



THE ROLE OF ARTIFICIAL INTELLIGENCE IN EDUCATION

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Abstract: Artificial intelligence is a diverse field that is experiencing an increasing impact on education, offering significant opportunities to personalize the learning process according to individual student needs. This study aims to explore the impact of artificial intelligence on education by analyzing how it improves student outcomes and customizes educational content, as well as enhances self-directed learning and supports teachers in assessing student performance and providing appropriate guidance. The results showed that artificial intelligence enhances interaction and facilitates self-directed learning through smart tools like virtual assistants, but it faces challenges related to data privacy and the ethics of its use, along with exacerbating the digital divide between schools. Integrating artificial intelligence into education also requires a shift in the teacher's role to become more supervisory and guiding. This study provides a comprehensive understanding of the impact of artificial intelligence on education, enabling educational institutions to improve their strategies and effectively and sustainably leverage technology.

Keywords: Artificial Intelligence, Education, Data, Technology, Digital Divide

LE RÔLE DE L'INTELLIGENCE ARTIFICIELLE DANS L'ÉDUCATION

Résumé : L'intelligence artificielle est un domaine diversifié qui connaît un impact croissant sur l'éducation, offrant d'importantes opportunités de personnaliser le processus d'apprentissage en fonction des besoins individuels des étudiants. Cette étude vise à explorer l'impact de l'intelligence artificielle sur l'éducation en analysant comment elle améliore les résultats des étudiants et personnalise le contenu éducatif, tout en favorisant l'apprentissage autonome et en soutenant les enseignants dans l'évaluation des performances des élèves et la fourniture de conseils appropriés. Les résultats ont montré que l'intelligence artificielle améliore l'interaction et facilite l'apprentissage autonome grâce à des outils intelligents tels que les assistants virtuels, mais elle fait face à des défis liés à la confidentialité des données et à l'éthique de son utilisation, tout en exacerbant la fracture numérique entre les écoles. L'intégration de l'intelligence artificielle dans l'éducation nécessite également un changement dans le rôle de l'enseignant pour devenir plus supervisant et orientant. Cette étude offre une compréhension globale de l'impact de l'intelligence artificielle sur l'éducation, permettant aux établissements éducatifs d'améliorer leurs stratégies et d'exploiter la technologie de manière efficace et durable.

Mots-clés : Intelligence Artificielle, Éducation, Données, Technologie, Fracture Numérique.

Introduction

Artificial intelligence is one of the most impactful innovations of the modern era, reflecting the evolution of technology and its ability to simulate human intelligence in processing information and making decisions. Since its inception, this field has undergone significant development, from simple rule-based systems to deep neural networks and deep learning, enabling machines to learn from data and improve their performance over time. Today, artificial intelligence is used in a wide range of applications, from virtual assistants and recommendation systems to disease diagnosis and big data analysis, fundamentally changing the way we work and interact with technology. As reliance on these technologies increases, new challenges related to ethics and privacy emerge, necessitating ongoing discussions about how to use artificial intelligence responsibly and sustainably.

There is no doubt that today's learners suffer from a lack of motivation and interest in their studies, which negatively affects their ability to benefit from the knowledge and experiences presented by the teacher during the teaching process. As a result, learners do not respond to stimuli associated with the teaching process. Therefore, it is essential for us to take advantage of technology, especially in the field of education. The use of computers in education is one of the latest contemporary educational trends, aimed at adapting computer technologies to serve linguistic studies. This is achieved by relying on highly effective technological mechanisms proposed by the field of computational linguistics, such as electronic games, software programs, and artificial intelligence, which represents a linguistic planning process within an advanced mental activity aimed at charting the future course of education.

The study of the topic of artificial intelligence in education aims to understand how these technologies can be used to improve the learning experience and enhance student outcomes. This includes exploring ways to use artificial intelligence to personalize education and meet individual learners' needs by developing intelligent educational systems capable of analyzing student performance and providing appropriate recommendations. The research also seeks to analyze the impact of artificial intelligence on the role of the teacher, and how it can enhance teaching strategies and help create interactive and engaging learning environments.

