



Artificial Intelligence: Transforming Education for 21st Century Skills

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Abstract

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AIED,
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The purpose of this review paper was to determine the influence of artificial intelligence in education (AIED) on 21st century skills. The procedures for selecting and categorizing literature were as follows. Papers were collected using academic databases such as Science Direct, Scopus, and Google Scholar ("Artificial Intelligence" OR "AI" OR "AIED") and ("21st century skills" OR "6C"). The review period primarily covered the years 2012–2024. Thematic analysis was used based on Maximum Data Quality Assurance (MAXDQA). The results suggest that artificial intelligence in education has an impact on 21st century abilities (6C) such as character, citizenship, critical thinking, creativity, teamwork, and communication. AI approaches are used to address a variety of learning and education-related difficulties. AI not only helps students learn but also makes them work with it. This bidirectional process has both beneficial and detrimental effects on students' 21st century skills. Resolution of learners' learning difficulties can certainly be facilitated by AIED, but their ability for critical, creative, and moral thinking will be declined.

I. Introduction

Artificial intelligence (AI) use has become more and more popular. With the advent of software that can be used to create, synthesize, and analyze textual works, the phenomena of artificial intelligence's advancement are inevitable. Numerous circles advocate technological advancement since it can benefit people. Concurrently, there are a lot of concerns about the possibility of ethical violations in the areas of honesty and learning. According to Koo (2025), 3231 scholarly articles addressed the issue of ChatGPT in the educational setting from January 2023 to June 2024.

The discussion with regard to AIED's benefits and drawbacks raises interesting and diverse issues. In fact, many teachers who were born before 1980 questioned and refused to accept it. Rather than assessing whether students are utilizing this software effectively to accomplish their assignments, many educators are likely to be reluctant and unwilling to learn how to take advantage of it. Conversely, millennial educators (those born between 1980 and 2000) are motivated to seize the chances which it offers rather than being neutral. With the use of AI software, scholars can write without having to worry about constructing proper sentences and paragraphs. Millennials are mature enough to be productive, and knowledgeable enough to manage AIED. However, what about pupils who

are still maturing in age and proficiency?

In the meantime, learners need to be primed with 21st century skills (6C), which include critical thinking, culture, connectivity, creativity, collaboration, and communication—that are crucial for an individual who aspires to thrive in a rapidly evolving world. The implementation of 6C skills emphasizes an educational shift from merely enabling the mastering of content to fostering a holistic educational experience that integrates values and character development. This humanist approach seeks to prepare graduates, not just as workers but as responsible citizens who can contribute positively to society. Consequently, we enquire if the current development of AIED does have a positive effect on learners' 21st century skills?

II. Research Methods

This research was conducted as a review of recent and relevant literature. It mainly focused on synthesizing existing studies on the influence of AIED on the development of 21st century skills. The following processes were used to select and categorize literature. Science Direct, Scopus, and Google Scholar were the primarily academic databases used to collect papers. ("artificial intelligence" OR "AI" OR "AIED" and ("21st century skills" OR "6C"). The review period revolved around the years 2012–2024. With regard to the analysis, the Thematic analysis was performed using the MAXDQA (Maximum Diversity Qualitative Analysis) approach to identify and categorize key themes emerging from the literature.

III. Results and discussion

Given the fact that Artificial intelligence (AI) is becoming more and more common in daily life, it makes it easy and feasible for users to accomplish different tasks. ChatGPT, a trained language model program, is an example. It allows users to give different commands and receive responses as if they were speaking to a real person. Furthermore, many aspects of artificial intelligence still benefit other facets of life. AI can be a threat to certain professions, despite its benefits, which include increasing productivity and efficiency. AI is beginning to replace some occupations and skills. Additionally, there are still a lot of aspects of artificial intelligence that directly benefit several facets of life. While AI has the potential to improve productivity and efficiency, it can also risk making certain employees experience a threat of jeopardize. AI is in its path to replace some occupations and skills.

AIED toward 21st Century Skills

a. *The Use of AI in the Learning Process*

According to Chiu et al, (2023), the application of AI on student learning can be achieved via four ways, namely, (i) assigning tasks based on individual competence, (ii) providing human-machine conversations, (iii) analyzing student work for feedback, and (iv) increasing adaptability and interactivity in digital environments.

Assigning assignments based on individual ability implies that tasks for student learning have been purposefully constructed to personally utilizing AI-powered settings. The greatest barrier to individualized learning provided by AI technologies is a shortage of sufficient learning resources, both in terms of technology and implementation (Hirankerd and Kittisunthonphisarn, 2020; Munawar et al., 2018; Yang & Shulruf, 2019).

