Proceedings of the 2023 International Conference on Machine Learning and Automation
DOI: 10.54254/2755-2721/33/20230239

The future prospects of deep learning and neural networks: Artificial intelligence's impact on education

Peiran Yu

Shijiazhuang Foreign Language Education Group, Shijiazhuang, 050000, China

1635486082@qq.com

Abstract. Artificial Intelligence (AI) has transformed a variety of areas, and education is no exception. With the development of deep learning and neural network, AI is poised to change the way people teach and learn. This paper explores the future prospects of deep learning and neural networks in education, highlighting the potential benefits and challenges they may bring. AI technologies, like deep learning algorithms and neural networks, have the potential to transform education through customized learning experiences, intelligent tutoring, streamlining administrative duties, and facilitating data-based decision making. Enhanced personalized learning helps students to learn at their own pace and in their preferred style, smart tutoring systems offer personalized guidance and support. Automation of administrative tasks increases efficiency and accuracy, while data-driven decision making helps educators make informed choices about students' outcomes. However, the implementation of AI in education poses challenges such as data privacy, equity, and the preservation of the teacher-student relationship. Efforts should be made to address these challenges and fully harness the potential of deep learning and neural networks in education.

Keywords: artificial intelligence, deep learning, neural networks, education.

1. Introduction

Using Artificial Intelligence (AI) technologies to improve the learning experience and enhance outcomes has gained significant attention in recent years. Deep learning algorithms and neural networks provide opportunities for personalized education, intelligent tutoring, automation of administrative tasks, and data-driven decision making. These breakthroughs hold the capability to transform the field of education and cater to the individual requirements of students.

With the help of deep learning and neural network, institutions could tailor studying experiences in order to meet the special requirements and abilities of every student. By personalizing learning, students can have a more engaging and effective learning experience, and it also helps with the improvement of students' academic performance. Deep learning and neural network have great potential to make a significant impact on smart tutoring. Smart tutoring systems can be used to individualize the learning process for each student, providing personal feedback and recommendations based on a student's needs and requirements. This approach has the potential to significantly improve the academic performance of the students.

Apart from that, deep learning of AI could complete administrative tasks much more efficiently. AI technology can be used to automatically routine tasks such as grading and course planning, freeing up

DOI: 10.54254/2755-2721/33/20230239

teachers and administrators to focus on more important tasks. This helps to reduce the workload of both educators and students, and it can also lead to more accuracy and efficient grading, estimating, and planning. Another potential application of deep learning and neural networks in education is the use of data-driven decisions making. By analyzing large amounts of data, educators can make more informed decisions about students' outcomes, including predicting future performances, which helps to identify areas where students may need additional support and practice.

This paper conducts an analysis on the use of deep learning and neural networks in education, examining the benefits and difficulties of AI technologies within the educational setting. As a result, it offers a comprehensive overview of the application of AI in education and serves as a valuable resource for future advancements in AI technology.

2. Advantages of deep learning and neural networks applied in education

2.1 Personalized learning enhancement

One of the most significant advantages of deep learning and neural networks in education is their ability to personalize the learning experience. AI algorithms have the ability to examine large quantities of data, such as student achievements, preferred learning methods, and unique needs. By doing this, personalized learning journeys can be constructed, which guarantees that students are provided with materials and tools that meet their specific needs. As a result, they can learn at their own speed and in the manner that suits them best.

