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Application and Impact of Artificial Intelligence in Education: A Case Study of Programming Education

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Abstract: With the rising demand for personalized learning and increased digital natives, the traditional education model is under pressure to reform. the rapid development of artificial intelligence (AI) provides new education solutions, and the application of AI is becoming widespread, from intelligent tutoring to automated grading to learning analytics. However, the application of AI in education is not without challenges. This literature review aims to explore the impact of AI on education, analyze its potential advantages, and propose strategies to address the challenges and provide guidance for the future development of education. Understanding the impact of AI on education is instructive for the future direction of AI in education and reveals the importance of AI for education to the extent that it is important for formulating effective educational policies and cultivating future talents in AI technology. The final results of the study show that although AI in the education industry there are various difficulties and limitations, but AI offers great potential for smarter and more efficient education levels and education systems. In today's era, computer programming education is emerging as a pivotal force in shaping the future, as it not only hones students' logical thinking and innovative capabilities but also lays a solid foundation for their career paths in the digital world. By integrating knowledge across various disciplines, programming education stimulates students' enthusiasm for applying their learning to real-world problems and enhances their sense of social engagement, enabling them to tackle challenges through technological means.

Keywords: artificial intelligence, applied cognition, basic cognition, education, attitudes.

1. Introduction

With the rapid development of artificial intelligence (AI) technology in today's society, its application in the field of education has become increasingly widespread. In the 21st century, AI, as a disruptive technology, is reshaping the face of education. AI, as an important branch of modern science and technology, is gradually penetrating all areas of society. In particular, it is widely used in the field of education and plays a huge role. Starting from the breakthrough in 2023, generative artificial intelligence such as ChatGPT, SORA, SUNO, and KIMI have rapidly surpassed the limitations of traditional AI technologies with their simplicity of data collection, innovation of information processing, and personalization of applications, becoming a hot topic among the public. It has become a hot topic among the public. The emergence of generative AI has undoubtedly had a significant

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impact on education, a key area of knowledge innovation, information exchange, and technological advancement.

AI is reshaping people's future, particularly in enhancing creativity and transforming education. A recent study shows that despite AI's frequent media presence, people lack knowledge about its educational applications. The study also found a generally positive public perception of AI. Further research indicates that those with a positive view believe AI offers job benefits, and respondents showed high levels of positivity towards AI. These studies underscore AI's potential in education and reflect society's growing awareness and acceptance of the technology. As AI evolves, it's crucial to educate the public about its benefits for social progress and address ethical and security concerns to ensure its positive impact.

Issues such as educational equity, technical difficulties, and cognitive barriers are becoming more prominent with the introduction of AI technology. In addition, as the demand for technical skills in the education market increases, systems within education must adapt to this change and develop the talent of the future. Policymakers, educators, and researchers are exploring how to effectively integrate AI technologies to improve the quality and efficiency of education while addressing the accompanying ethical and social issues. The integration of AI has brought about a transformative impact on programming education. It offers personalized learning trajectories, intelligent tutoring, automated assessment, and targeted learning resource recommendations, making the learning process more efficient and engaging. AI can also create simulated environments and gamified learning experiences to increase student participation, predict and assist students in overcoming learning obstacles through data analysis, and foster collaboration and communication among students. As AI technology continues to advance, its role in programming education becomes increasingly prominent, enhancing the quality and efficiency of education and providing students with a more diverse and dynamic learning environment that supports their lifelong learning journey from school to society.

Education bureaus may use AI to make and guide some decisions, as well as some forward-looking opinions; educational institutions can use AI to personalize tutoring of audience groups, such as enlightenment, primary and secondary education, higher education, and even adult education, where AI can quickly and accurately judge and give the best guidance plan, and can provide personalized learning resources and teaching plans based on the learning history and performance of the recipients, in order to maximize the impact of AI. Understanding the impact of AI on education will not only help to raise the importance of AI and assist in optimizing the IT curriculum, but also provide guidance and motivation for the cultivation of new technological talents in the future. This study aims to summarize the extent (breadth and depth) of AI's impact on IT education through a literature review, discuss how AI factors affect people's learning and lives, as well as explore people's acceptance and willingness to accept AI.

2. Perception of AI Applications

When educators analyze it from a broader perspective, the generative technology of AI has achieved more significant successes in facilitating knowledge, which in many cases have surpassed the problems it may have encountered in the process of content generation and the technological challenges it has faced. This technology holds great potential to change the existing landscape. From an individual perspective, it is expected that this technology can be effectively used in areas that have far-reaching implications and great room for growth, while the use of AI-generating technologies should be limited in areas that may violate ethical norms or pose potential risks. This selective strategy has facilitated the rapid development of the technology in appropriate areas and further expanded its impact.