Most researches used interactive books and AI chatbots to promote human-machine dialogues in which students are likely to discuss their learning with computers. Artificial intelligence techniques simulate human thought processes by using structures that incorporate the knowledge and experience of human specialists. According to Chew and Chua (2020), Kim et al. (2021), Koc-Januchta et al. (2020), Palasundram et al. (2019), and Vazquez-Cano et al. (2021), these techniques have been utilized to develop AI chatbots and language learning books that assist students in developing their own communication abilities through continuous interaction. A question-and-answer structure was used to engage pupils with AI bots. For most students so far, this has been a pleasant and practical approach to find answers to basic issues.

According to Fu et al., (2020) and Porter & Grippa, (2020), feedback analysis of student work is nothing but another popular and prominent feature of AI. In other words, AI provides students with timely guidance and feedback by constructively evaluating their work and learning processes. Bonneton-Botte et al. (2020) employed an

AI notebook application to recognize and learn about kindergarten kids' handwritten text before assessing its dynamical properties (segment shape, order, and direction). At the end of every writing session, the students receive constructive feedback from the application. In order to enhance the attention given to autistic students, Vahabzadeh et al. (2018) used AI-enabled smart glasses to track their socially conscious emotions and behaviors. As digital environments have become more flexible and interactive, artificial intelligence (AI) technologies have been employed to gather information on student learning and facilitate interactions. An innovative e-learning environment was developed for engineering students by Samarakou et al. (2015). In order to profile learners, Westera et al. (2020) employed strategies such as face emotion recognition, stealth evaluation, and automatic difficulty adaption. They also created non-playing characters using lip-synchronized speech and nonverbal body motion. The student profiles and personas improved the flexibility and engagement of the learning process. However, most research concentrated on the development and deployment of AI-supported digital environments and did not investigate the impact of these environments on student learning outcomes.

b. The Use of AI to enhance facilitation of Learning

According to Chiu et al. (2023), artificial intelligence has been tasked with three main tasks: assisting instructors with their own professional growth, improving their teaching skills, and offering flexible teaching methods in the classroom. AI has been utilized to enhance professional development for instructors as well as to support instruction (Gunawan et al., 2021; Lampos et al., 2021). Teachers have received feedback on their instruction from AI agents that examined real-time classroom data, including their answers to diagnostic assessments of their pedagogical material understanding as well as their behavior and questioning abilities. Additionally, models for teacher evaluation have been developed using instructional data (Hu, 2021). Due to AI assessors' objectivity, teachers are less likely to take offense at criticism and are encouraged to think critically about their teaching strategies. Application of AI in teacher professional development is still in its infancy, only one of the reviewed studies were primarily about teachers' professional development (Gunawan et al., 2021).

AI and computer-assisted instruction have been utilized to help teachers manage their classroom instruction, hence improving their teaching abilities (Yang, Oh, & Wang, 2020; Jaiswal & Arun, 2021; Nabiyeve et al., 2013; Wang & Zheng, 2020; Zhang, 2021). Artificial intelligence (AI) technology has been utilized to help teaching in a variety of topic classrooms (such as physical and linguistic education) by effectively uploading, assigning, and distributing learning materials and tasks, as well as by voicing out text-based difficulties. These applications have significantly improved teachers' abilities to effectively manage classrooms (Gupta & Bhaskar, 2020; Huang et al., 2021; Jarke & Macgilchrist, 2021).

Intelligent tutoring systems aim to provide adaptable teaching tactics in the classroom by suggesting courses and activities that are appropriate for teaching and learning needs. In order to provide teachers of autistic children with suggestions for effective communication techniques, Lampos et al. (2021) examined the responses and traits of the students. Standen et al. (2020) and Luo (2020) employed AI systems and multimodal sensor data to ascertain students' affective states and help teachers choose the best communication, teaching, and content presenting techniques. Teachers changed the way they taught in response to the immediate feedback that an academic writing software program gave them about how each student and class processed the course material. Nevertheless, our research identified two significant challenges in this field. First of all, there is no real-world testing and objective evaluation of these sophisticated systems. In their studies, some researchers identified two limitations inhibiting development: a short experiment period and a shortage of volunteers. Second, the lack of any standards for judging these systems' efficacy hinders both the objective assessment of these systems and the useful development of related technology.

c. The Use of AI in the Assessment Process

In the realm of assessment, AI has been assigned two key responsibilities: predicting student achievement and delivering automatic marking. Predicting student success appears to have become easier with AI technology, particularly in online education (Akmese et al., 2021; Costa-Mendes et al., 2021; Yu, 2021). These researchers have shown that by examining how much and how well students participate in learning activities such as forum discussions,

they can predict how well students would perform in online courses. Because there are no active teachers in most distance education, this capability is critical. However, it is challenging to choose the data to inform predictions. Costa-Mendes et al. (2021) contended that AI predictive models may be incompatible with student data utilized in classical statistics. For example, current AI models could not effectively depict socioeconomic characteristics based on current data on scholarship help, family income support, and county socioeconomic status.