In light of the rapid development of artificial intelligence technologies and their increasing impact on various aspects of life, the role of this technology in education emerges as one of the fields that has undergone significant transformations. However, despite the numerous benefits that artificial intelligence offers in improving the learning experience and personalizing

content according to students' needs, questions remain regarding the effectiveness of this technology in enhancing interaction between students and teachers, as well as its ability to support the teacher's role in guiding students. Additionally, challenges related to ethics and privacy arise, along with the digital divide that may lead to unequal educational opportunities between institutions. Therefore, the research problem crystallizes around: How does the use of artificial intelligence in education affect the improvement of student outcomes, support the role of teachers, and address the challenges related to ethics and the digital divide?

In studying the impact of artificial intelligence on education, three main hypotheses can be proposed. First, the hypothesis of personalized education, which suggests that artificial intelligence contributes to improving student outcomes by providing customized educational content according to their individual needs, thereby enhancing interaction and engagement in the educational process. Second, the hypothesis of supporting teachers, where artificial intelligence helps teachers analyze student performance in greater depth, allowing them to identify weaknesses and provide targeted and effective support for students who need additional assistance. Finally, the hypothesis of ethical and technical challenges, which assumes that educational institutions face challenges related to privacy and the ethics of data usage, as well as digital divides that may lead to unequal opportunities among students.

1. The Concept of Artificial Intelligence

Artificial intelligence is the simulation of human intelligence and the understanding of its nature through the development of computer programs capable of mimicking intelligent human behavior. Currently, artificial intelligence is present everywhere around us, ranging from self-driving cars and drones to translation software, investment programs, and many other applications that are widespread in daily life.

Artificial intelligence (AI) is defined as "a specialized scientific field that aims to program computers in a way that enables them to possess the ability to think, solve problems, and make decisions in a manner that mimics human capabilities." AI allows for the creation and design of computer programs that emulate human intelligence, enabling computers to perform certain tasks on behalf of humans that require thinking, understanding, hearing, speaking, and movement in a logical and organized manner (Mahmoud Mustafa Khalil, 2018, p. 06). Therefore, we can conceive of artificial intelligence as a cognitive process par excellence, through the design of intelligent machines that mimic human mental capabilities and their operational patterns.

John McCarthy referred to the term "artificial intelligence" and coined it in 1956, considering it "the science of engineering intelligent machines" (Abdul Raouf Mahmoud Ismail, 2017, p. 47). This means that it is regarded as one of the expert systems discovered to date.

Martin Weik defines it as "the ability of a machine to perform tasks that require human intelligence when executing them, such as logical reasoning, learning, analysis, and innovation" (Hamadi Al-Mouqat, 2017, p. 21).

Issam Sarhan defines it as "a science that deals with machines that help find solutions to difficult problems in a way that is more suitable for humans, aiming to produce programs that mimic human intelligence" (Abdul Raouf Mahmoud Ismail, 2017, p. 47).

Most of this knowledge and these sciences help establish the fundamental pillars of artificial intelligence, including fields such as linguistics, computer science, logic, and psychology.

Among the applications of artificial intelligence, it has achieved significant success in the field of medicine, where it has become capable of diagnosing diseases and suggesting solutions. Its applications are numerous, with one of the most notable being "Natural Language Understanding," which refers to the languages used in our daily lives, whether written, spoken, or compressed in narrative or dialogue form, including all the ambiguities, deficiencies, and linguistic errors it may contain. This involves references to previously mentioned concepts, the deletion of what can be inferred by default or in light of context, or based on the listener's knowledge derived from acquired experiences and knowledge (Abdul Raouf Mahmoud Ismail, 2017, pp. 35-36). This is based on the idea that the mission of artificial intelligence has shifted from data processing to knowledge processing, becoming a new wealth that serves language and all scientific knowledge.

