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# AI-DRIVEN TRANSFORMATIONS IN EDUCATION: A CONCEPTUAL REVIEW STUDY

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## ABSTRACT

*We also noted that AI applications in the education field include enabling the preparation of content, assignments, automated grading, and assistance to students. The benefits of AI in education include greater flexibility in terms of time and space and a changing role of the tutor as a facilitator. We also discussed key challenges including ethical issues such as data privacy, lack of inclusion and equity for students of all backgrounds, and lack of human touch. Based on these themes we concluded that AI's role in education will increase in the future, but the challenges also need to be addressed to fully unlock the benefits of AI in the education field.*


**KEYWORDS:** *Artificial Intelligence; Education; Technology; Learners.*

## 1. INTRODUCTION

The concept of AI is about the combination of applications of machine learning, deep learning, algorithm production, and natural language processing (Akgun and Greenhow, 2022). AI is beneficial for organizations and individuals as it can increase efficiency, productivity, save time and effort, and improve overall performance (Ali, Abdelbaki, Shrestha, Elbasi, Alryalat, and Dwivedi, 2023; Flavian and Casalo, 2021). Despite many benefits, AI has challenges such as data security, confidentiality, and causing unemployment (Becue, Praca, and Gama, 2021; Perc, Ozer, and Hojnik, 2019). Overall,AIispermeatingmoreandmoreareasofourdailylives,andisincreasinglybeingusedinprofessionalcontexts such as education (Chen, Chen, and Lin, 2020;Hwang, Xie, Wah, andGašević,020); healthcare delivery (Matheny, Whicher, and Israni, 2020). It has become one of the key technological drivers and trends in the 21$^{st}$century. The present article is organized based on the themes of AI in Education, its application, benefits, challenges, and future opportunities of AI in the education field.

## 2. AI IN THE EDUCATION FIELD

The concept of AI is gradually making its way into the education field. Initially, it was known as AI literacy refers to the ability to understand, use, monitor, and critically reflection AI applications without necessarily being able to develop AI models themselves (Long and Magerko, 2020). The term AI

was first used in an online article in 2015 (Konishi, 2015). The term joins a long line of proposed literacies intended to symbolize the understanding of a particular technological construct, like "media literacy" or "data literacy" (Wolff, Gooch, Montaner, Rashid, and Kortuem, 2016). "AI literacy" encompasses AI competencies that the general population should possess and accordingly focuses mainly on learners without a computer science background ("non-experts"). A frequently cited definition of AI literacy was developed by Long and Magerko (2020), who defines it as "a set of competencies that enables individuals to critically evaluate AI technologies, communicate and collaborate effectively with AI, and use AI as a tool online, at home, and in the workplace".

The use of AI in the field of Education can be traced back to the1970s when LOGO programming and Turtle robots were introduced to young learners. However, those tools focused more on computational thinking or programming concepts instead of AI. In 1995, a book named "Artificial Intelligence: A Modern Approach" was published and is considered the most standard textbook in the field of AI for computer science undergraduates (Russell and Norvig, 1995). Accordingly, computer science university students could learn how AI can solve problems, reason, learn, make decisions, communicate, perceive, and act (Russell and Norvig, 1995). However, the concept remained limited to the field of computer science only. Later the concept of AI in education evolved as the integration of AI into the education management system which facilitates teaching, learning, and decision-making, as well as providing virtual assistance for personalized education (Dignum, 2021; Hwangetal., 2020). AI can further enable providing individual customized learning for students thus facilitating the learning needs. Educators can deliver the learning content to the students using AI-based technologies such as cloud computing to students in a format and form suitable for various student needs (Kabudi, Pappas, and Olsen, 2021), AI can also provide an opportunity for students to interact with Chatbots thus enhancing their learning and clearing any confusions resulting in facilitating independent learning (Chen et al., 2020).