Taken together, the capabilities demonstrated by the generative technology of AI are more valued in areas that are perceived to have positive value and positive impacts as compared to those areas that

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are perceived to have negative effects or risks. This is one of the reasons why the field of education is likely to experience significant technological innovation and it is one of the reasons why people are willing to embrace and adopt this technology. The development and application of this generative technology could not only drive innovation in education, but also revolutionize multiple other fields, thereby advancing society as a whole. Generative AI is already an important component of the future strategies of the great powers [1].

However, the application of AI in education also faces a number of challenges, including the protection of personal privacy, avoidance of aggravating social injustice and prevention of misuse, all of which need to be addressed urgently. In addition, the application of AI in education is still in its infancy, with technical limitations in understanding students' intentions, emotional interactions and automated corrections. Therefore, while fully exploiting the potential of AI, people should cautiously address potential problems to ensure that technological advances bring benefits to humankind rather than adding new risks and challenges.

In addition to this, as this technology continues to advance, there are growing considerations about its ethics and safety. The public is increasingly concerned about how to ensure that the use of technology does not violate the right to privacy, widen social disparities, or be used for inappropriate purposes. Therefore, in order to keep pace with technological advances, relevant laws, regulations, and ethical standards have been updated and strengthened, with the aim of ensuring that the application of technology is in the broader interests of society. All in all, the generative technology of AI has triggered a series of challenges and opportunities while contributing to the development of society. Educators need to fully utilize the potential it brings, but also prudently address the challenges that may arise to ensure that the technology is developed to serve humanity.

3. Impact of AI on IT Education

The rapid rise of AI chatbots has not diminished the need for students in higher engineering education to acquire programming skills. While these AI tools can help with simple programming tasks, they still appear to be out of their depth when faced with more complex programming challenges. As a result, a challenging question arises when students utilize AI chatbots to aid programming during the learning process: which programming elements are essential in programming learning, and which ones can be accomplished by relying on AI tools? To answer this question, the findings point to the need for educators to define learning objectives more carefully and clearly.

For example, learning objectives should go beyond a generalization of programming as a whole and specifically cover the elements of programming, including syntax, semantics, and pragmatics. Such refined learning objectives help students identify what knowledge they must acquire and what skills can be supplemented by AI tools. In addition, the importance of information literacy skills was emphasized in the study, especially how AI chatbots can be used effectively and responsibly to improve programming skills and code writing. This is in line with the research of Zhai and Chiu, who argued that students should master how to appropriately utilize AI tools to assist in solving tasks in specific domains during the learning process, and at the same time learn to use these tools in a way that protects their privacy [2].

Other experts have suggested that education should focus more on developing students' creative and critical thinking skills and encourage hands-on learning activities [3]. This further suggests that elements such as creativity and critical thinking should be more visibly emphasized in learning objectives to better adapt to the impact of future technological developments. Taken together, as AI technology continues to advance, future education systems will need to flexibly adapt their teaching objectives to ensure that students can effectively utilize AI tools alongside basic programming skills, and develop core creative and critical thinking to adapt to the ever-changing field of engineering and technology [4]. The case study reveals that AI chatbots still have limitations in handling complex

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tasks in the programming field. Students must personally master code writing and develop the necessary programming skills to reach their learning goals. Thus, performing complex programming tasks remains a serious challenge and an important learning experience, even if AI chatbots are included in the learning process. In the case study, pair programming proved to be a central component of the learning process. Pair programming typically serves two main goals: first, to provide a platform for students to learn coding best practices from each other; and second, to facilitate the development of transversal skills, of which communicating and collaborating with others is a crucial part. The results of the study suggest that effective communication and collaboration are critical for integrating individual code into high-quality code. The study also found that the use of ChatGpt in pair programming may undermine the principles and limit peer-to-peer communication, collaboration, and corresponding skill enhancement. How to adopt this approach while maintaining the principles of pair programming, and whether it should be adopted in programming education, still needs to be further explored and researched, as the current case study only reveals the problem and does not provide a clear solution [5].

In their 2022 study, Kim et al. present the idea that AI chatbots can replace traditional navigators for pair programming in some cases [6]. They observed that students go through three successive stages in using AI: understanding AI, learning from AI, and utilizing AI to move to the third stage with the help of appropriate teaching strategies. This finding provides a new perspective on the use of AI in education.