2.1.1 Helping with collaboration. The research by Prain et al. demonstrates the importance of fostering student collaboration in the learning process [1]. The advent of AI technologies has fueled the rise of Web 2.0, opening up avenues for casual discussions, thoughtful exchanges, and collective content creation. Additionally, it grants access to a wide range of concepts and portrayals. These tools have the potential to shift control to the learner in various ways. However, for an individual's learning to fully thrive, they also need the ability to choose relevant tools and content from available resources, as well as access to the necessary scaffolding to support their learning. An example of this can be given by one of the respondents. *"To support high-achieving students who were at or above grade level in an underperforming urban school, I employed educational psychology and Web 2.0 instructional technology to enhance their performance. The most capable students took the lead in guiding small online groups, offering assistance for inquiries, and verifying answers during class exercises, all while prioritizing their homework. On the other hand, average students received instruction in larger online groups that focused on strategies for meeting objectives. They then joined smaller groups for practice, where they could learn by checking answers and seeking guidance from the top-performing students, as the teacher's availability was limited. In the case of struggling students, I provided step-by-step explanations as they worked through sample text problems, encouraging written discussions to aid comprehension. I also considered incorporating alternative teaching methods, such as using tangible materials and hands-on techniques, to better accommodate slower learners. It is important to note that I did not have any teacher assistants assisting me during this process."*

DOI: 10.54254/2755-2721/33/20230239

2.1.2 Helping build game-based learning experience. The growing attention to game-based learning provides numerous opportunities for personalized learning experiences. This approach aligns with constructivist learning theories [2], emphasizing that learning is active, and knowledge is constructed through one's experiences. Personalized games promote a safe environment for tolerance [3] and the encouragement of risk-taking [4,5], leading to a more active and engaging learning experience. They align with constructivist learning theories and encourage experimentation, rather than simply passively learning [5]. By providing a supportive and interactive environment [6], personalized games support personalized learning that is active, experiential, situation-based, problem-based, and inquiry-based. Additionally, they offer immediate feedback and involve communities of practice, providing collaborative support for learners. The research [7-9] on the effectiveness of personalized games as educational tools is growing, with studies suggesting that they can improve learning and retention more than traditional methods. A respondent stated the following: "Gifted students were given computer exercises/games to practice without much explanation. Those who finished early were challenged with more advanced concepts on the computer under the supervision of their peers. Students were allowed to choose alternative tasks such as distributing textbooks, forms, and other routine responsibilities for the group. Grades, including test scores, classwork/homework, and related notes, were posted anonymously on a weekly basis. My classes, which included students from various grade levels and ability levels, consistently achieved top results. Even students with special education needs achieved impressive results, leading to inquiries from their other teachers."

2.1.3 Helping with context awareness learning. The development of mobile technology has generated a growing interest in context-aware learning within the research community over the last decade. Context-aware learning refers to the practice of learning that is tailored to an individual's specific context and needs. This concept has been explored in various studies, with one of the most notable examples coming from Hwang's research [10].

Hwang's studies [10] and others have focused on the implementation of context awareness learning activities that utilize an algorithm to plan personalization learning paths. Personalized learning paths are digital itineraries that are created based on an individual's interests, skills, and learning objectives. By using an algorithm [10] to plan personalized learning paths, learners can experience a more customized and effective learning experience.

A Context-Aware English vocabulary Learning system with personalized experience[11] has been introduced to improve learners' language proficiency in using and practicing the language appropriate to their current context. This application takes into account three main variables: the learner's location, individual abilities, and the time of day. Based on these variables, the system determines the appropriate vocabulary for the learner to consume and provides relevant content. For instance, if the date is December 25th, the system serves vocabulary related to Christmas. if the learner is in a restaurant, the system serves vocabulary related to food and drinks.

The CLUE knowledge-awareness application [12] enables distance learners to engage in collaborative learning. This is achieved by providing information about the nearest learners and their current comprehension of the subject or topic they are studying. The data is then shown on a knowledge awareness map, enabling students to seek out study partners and ask for assistance from one another for learning or problem-solving.

The SCORM, the Sharable Courseware Object Reference Model, which was created by Wang et al. [13], makes use of the idea of context awareness. The cornerstone for choosing pertinent learning items in this system is the learners' objectives and preferences. The Advanced Distributed Learning Initiative (ADL) developed SCORM (2003), which has now become a widely adopted worldwide standard to overcome the difficulties of sharing and reusing educational resources across incompatible web-based learning systems.