The role of AI in education is increasing as evident from global initiatives (e.g., ISTE, UNESCO, DigComp) which started to conceptualize AI education according to the latest educational standards and design guidelines to address digital literacy levels across the globe (DigComp, 2022; ISTE, 2022; Miao and Shiohira, 2021). These frameworks represent different perspectives on the idea of AI education. For example, Miao and Shiohira, (2021) reported that eleven countries around the world have incorporated AI in to their STEM/computing curricula to promote competitiveness and equip young people for the future workplace. AIK12 (2019) proposed the "five big ideas" about AI that serve as the framework to uncover the necessary AI concepts that students in each grade level should learn. The five big ideas include perception, representation and reasoning, learning, natural interaction, and the societal impact of AI (AIK12, 2019).The ISTE (2022) further designed an AI project guideline and proposed seven standards to prepare students to become (1) empowered learners, (2) knowledge constructors, (3) computational thinkers, (4) innovative designers, (5) digital citizens, (6) creative communicators, and (7) global collaborators. Overall, currently, AI is becoming the next big trend in the education field at all levels including primary, secondary, as well as higher-level studies.

## 3. AI APPLICATIONS IN THE EDUCATION FIELD

There are various applications of AI in the education field including content design, delivery, assessment, feedback, and support. In terms of content design, AI can enable the designing of content which is friendly and flexible. According to Culican (2024), AI algorithms can scan large data to tap in to the gaps thus creating content that is interesting and trendy. AI can also be used for making content including textbooks, personalized learning materials, and interactive courses according to the target audience. AI tools enable the development of educational material that is based on natural

language processing capabilities thus ensuring material that is consistent, concise, and grammatically correct (Dawes, 2023).

In terms of delivery of contents, AI enables delivery of contents more efficiently and flexibly by substituting classroom instruction and providing support for students to learn from anywhere in the world at any time. In the future, AI systems might replace lecturers in some subjects. Currently, some educational programs are equipped with AI, and scaffolding students to learn basic skills. According to Fahimirad and Kotamjani (2018), Classroom AI systems have a high capability to analyze multiple sources of data and compare those data to known patterns. They can recognize the source of problems and give guidance to lecturers to achieve more consistent outcomes across various classes (Chenetal.2020). In other words, the AI and teachers can work together to create the best delivery method for students with maximum positive outcomes. The benefits of using AI for delivering educational content include the provision of individualized and customized learning, and universal access for all students who may speak different languages or have some disability such as visual or hearing impairment (Marr, 2024). Furthermore, according to Dawes (2023), AI can be used to analyze advanced insights about how students are receiving educational delivery and making progress thus enabling a more personalized learning experience. Thus, it can be argued that AI- based education delivery is more learner-centric compared to the traditional method of educational delivery and is beneficial for learners as well as tutors.

In terms of assessment, AI can enable automated assessment (Holmes and Tuomi, 2022). For example, AI can automate grading homework and tests usually take a significant amount of time. This time could be used to work on professional development, interact with students, and prepare for class. As AI is also replacing human grading gradually, AI automated grading can grade nearly fill-in-the-blank and all kinds of multiple-choice testing. However, essay-grading software is still in its early stages yet and it will be improved over the coming years. According to the European School Education Platform (2023), AI can be used by tutors to personalize assessment and provide timely feedback addressing individual learning needs. The benefit of AI in assessment is that it can reduce human subjectivity and time taken for assessment (ibid). Furthermore, Sarker (2022) suggests that AI use in educational assessment increases consistency, personalization, and scalability. The reported benefits of AI in educational assessment include the ability to analyze large data with multiple sources, individual consideration, and flexibility (Mishra and Deep, 2023).