Rudolph et al. 2023 further suggest that with appropriate instructional strategies guided by the use of Chatgpt for collaborative learning and with appropriate support, AI chatbots can not only act as navigators for pair programming, but also facilitate the effects of collaboration among peers [7]. The results of this study emphasize the potential for the judicious use of AI in educational settings, while also reminding us of the need to carefully consider instructional strategies and support mechanisms during implementation.

These findings provide educators with valuable insights into the key factors to consider when introducing AI into programming education. They emphasize the need to focus on interactions and collaboration among students while promoting independent learning, and how these interactions can be enhanced by AI technologies. In addition, these studies remind people that while pursuing technological advances, they should not lose sight of the fundamental principles and goals of education.

In addition, the repeatability of programming requires the intervention of artificial intelligence. Li Ting believes that: first, artificial intelligence can help students better master information technology knowledge. Because the traditional teaching mode can't well meet the students' needs for information technology classes, it is necessary for artificial intelligence to intervene, such as computer basics, network basics, office software, multimedia software and so on. Second, to improve students' learning interest. Middle school students are in a period of curiosity and are interested in new technologies. Artificial Intelligence makes the learning experience lively and interesting through VR and AR technologies, promotes students' understanding of information technology, inspires enthusiasm for learning, improves learning efficiency, and lays the foundation for future learning. At the same time, AI provides personalized learning solutions to meet the learning needs of different students, making learning more efficient. Third, it improves the teaching efficiency of teachers. Under the traditional teaching mode, teachers need to invest a lot of time and energy in preparing lessons and organizing activities, and these repetitive tasks often make teachers feel tired. The introduction of AI is expected to reverse this situation. Intelligent teaching systems can reduce the burden on teachers and help them focus more on students and the quality of education. At the same time, AI analyzes student data, provides accurate feedback, and automatically adjusts teaching strategies based on student progress to ensure that each student receives appropriate teaching resources. This not only reduces the burden

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on teachers and improves teaching efficiency, but also brings personalized learning support to students and promotes fairness and efficiency in education [8].

4. The Impact of AI in Education

AI can provide personalized learning resources and teaching plans based on the learning history and performance of the educated person, so as to adapt to the needs of each educated person to the greatest extent possible. It can even quickly produce well-crafted forms to give feedback to the educated group; in teachers' personal teaching and research activities, AI can provide teachers with useful assistance such as customized training resources and professional development courses for teachers to help them improve their teaching skills, and it can also help schools to manage their daily operations, course scheduling, student enrollment, and grade management to improve administrative efficiency, and for primary and secondary education, the AI can identify what students are interested in as a way to provide more targeted teaching suggestions or content that interests students. For example, students can use AI to expand their after-school knowledge for themselves, and teachers can use AI to develop appropriate teaching plans and even correct homework.

5. Conclusion

In the increasingly developing modern society, Artificial Intelligence has become an essential part of education, as well as a major trend in the development of education in the future. How educators can apply AI in education, and gain a deeper understanding of the impact of Artificial Intelligence on education, as well as the extent of people's understanding of AI in education and their willingness to agree with it, etc., is one of the most important journeys educators can take towards the future. As society moves forward at a rapid pace, AI is steadily stepping into the field of education, foreshadowing the critical path of education's future development. Exploring the effective use of AI, analyzing its effects on education, and measuring public awareness and acceptance of this technology within the education system has become a key mission in reaching our vision for the future of education. AI is increasingly being used in a wide range of applications as technology changes rapidly, revolutionizing traditional teaching models and opening up new horizons for personalized learning. AI technologies, such as machine learning and natural language processing, have gradually penetrated into the core aspects of education, significantly improving the intelligence of education infrastructure, learning processes, evaluation systems and management effectiveness. Going forward, AI will play a more pivotal role in education, building a bridge between formal and informal learning for students, helping them acquire knowledge efficiently, and enjoying instant assessment and high-quality feedback. At the same time, the spread of AI technology will also free teachers from heavy administrative tasks, reducing their burden and allowing them to focus more on the personalized development of their students.

The integration of AI will profoundly change the future pattern of education. Education is no longer limited to the dissemination and transmission of knowledge, but pays more attention to innovation and knowledge creation.AI accelerates the knowledge generation cycle with its powerful knowledge discovery ability, and the intelligent collaboration between people and machines also broadens the ways and opportunities for knowledge creation. Therefore, the impact of AI in the field of education is far-reaching and long-lasting, and it will not only reshape the operation mechanism of education, but also change the content and form of education. Educators, students and society as a whole need to adapt to these changes and embrace the new technologies, while at the same time upholding the core values of education to ensure that technological advances can truly contribute to the advancement of education and the well-being of humanity as a whole.

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