DOI: 10.54254/2755-2721/33/20230239

2.2 Smart tutoring and adaptive assessments

Deep learning algorithms can act as intelligent tutors, providing individualized guidance and support to students. These AI-powered tutors can analyze student responses, identify areas of weakness, and offer targeted feedback and explanations. This personalized tutoring can greatly enhance the learning experience, providing students with immediate assistance and allowing teachers to focus on areas that require more attention.

According to Sharma et al [14], AI has been integrated into various educational systems, including learning systems and intelligent tutoring systems, to enhance the quality of administrative procedures, instructions, and learning. According to Pokrivcakova [14], AI in education has transformed into an intelligent system with the ability to adapt and adjust. AI in education possesses these attributes that enable it to perform a range of tasks commonly handled by teachers, while simultaneously enhancing the learning journey of students by offering guidance and tailoring the educational experience to meet individual preferences and needs [14]. Mikropoulos and Natsis emphasize in their study another element of AI in instructions, claiming that VR offers major learning potential since it allows for simulations and gives students the chance to engage in experiential learning [15].

Research has proved that smart tutoring systems are effective and efficient in improving student learning outcomes and academic performance. Here is the first example, the Cognitive Tutor developed by Carnegie Mellon University has been widely studied and proven to be effective in various subjects, including algebra and geometry [16]. The system uses deep learning algorithms to adapt to individual student needs, providing personalized feedback and scaffolding to support learning.

Another example is the ALEKS (Assessment and Learning in Knowledge Spaces) system, which uses adaptive assessments and intelligent tutoring to help students learn mathematics [15]. The system dynamically adjusts the difficulty of questions based on the student's performance, ensuring that they are appropriately challenged and engaged. The BIP system, one of the initial instances of intelligent tutoring, provided students with personalized programming tasks based on their unique learning requirements and skills. The researchers from BIP devised a domain representation which linked the objectives, such as printing variables, to the programming tasks that posed a challenge. When students performed a task in the BIP system, it supported inferences about their proficiency in that skill. In the early version of Smart Tutoring, the student model was a smaller version of the domain model, just like in many other versions that came afterwards. By the time the International Journal of Man-Machine [17] Studies published a special issue on Intelligent Tutoring Systems, it was clear that a fresh educational system and a novel field of study had emerged. Student modeling was the main topic of almost all the papers in the special issue and the related book [17].

In their study, Kahraman et al. explored the progress and usage of AI in education by focusing on the creation and application of Adaptive and intelligent Web-based educational systems (AIWBES). These technologies are substituting the conventional methods of utilizing the Internet and the World Wide Web [18] by implementing a more intricate mechanism. AIWBES refers to the fusion of AI concepts and technology with web-based learning systems to enhance the learning experience for students. Peredo et al. also discussed the integration of AI into web-based systems. They argued that intelligent web-based education (IWBE) has become an essential part of education, especially with the rise of online learning. IWBE allows platforms to incorporate AI and other intelligent techniques, tools, and theories for modeling engineering agent-based systems and technologies [19]. According to their study, IWBE entails the use of various factors, such as the knowledge and skills, learning performance capabilities, and compatibility of the learners. These factors are leveraged to optimize teaching-learning experiences.

The use of natural language processing techniques in smart tutoring systems has shown promising results. For instance, the AutoTutor system, developed at the University of Memphis, uses natural language processing to engage students in interactive conversations and provide feedback [5]. This approach allows students to learn through dialogue and receive personalized assistance.

Moreover, upon analyzing the articles, various methods of utilizing AI in education were observed. For instance, research papers have discussed the implementation of intelligent tutoring systems equipped

DOI: 10.54254/2755-2721/33/20230239

with conversational and dialogue capabilities, as well as the exploration of chatbots or cobots [20]. Pokrivcakova [21] has also emphasized these concepts in the discussion of AI applications in education. Within computer-assisted language learning (CALL), personalized guidance is offered to students or learners, along with language learning aids like writing and translation assistants [21]. Furthermore, other uses of AI in education, particularly in guiding teacher or instructor tasks, are also emphasized [22]. These examples highlight how deep learning and neural networks enable smart tutoring systems to provide personalized and adaptive support to students. By leveraging AI technologies, these systems can analyze student data, identify misconceptions, and provide targeted interventions, ultimately enhancing the learning experience.