For feedback and support, it is generally agreed that for learners, timely, relevant, and objective feedback is very important. AI also has the potential to provide feedback that meets these criteria. The use of AI in providing feedback on student's assessments or work is already in use (Hooda, Rana, Dahiya, Rizwan, and Hossain, 2022). For example, some schools are employing AI systems to track and monitor students' progress and to notify tutors if there is an issue with students' performance. Some tutoring programs are based on artificial intelligence to help students through writing, basic mathematics, and other subjects (Leite and Blanco, 2020). These AI programs can instruct students only in basic subjects; however, these machines aren't perfect for teaching high-order thinking and creativity to students. Furthermore, generative AI tools like Chat GPT or Microsoft Bing can provide customized and quick feedback on students' work. According to Mollick and Mollick (2023), AI is being used in providing feedback to students which is personalized and asks students to take a different perspective. However, the authors noted that AI-based feedback is limited in the sense that it cannot replace human- grounded knowledge that a teacher has about their students.

## 4. BENEFITS OF AI IN THE EDUCATION FIELD

The general benefits of AI such as efficiency and customization also apply to AI in education. The main benefit of AI in education is that it can facilitate learning with greater flexibility and convenience

as learners can learning their own time and space using AI -related infrastructure (Kabudietal., 2021; Tahiru, 2021). Along with flexibility, AI can also enhance accessibility to education as more and more learners can access quality educational resources regardless of their economic background or geographic location. This advantage makes providing universal access to education much easier (Baidoo-Anu and Ansah, 2023).

AI can also enable tutors to empower their students' AI competencies, attitudes, and readiness to communicate with other learners, solve authentic problems, and develop ideas, theories, and solutions innovatively and collaboratively (ISTE, 2022). Thus, the use of AI in education is resulting in overall improvement of the student's performance.

A benefit of AI includes greater support available to students (Baidoo - Anu and Ansah, 2023 ; Tahiru, 2021). For example, AI - based assistance to students uses Chatbot and virtual assistants which are based on intelligent systems and can offer round-the-clock availability, address queries, and offer valuable feedback. AI also enables enhanced engagement and motivation of students by providing tools such as gamification of learning or interactive content. It enables students to be more engaged and motivated (Zhang and Aslan, 2021).

AI systems also enable automated grading thus enabling more time available to tutors for lesson planning and preparation (Adlawan, 2024; Baidoo-Anu and Ansah, 2023). The automation of assessment is shifting the role of the teacher to a facilitator (Holmes and Tuomi, 2022). Teachers can integrate AI lessons as supplementary materials to assistweak studentsand provide hands-on experiences inthe form of human interaction for students.AI systems also provide students with a judgment-free environment of learning and can suggest solutions to improve students' performance.

AI can also reduce the cost borne by educational institutes as it removes unnecessary work and automates processes which reduce the resource requirements (Adlawan, 2024; Tahiru, 2021). The reduced cost thus can be transferred to other stakeholders such as students. Overall, we can argue that AI use in the education field has benefits for learners, tutors, and educational institutes in terms of flexibility, increased learning, a focus on more important tasks, and increased efficiency.

## 5. AI CHALLENGES IN THE EDUCATION FIELD

There are certain challenges related to AI in education. Literature suggests that one of the key challenges for AI in education is related to ethics. The ethical issues that can arise while using AI in education are the issues of transparency, fairness, privacy, morality, and removal of bias (Garrett, Beard, and Fiesler,2020; Holmes and Tuomi, 2022; Kulet, Ilic, Dumangiu, Rankovic, Martins, Paun, and Mihoreanu, 2021). A relevant challenge of AI in education is students' privacy. Because students must interact with the AI-based system which can limit their privacy through aspects such as facial recognition and recommender system (Akgun and Greenhow, 2022). Student privacy can also be compromised if data captured by AI-based education systems lands in the wrong hands such as hackers. (Dignum, 2021; Kuleto, Ilic, Dumangiu, Rankovic, Martins, Paun, and Mihoreanu, 2021). Therefore, the privacy of users of AI-based education systems remains a challenge.