Artificial intelligence has become one of the "central themes in contemporary scientific research, where the significant and rapidly growing interest revolves around developing intelligent systems capable of acting in a manner similar to human behavior, as much as possible" (Abdul Raouf Mahmoud Ismail, 2017, p. 48).

Artificial intelligence is expected to play a significant role, particularly in the educational field, by searching for solutions to linguistic problems and addressing them experimentally.

One can refer to what the Japanese Marvin Minsky, the father of the information revolution and the innovator of artificial intelligence, stated, emphasizing with great conviction that "computers in the future will understand the meaning of discourse; they will speak to us and we will speak to them, we

will ask them questions and they will answer us, without resorting to a special programming language, thanks to the speed, power, and logical reasoning that computers possess" (Abdul Raouf Mahmoud Ismail, 2017, p. 49). This view is supported by the wealthy Bill Gates, founder of Microsoft, who said, "Indeed, the majority of software has not yet been developed." What emerges from this statement makes us look forward to a better tomorrow, as what we expect from new technologies will be better than what came before.

2. The Fundamental Capabilities of Artificial Intelligence

It is difficult to precisely determine the boundary between non-intelligent behavior and intelligent behavior, making it wise to avoid suggesting a strict standard for this boundary. However, there are several core capabilities that distinguish artificial intelligence. These capabilities include the ability to respond flexibly to various situations, exploit favorable conditions as they arise, and understand ambiguous and conflicting phrases and sentences. Artificial intelligence is also characterized by its ability to discern the relative importance of different elements in specific contexts and find similarities between situations despite differences that may isolate them. Additionally, artificial intelligence can deduce distinguishing features between similar situations and construct new concepts by merging old concepts in innovative ways. It also allows for the creation of new ideas through modern methods, contributing to enhancing the ability to learn and adapt to various challenges.

However, the field of artificial intelligence aims to understand the nature of artificial intelligence by developing computer programs capable of simulating human behavior and the brain, which consists of billions of interconnected neurons in a very complex manner through the dendrites of each neuron. This forms a vast network of neurons linked to each other through these dendrites.

This interconnection among neurons allows them to store information, images, sounds, and signals received through the five senses, enabling them to learn through repetition and trial and error.

For example, if we take a small child and show them a set of pictures of different animals, such as an elephant, a giraffe, and a parrot, the child learns these animals and their names. If we then show them a picture of a bird they have never seen before, let's say a canary, and ask them, "What is this animal?" based on their previous learning, they will respond that it is neither an elephant nor a giraffe, but it resembles a parrot quite a bit. We would tell them, "That's right, it resembles a parrot, but it is not a parrot; it is a canary." Now, what has happened?

This young child was able to learn based on the three initial models he was trained on, and he was also able to make the correct decision regarding the new

bird. Finally, he learned about the canary so that in future instances, he would be able to distinguish between the parrot and the canary, despite their similarities.

All of this happened with this young child because the human brain functions in a way that enables it to learn, remember, and make decisions when needed, due to the structure of the brain that we discussed earlier. When scientists discovered how the brain works, mathematicians attempted to simulate the brain's functioning through mathematical models.

This new field has given rise to what is called artificial intelligence, and one type of this artificial intelligence is neural networks, which is the foundation of our current topic. We previously observed that the young child dedicated a portion of his brain cells to form a neural network that learned to distinguish between the images presented to him. This network can continue to develop, learn, and grow increasingly capable of making correct decisions.

3. Characteristics of Artificial Intelligence

- Symbolic Representation:

The property of symbolic representation is one of the fundamental features in artificial intelligence programs, as these programs deal with symbols that represent available information. For example, information such as "the weather today is hot" or "the car is out of fuel" can be represented symbolically, allowing systems to process this information in a manner similar to how humans handle it in their daily lives. This symbolic representation enhances the ability of machines to understand and interpret information in a way that aligns with human context (Khalil, 2018, p. 06).