2.3 Efficient administrative tasks

AI technologies have the ability to automate administrative duties, allowing educators to have more precious time at their disposal. Deep learning algorithms can assist in tasks such as grading assignments, analyzing student data, and generating reports. By automating these processes, teachers can dedicate more time to instruction, mentoring, and providing individualized support to students.

2.3.1 Grading systems powered by AI. The act of evaluating a student's assignment and giving it a grade is known as grading. It is important for students at various education levels, from high school to college, to have their assignments graded. Graded assignments serve as a means for students to comprehend the criteria for their work and evaluate the caliber of their submissions. The manual grading process entails thoroughly reviewing each assignment and assigning a score based on its quality and the significance of its subject matter.

AI software can use the data it is provided with to learn and improve its grading capabilities. Graded papers provide valuable data that allows AI software to model the grading process used by humans. By combining machine learning and artificial intelligence, software can automatically assign grades to papers. While the grades generated by AI software and human graders may not always be identical, the speed and efficiency of AI grading tools [23] make them an attractive alternative for large-scale grading.

In addition to easing the workload of teachers, AI grading tools offer a range of other advantages. For instance, these tools have the ability to update themselves by assimilating new information, enabling them to stay current. Moreover, AI paper-checking software can effectively evaluate research papers and essays, while also being capable of analyzing content in various languages. This becomes particularly crucial in the context of state-level and national-level job examinations, where there is often a high volume of applicants vying for a specific course or position. Consequently, it becomes imperative to swiftly obtain examination results in order to facilitate the progression of the application process. Successful candidates can proceed to the interview stage, while those who do not pass have the option to explore alternative exams or make another attempt. In this manner, the implementation of AI not only avoids the wastage of individuals' time waiting for results but also enables a more efficient utilization of labor resources.

2.3.2. Automated essay scoring powered by deep learning. Essays play an essential role in evaluating an academic's proficiency and connecting diverse concepts, but they can be time-consuming to assess manually. Manual grading requires a substantial investment of the evaluator's time, making it a costly endeavor. However, if automated grading is demonstrated to be reliable, it has the potential to streamline the assessment process and save time.

Automated essay grading is a crucial application of machine learning. It has been studied extensively using various techniques such as latent semantic analysis. This approach aims to model language features such as language fluency, grammatical correctness, and domain information content of essays by fitting the best polynomial in the feature space using linear regression with polynomial basis functions. The proposed approach has been found to be effective in achieving an average absolute error that is significantly less than the standard deviation of human scores across all domains used.

DOI: 10.54254/2755-2721/33/20230239

The future of this problem can expand in various fields. One such area is to search for and model good semantic and syntactic features. This can be achieved by using various semantic parsers. Another area of focus can be to develop a better approach than linear regression with polynomial basis functions using neural networks.

2.4. Data-driven decision making

Deep learning and neural networks can process vast amounts of data from educational data to make informed decisions for educators and policymakers. By examining student performance, engagement levels, and learning patterns, AI can identify trends and insights that can guide instructional strategies and curriculum development. This data-driven approach has the potential to improve teaching methods and achieve better learning outcomes.

With the advancements in technology, educators now have more chances to collect data and improve teaching according to the data analysis. At present, teachers can track their students' understanding in real time throughout a lesson or receive the results of assigned homework before planning their next lessons. Teachers have the ability to generate videos and allocate them as homework on EdPuzzle, a platform for analyzing data. This platform enables teachers to monitor students' video views, performance scores, identify students who require additional assistance, and identify potential candidates capable of leading class discussions. This allows teachers to adjust according to data analyses and results so that their classes can be more efficient. Sometimes, the adjustments are on-the-spot fixes; other times, they are long-term shifts in instructional methods.