Another relevant issue is inclusion and ease of accessibility (Awofiranye, 2024; Pedro, Subosa, Rivas, and Valverde, 2019). This is because many individuals do not have equal access to technology which can create a disadvantageous position for such individuals. For example, many students in developing countries do not have access to a smart phone or internet connection which can put them in a disadvantageous position compared to those who have such facilities. Besides the socio-economic status of students, geographical location can also be a factor in access to AI-based education.

A big challenge related to the use of AI in education is dehumanize the learning experience (Adlawan, 2024; Kuleto et al.,2021; Luan, Geczy, Lai, Gobert, Yang, Ogata, and Tsai, 2020). A decreased dependence on teachers is a challenge since AI despite its capacity cannot replace the need for human

teachers. We put this argument since the teacher's role is important not only for education but also for shaping the students' careers. Therefore, AI brings a challenge as a decreased dependence on teachers means a decreased focus on students' moral and personality development (Chiu, Xia, Zhou, Chai, and Cheng, 2023).

A relevant challenge is the inadequate preparedness of tutors and educational institutes in general (Awofiranye, 2024; Chiu et al., 2023; Pedro et al., 2019). Implementing AI requires training a large number of tutors and educational managers to use the system which may not be an easier task. The educational system of many countries is not upto date to accommodate such change and thus it remains a challenge.

Another challenge is the in ability of students to explore their full potential (Awofiranye, 2024; Kuleto etal. 2021; Luan etal.2020).This is because if students start depending too much on AI – based education, it will limit their critical abilities including thinking, logic, and memory which is a big drawback. In other words, students will be depending too much on machines which can hinder their learning and making full use of their potential.

The cost factor related to AI is another challenge and cannot be ignored (Adlawani, 2024; Chiu et al., 2023; Luan et al., 2020). Provision of the initial outlays for software and cloud support is very costly for educational systems. Not only the costs for continuous employee training are expensive but also ongoing training of the AI system would be costly if organizational processes change. Since there are several technology options, hence it is a difficult decision to restrict the potential options to a few (Fahimirad and Kotamjani 2018; Chiu et al., 2023; Pedro et al., 2019). Overall, it can be argued that there are some subtle challenges related to the use of AI in the education field.

## 6. CONCLUSION

The conceptual paper discusses the role of AI in the education field. Our review of previous studies shows that AI in the education field is changing the landscape of education in the domains including course plan, delivery of courses, content creation and distribution, and soon. The application of AI in education delivery is customized and more flexible learning content along with the opportunity to interact with the system. The AI is thus empowering both the teaching staff and the students to become more in control by focusing on more important tasks while leaving the routine repeated simple tasks to the AI system. The key challenges we discussed included ethical issues related to AI in education, lack of human touch, data privacy issues, as well as the cost involved in developing AI systems. Overall, we can conclude that AI is revolutionizing the education field and bringing big changes along with some challenges that need to be addressed properly before real gains can be made.

## FUTURE DIRECTIONS

In the future, AI based systems such as the role of Chat GPT and similar AI-related tools will play a key role in future education. Therefore, future researchers can focus more specifically on Chat GPT's role in education. Similarly, Hybrid AI is the future direction, which represents joint intelligence from human beings and algorithms. To date, hybrid AI has gained less attention and started to be applied to some realistic applications, such as management. However, most of them are simple combinations of human and AI decisions. The way to better take advantage of humans and algorithms should be explored. (Lin and Hsu 2017)

After 2020, more studies documented treatment and control groups and used varied data analysis procedures (like structural equation modeling and ANOVA) (Chiu et al., 2023). In the future, we foresee that researchers will conduct more rigorous evidence-based research using quantitative and qualitative methods to critically examine the effectiveness of AI curricula. Lastly, there is insufficient research before 2021 to support the development of theoretical frame works for the teaching and

learning of AI. To advance the field of AITL, recent researchers have started to develop more theoretical frameworks (Long and Magerko, 2020) to guide educators in creating lesson designs that offer the most appropriate pedagogies and teaching tools for each AI training goal.

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