- Experimental Research:

Artificial intelligence programs face problems that may not have clear solutions based on specific logical steps. These programs rely on experimental research, much like a doctor diagnosing a disease. Before reaching an accurate diagnosis, the doctor considers several possibilities. Similarly, in games like chess, the player needs to evaluate a set of potential options. This approach requires high computational power and speed in data processing to effectively assess different probabilities (Ismail, 2017, p. 47).

Knowledge Acquisition and Representation: One of the fundamental characteristics of artificial intelligence programs is the need for a strong knowledge base that includes links between situations and outcomes. For example, if the disk drive is not reading data while the disk is intact, the malfunction lies within the drive itself. This type of knowledge representation

aids in making accurate decisions based on the available information and reflects the system's ability to deduce appropriate solutions (Ismail, 2017, pp. 35-36).

Uncertain or Incomplete Data: Artificial intelligence programs require the ability to provide solutions even in cases of uncertain or incomplete data. For example, in medical applications, if a specific case is presented without laboratory test results, the programs should be able to make reasonable inferences based on the available information. This indicates the necessity of developing systems capable of effectively handling uncertainty (Ismail, 2017, p. 48).

Learning Ability: The ability to learn is one of the most prominent features of artificial intelligence, as these systems must rely on machine learning strategies to improve their performance over time. This learning is based on data analysis and pattern recognition, which aids in the development of the systems and enhances their effectiveness in providing solutions (Ismail, 2017, p. 49).

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Additional Characteristics: Other characteristics of artificial intelligence include its use of methods that compare with human approaches to problem-solving, as well as its ability to handle hypotheses with precision and speed. Furthermore, these systems must maintain a consistent level of scientific and consultative performance, which requires representing vast amounts of knowledge in specific fields. These systems also process non-numeric symbolic data through analytical and logical comparison operations (Abu Rashid et al., 2018, p. 102; Al-Duraini, 2021, p. 112).

Fields and Applications of Artificial Intelligence: Artificial intelligence is widely used across various fields, with applications including (Abdul Rahman Al-Amri, 2020, p. 120). AI is increasingly utilized in a diverse range of applications that affect different aspects of daily life. Among the most prominent applications is the development of self-driving cars and drones, where AI is

employed to design autonomous driving systems that enable these vehicles to navigate independently, enhancing the efficiency and safety of transportation.

In addition, artificial intelligence contributes to the design and development of robots capable of operating independently in various tasks without the need for human intervention, opening new horizons in fields such as industry and services. AI is also used in developing automation control systems for various applications, such as railway control, enhancing safety and efficiency in transportation operations.

In the field of medical diagnosis, artificial intelligence programs are used to analyze medical data, enabling accurate disease diagnoses and effective treatment planning. This contributes to improving health care outcomes for patients. AI is also employed in analyzing economic data, such as the stock market, where it helps develop stock trading systems that provide precise analyses and reliable investment forecasts.

Artificial intelligence applications are also found in the field of video games, where they are used to develop advanced programs for video games and strategy games like chess, adding a new dimension to the gaming experience. Expert systems are also an important part of these applications, as systems are developed to mimic experts in performing tasks and making decisions based on available data and knowledge.

The importance of artificial intelligence is also evident in smart home services, where intelligent systems are developed to facilitate daily life and enhance energy efficiency and security. Finally, AI technologies are used in natural language learning and machine translation, helping to develop advanced systems for understanding and analyzing texts, thereby enriching the learning and teaching experience.

All these applications highlight the importance of e-learning using advanced artificial intelligence technologies, as information can be delivered quickly and effectively through the production of new creative works based on meaningful topics. Education is shifting towards providing learners with beneficial knowledge in various fields, with many preferring modern electronic media over traditional printed materials.