Schools employ cooperative methods to effectively utilize data. Through analyzing standardized test scores, attendance records, and behavioral data, school administrators and teachers are able to make informed decisions. These practices help identify struggling students, pinpoint areas where the curriculum needs improvement, and enhance course coordination across different departments and grade levels. Additionally, data and analytics are crucial in addressing educational disparities, as they enable educational researchers to identify influential factors like nutrition and parental engagement that contribute to achievement gaps. In summary, data-driven decision making in education has the potential to transform classrooms and address inequalities in education. By utilizing tools such as EdPuzzle and analyzing data, educators can make data-driven decisions that inform instruction, personalize learning, and improve learning outcomes

3. Challenges and ethical considerations

While the potential benefits of deep learning and neural networks in education are promising, it is essential to address the challenges and ethical considerations associated with their implementation. Some concerns include:

1. Data Privacy: The use of AI in education requires careful handling of student data to ensure privacy and security. Transparent policies and robust data protection measures are necessary to protect sensitive information.

2. Equity and Access: The adoption of AI technologies should not exacerbate existing educational inequalities. Ensuring equitable access to AI-powered tools and resources is crucial to avoid creating a digital divide.

3. Teacher-Student Relationship: While AI can enhance the learning experience, it should not replace the essential role of teachers. Maintaining a balance between technology and human interaction is vital to foster meaningful relationships and support holistic development.

Additional Contents:

4. Case Studies: Including real-life examples of how deep learning and neural networks have been implemented in educational settings. For instance, the use of AI-powered chatbots for personalized tutoring or adaptive learning platforms that cater to individual student needs.

5. Challenges in Implementation: Exploring the practical challenges that may arise when implementing deep learning and neural networks in education. This could include issues such as infrastructure requirements, training and upskilling of teachers, and resistance to change.

DOI: 10.54254/2755-2721/33/20230239

6. Ethical Considerations in AI-Powered Education: Delving deeper into the ethical considerations surrounding the use of AI technologies in education. This could include discussions on bias in algorithms, the impact on student privacy, and the potential for AI to reinforce existing inequalities.

7. Potential Limitations: Acknowledging the limitations of deep learning and neural networks in education. This could involve discussing the areas where AI technologies may struggle to provide effective solutions, such as creative and critical thinking skills, social-emotional learning, and the importance of human interaction in the learning process.

8. Future Developments and Trends: Considering emerging trends and future developments in AI-powered education. This could involve discussing advancements in natural language processing, virtual reality, or augmented reality and their potential impact on teaching and learning.

9. Collaboration and Interdisciplinary Approaches: Exploring the importance of interdisciplinary collaboration in the development and implementation of AI technologies in education. This could involve discussing the role of educators, data scientists, and policymakers in working together to ensure that AI technologies are used responsibly and effectively.

10. Long-term Implications: Reflecting on the potential long-term implications of widespread adoption of AI technologies in education. This could involve discussing the impact on employment in the education sector, the need for ongoing professional development for educators, and the role of AI in shaping the future of work and lifelong learning.

4. Conclusion

This paper reviews the advantages and challenges of AI technologies, deep learning and neural networks, in the field of education. To conclude, deep learning and neural networks have immense potential to reshape education, offering personalized learning experiences, smart tutoring, and efficient administrative tasks. With careful implementation and consideration of ethical concerns, AI technologies can support educators in providing high-quality education to students of all backgrounds. When embracing the future of AI in education, it is crucial to strike a balance between technological advancements and the human element, ensuring that students receive the best of both worlds.

References

[1] Prain, V., Cox, P., Deed, C., et al. (2013). Personalisedlearning: lessons to be learnt. British Educational Research Journal 39(4), 654–676.

[2] Savery, J. R. and Duffy, T. M. (1995). Problem based learning: An in-structional model and its constructivist framework. Educationaltechnology 35(5), 31–38.

