of AI into educational systems is inevitable and that research in this field has gained a distinctly international dimension.

The comprehensive review conducted in this study reveals that AI-supported educational systems hold significant potential in the field of education. By providing personalized learning experiences, these systems enhance learning efficiency, reduce teachers' workload, and contribute to making educational systems more effective and efficient. Future research could focus on exploring the effects of AI-supported educational systems on student motivation, learning quality, and learning processes in greater depth. Additionally, efforts may be directed toward adapting these systems to different learning styles and cultural contexts.

In conclusion, AI-supported educational systems have ushered in a new era in education. When implemented correctly and effectively, these systems can make education more equitable, more efficient, and more personalized. Indeed, the history of AI represents a journey filled with both exciting advancements and significant challenges. From early symbolic approaches and expert systems to today's deep learning and big data–driven models, the field continues to evolve and explore new horizons. Although the future of AI remains uncertain, it is clear that it holds the potential to transform many aspects of our society.

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References:

1. Assistments. (2024). Assistments platform overview. Worcester Polytechnic Institute. Retrieved from https://www.assistments.org
2. Butz, C. J., Hua, S., & Maguire, R. B. (2006). A Web-based intelligent tutoring system for computer programming. Proceedings of the 2006 International Conference on Web-Based Education, 24–29.
3. Carbonell, J. R. (1970). AI in CAI: An artificial-intelligence approach to computer-assisted instruction. IEEE Transactions on Man-Machine Systems, 11(4), 190–202.
4. Chen, X., Xie, H., & Hwang, G. J. (2020). A multi-perspective study on artificial intelligence in education. Computers & Education, 146, 103770.
5. Cognii. (2024). Cognii Virtual Learning Assistant. Retrieved from https://www.cognii.com
6. Embretson, S. E., & Reise, S. P. (2013). Item response theory for psychologists. Mahwah, NJ: Lawrence Erlbaum Associates.
7. Friedman, N., Simons, G., & Bhatia, R. (2021). Artificial intelligence as autonomous reasoning: From data to decisions. AI Perspectives, 3(2), 45–59.
8. Gardner, H. (1983). Frames of mind: The theory of multiple intelligences. New York, NY: Basic Books.
9. Getting Smart. (2015). Fishtree: Learning relationship management for teachers and students. Retrieved from https://www.gettingsmart.com
10. Goel, A., & Polepeddi, L. (2016). Jill Watson: A virtual teaching assistant for online education. Georgia Institute of Technology Technical Report.
11. Goel, A., Joyner, D., & Shrestha, R. (2020). The future of artificial intelligence in education. Journal of Educational Technology, 18(4), 1–15.
12. SUN'IY, I. T. T. V., & TA'LIMDAGI, O. R. N. I. ISSN 3060-4915 p. OSIYO XALQARO UNIVERSITETI AXBOROTNOMASI.
13. Fatulloyevich, S. S. TA'LIMDA SUN'IY INTELLEKTDAN FOYDALANISH VA UNING KELAJAKDAGI RIVOJLANISH YO 'NALISHLARI. OSIYO XALQARO UNIVERSITETI AXBOROTNOMASI, 103.