4. The Use of Artificial Intelligence in Education and Teaching

4.1. Personalizing and Enhancing Education:

One of the primary goals of using artificial intelligence in education is to improve the learning experience for each student. By leveraging this technology, education can be personalized and enhanced in various ways.

One of these methods is analyzing student data, where data related to academic performance, test responses, and interaction patterns with educational content can be collected and analyzed. This helps in understanding the individual needs of each student, thereby enhancing the effectiveness of education.

Based on these analyses, personalized learning guidance can be achieved, where each student is directed toward a learning path that aligns with their current level and individual learning style. This approach allows students to engage with the content in a way that suits their unique needs.

Moreover, personalized educational content can be provided to meet students' needs. The existing content can be adjusted, or additional educational resources can be made available to ensure that it accurately meets each student's requirements.

Regarding progress monitoring and performance evaluation, artificial intelligence can track students' progress and assess their performance periodically. This provides an opportunity to offer suggestions for adjustments in instructional guidance based on students' needs.

AI can also provide immediate educational assistance to students during the learning process. Whether through direct guidance or offering additional explanations, this contributes to enhancing students' understanding of the educational content.

Ultimately, AI can be utilized to improve the online learning experience through digital learning platforms. This allows for the creation of a personalized and effective learning experience for each student, thereby enhancing their academic outcomes.

In summary, through these methods, artificial intelligence can effectively achieve personalized education, enhancing the learning experience and boosting students' academic success (Abdul Rahman Al-Omari, 2020, p. 120).

4.2. Curriculum Development:

Personalization and improvement of education are among the primary objectives of using artificial intelligence in education. By analyzing student data, it is possible to collect and analyze information related to academic performance, test responses, and interaction patterns with educational content. This process contributes to understanding the individual needs of each student, thereby enhancing the effectiveness of education and improving the learning experience.

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Moreover, personalized educational content can be provided to meet the needs of students. Existing content can be modified, or additional educational resources can be offered to ensure that it precisely meets the requirements of each student. This helps enhance students' understanding and facilitates their absorption of information.

In addition, artificial intelligence can monitor students' progress and assess their performance periodically. This can provide an opportunity to offer suggestions for adjustments in educational guidance according to students' needs. It also allows for providing immediate educational assistance to students during the learning process, whether through direct instructions or by offering additional explanations.

In conclusion, artificial intelligence can be used to enhance the online learning experience through digital learning platforms. This allows for the creation of a personalized and effective learning experience for each student, thereby improving their academic outcomes. Thus, it can be said that artificial intelligence significantly contributes to the customization and improvement of education, enhancing students' success in various educational fields.

5.3. Enhancing the Learning Experience

Smart technologies such as machine learning and data analysis can be used to enhance the educational experience. By utilizing these technologies, engaging and interactive learning experiences can be provided to students, motivating them to participate and learn effectively. For example, machine learning can be used to analyze students' responses and interests, allowing for the provision of educational content tailored to their personal interests and learning styles. Additionally, data analysis can help identify students' behavioral patterns and better understand their learning methods, enabling a more precise and effective direction of the educational process. Thus, this intelligent use of technologies contributes to enhancing the learning experience and motivating students to achieve better outcomes and further develop their skills.

5.4. Providing Immediate Feedback and Accurate Assessments

Artificial intelligence can provide immediate feedback and accurate assessments of student performance, helping them identify strengths and weaknesses and improve their performance effectively. Offering this immediate feedback can be a motivating factor in enhancing the learning experience.

Through the use of AI, student performance can be thoroughly analyzed, and precise assessments can be provided, highlighting strengths and weaknesses. This allows students to better understand their performance and identify areas that need improvement. Additionally, the instant feedback from AI can guide students immediately toward correction and improvement, contributing to an enhanced level of understanding and overall performance.

By using this technology, students can be motivated to actively engage in the learning process, encouraging them to make the most of their educational experience. Ultimately, artificial intelligence contributes to the development of effective teaching strategies that support student success and help them achieve their academic goals (Hussein Abu Rasheed et al., 2018, p. 103).