[3] I.B.M. (2007) Virtual Worlds: Real Leaders. Online Games putthe future of buisiness leadership on display.

[4] de Freitas, S. (2008). Emerging technologies for learning. Becta, Tech. Rep.

[5] Graesser, A. C., Chipman, P., Haynes, B. C. and Olney, A. (2005). Auto Tutor: An intelligent tutoring system with mixed-initiative dialogue. IEEE Transactions on Education 48(4), 612-618.

[6] Boyle, E., Connolly, T. M. and Hainey, T. (2011). The role of psychology in understanding the impact of computer games. Entertainment Computing 2(2), 69–74.

[7] Charles, D. and McAlister, M. (2004). Integrating ideas about invisible playgrounds from play theory into online educational digital games. in Entertainment Computing–ICEC 2004. Springer, 598–601.

[8] Connolly. T. M., Boyle, E. A., MacArthur, E., et al. (2012). A systematic literature review of empirical evidence on computer games and serious games. Computers & Education 59(2), 661–686.

[9] Druckman, D., Bjork, R. A., et al. (1992). In the mind's eye: Enhancing human performance. National Academies Press.

[10] Hwang, G.-J., Tsai, C.-C., Yang, S. J., et al. (2008). Criteria, strategies and research issues of context-aware ubiquitous learning. Educational Technology & Society 11(2), 81–91.

DOI: 10.54254/2755-2721/33/20230239

[11] C.-M. Chen and Y.-L. Li, “Personalized context-aware ubiquitous learning system for supporting effective English vocabulary learning,” Interactive Learning Environments, vol. 18, no. 4, pp. 341–364, 2010.
[12] Ogata, H. and Yano, Y. (2004). Knowledge awareness map for computersupported ubiquitous language-learning. in Wireless and Mobile Technologies in Education, 2004. Proceedings. The 2nd IEEE International Workshop on. IEEE, 19–26.
[13] Wang, T. I., Tsai, K. H., Lee, M.-C. and Chiu, T. K. (2007). Personalized learning objects recommendation based on the semantic-aware discovery and the learner preference pattern. Educational Technology & Society 10(3), 84–105.
[14] Sharma, R. C., Kawachi, P. and Bozkurt, A. (2019). The landscape of artificial intelligence in open, online and distance education: Promises and concerns. Asian J. Distance Educ. 14(2), 1–2.
[15] Piech, C., Huang, J., Chen, Z., Do, C., Ng, A. and Koller, D. (2015). Tuned models of peer assessment in MOOCs. Educational Data Mining.
[16] Koedinger, K. R., Booth, J. L. and Klahr, D. (2012). Instructional complexity and the science to constrain it. Science, 336(6081), 380-385.
[17] Sleeman, D. H. and Brown, J. S. (Eds.). (1979). Intelligent tutoring systems [Special issue]. International Journal of Man–Machine Studies, 11, 1–3.
[18] Kahraman, H. T., Sagiroglu, S. and Colak, I. (2010). Development of adaptive and intelligent Web-based educational systems. in Proc. 4th Int. Conf. Appl.Inf. Commun. Technol., 1–5.
[19] Peredo, R., Canales, A., Menchaca, A. and Peredo, I. (2011). Intelligent Web-based education system for adaptive learning. Expert Syst. Appl. 38(12), 14690–14702.
[20] Rus, V., D’Mello, S., Hu, X. and Graesser, A. (2013). Recent advances in conversational intelligent tutoring systems. AI Mag 34(3), 42–54.
[21] Pokrivcakova, S. (2019). Preparing teachers for the application of AI-powered technologies in foreign language education. J. Lang. Cultural Edu. 7(3), 135–153.
[22] Mikropoulos, T. A. and Natsis, A. (2011). Educational virtual environments: A ten-year review of empirical research (1999–2009). Comput. Edu. 56(3), 769–780.
[23] Kumar, A. (2020). AI's New Role In Education: Automated Grading. https://elearningindustry.com/artificial-intelligence-new-role-in-education-automated-paper-grading.