5.5. Developing Smart Educational Tools

Artificial intelligence can be used to develop innovative and intelligent educational tools, contributing to enhancing the learning experience and making it more enjoyable and effective. For example, AI-based educational applications and games can be created to allow students to learn challenging concepts in interactive and engaging ways. Additionally, game-based learning and virtual simulations can be employed to provide realistic and interactive learning environments, where students can actively engage with educational materials and experiment with concepts in a practical manner.

Thanks to artificial intelligence, educational tools can be designed to adapt to the individual needs of each student, offering personalized and customized learning experiences. Moreover, smart educational tools can provide immediate feedback and accurate assessments of student performance, helping them better understand concepts and achieve better academic outcomes. By using these smart tools, students can be motivated to actively engage in the learning process and gain more from the educational materials, which contributes to enhancing understanding and improving overall student performance.

Table 1. A Comparative Perspective on Teachers' and Learners' Roles in Digital Learning Environments

Learners	Teachers
Progress according to individual abilities	Ease of updating the material with new information
Gradual learning, moving from one mastered stage to the next	Variety of presentation methods (3D graphics, slides, others)
Learning in an environment tailored to the individual learner	Shift from traditional lectures to other electronic methods, which may capture students' attention
The possibility of discussion and interaction electronically or face-to-face (collaborative learning)	Learning without considering individual differences
Immediate feedback	Reinforcing information

Data Analytics and Predictions:

Artificial intelligence analyzes student data and their past performance, providing predictions about potential challenges they may face in their future learning paths. By analyzing this data, AI can identify performance and knowledge patterns based on data-driven insights, enabling teachers to better understand the strengths and weaknesses of each student (Hussein Abu Rasheed et al., 2018, p. 112).

Based on these analyses, teachers can adapt their teaching strategies and provide support more effectively. For example, if the analysis indicates that a group of students is facing challenges in understanding a particular concept, teachers can allocate more time within the classroom or curriculum to explain the concept in greater detail or offer different types of educational resources that make it easier for students to grasp.

In addition, artificial intelligence can provide predictions about students' future possibilities, enabling teachers to prepare for those potential challenges and offer the appropriate support in advance. By using these analyses and predictions, teachers can enhance the learning experience for students and increase the effectiveness of teaching and support, contributing to improved academic success and better achievement of educational goals.

Recent developments in the field of artificial intelligence open new and exciting horizons for improving learning and teaching processes. AI can contribute to personalizing education according to individual student needs, providing tailored and effective learning experiences, improving performance evaluation, and guiding students with greater precision. However, this progress also brings new challenges, such as privacy and security concerns, the need to consider its impact on the future job market, and ensuring equal access to

education. Therefore, fully harnessing AI in the field of education requires a careful balance between technological investments and achieving educational and social goals in a sustainable and inclusive manner.

Conclusion

The findings from the study highlight the significant and varied impact of artificial intelligence (AI) on education. First, AI has demonstrated its ability to enhance the learning experience by personalizing educational content, thus boosting interaction and engagement between students and teachers. Second, AI tools, such as virtual assistants, facilitate self-learning, allowing students easy access to information anytime. Moreover, AI assists teachers in analyzing student performance and identifying weaknesses, enabling them to provide targeted and effective support to students in need.

However, ethical and technical challenges remain concerning data privacy and the ethics of its use, underscoring the need for clear policies to protect students' personal information. Additionally, AI applications may exacerbate digital divides between schools and communities, leading to unequal educational opportunities. The integration of AI also requires a shift in the teacher's role, making it more focused on guidance and supervision, which calls for the development of new skills to adapt to these changes.

In conclusion, these findings offer a comprehensive understanding of how AI influences education, providing educational institutions with the opportunity to improve their strategies and harness this technology effectively and sustainably.

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