In terms of accuracy, speed, and safety while grading tests and exams, AI-enhanced grading systems surpassed teachers, even if they offered automatic marking mean for language writing and speaking as well as mathematics. For formative feedback in online learning, the systems might also provide instantaneous marks. It is clear that this AI application is still in its early stages because the accounts of the automated grading and marking were mainly limited to a few disciplines and domains, such language acquisition. It would be quite challenging to use the technology in real-world educational environments (Sun, 2021; Fu et al., 2020; Kumar & Boulanger, 2020).

AI is thus affecting not just the teaching and learning process but also the assessment and grading process. AI, for example, quickly compares research projects and assignments using Turnitin and other technologies. As a result, it becomes easy and simple to judge whether a learner plagiarized. Likewise, assignments with criteria and scales can be accompanied by online rubrics and grading forms, and final grades are seamlessly appended to the submitted work (Mahana et al., 2012). Additionally, AI provides learners with more privacy and autonomy, simple access in a relaxed manner at any time, and engaging ways to give constructive comments. The instructor can also write or record criticism to help learners learn from their identified mistakes.

Additionally, according to a Stanford University study, AI is used to assess student responses and build a computer model that supports guidelines derived from the tutor's grading decisions. AI is unique in that it enhances learning rather than rendering a final, authoritative judgment. Furthermore, it exhibits increased openness, confidence, and quality assurance (Stanford University, 2019). In the same vein, Tovia Smith contends in her article "More states opting to Robo-Grade' Student Essays by computer" that robo-graders—robots used to grade student papers—are becoming more and more common in Utah, Ohio, and soon Massachusetts (Brad Rose Consulting, 2019). Similarly, Peter Foltz, a research professor at Colorado University, claims that their AI methods are quite accurate at evaluating essays and can evaluate up to 100 aspects (Brad Rose Consulting, 2019). In brief, the assessment and categorization of higher education in the United States of America is increasingly influenced by artificial intelligence. Although the aforementioned researches are useful from several angles when discussing how AI can be used to grade and assess students and support the job of the instructor, a critical thinker would not overlook the following queries: How about prejudice in report marking? Who would ensure the objectivity and fairness of AI? What about the human aspect of evaluation and learning? Will AI take into account the psychology of students when assigning grades or evaluating papers?

d. *The Use of AI in the Administration Process*

According to Chiu et al. (2023), artificial intelligence serves three main purposes in administration: (i) improving management platform performance; (ii) offering tailored and convenient services; and (iii) offering evidence-based support for educational decision-making. It can improve the management platforms' performance in addition to making these platforms more secure by incorporating a facial authentication feature for portal management and exams, assigning AI-enabled routines to tasks like managing personnel data and scheduling courses also increased their efficiency for administrators (Khan & Alotaibi, 2020; Li, 2021; Liu & Wu, 2019).

AI-powered personalized academic and non-academic recommendations have increased staff efficiency and the quality of their inputs by offering convenient and customized services. AI systems can do some administrative duties in place of employees. However, a recurrent problem mentioned in all investigations was the low accuracy of the user models. Intelligent suggestions are predicated on the notion that algorithms can construct user models, despite the fact that the research included data like age, gender, and behavior (Li, 2021).

By providing evidence-based support for educational decision-making, AI technologies have given management teams and educational administrators the ability to support their choices on offer with data. AI agents that have access to big data can help students choose their courses, forecast the possibility that individuals would drop out of school, and discover the factors influencing students' academic success (Cukurova et al., 2019; Tsai et al., 2020). Consequently, AI can supply data for administrative and academic decision-making. However, the applications

in this field have the same challenges as those in other AI jobs (such as finding and choosing appropriate data for predictive models).

Negative Influence

Like any other technology, artificial intelligence (AI) has the potential to affect educational systems, but how this technology is employed and implemented will determine its influence. In order to guarantee that AI is applied in ways that benefit all students, it is crucial to thoroughly examine the possible effects of AI on educational systems and to collaborate with educators.

1. Teachers and learners will be less active. It occurs because the majority of actions are performed automatically by AI (Zawacki-Richter et al, 2019).
2. Human occupations are being eliminated. When Ai is utilized for administrative matters at school, it is possible that it will replace the position of administration (Wang & Cheng, 2021).
3. Lack of common sense. Like humans, AI is capable of learning and working independently. The AI simply does not comprehend the reason for the creation of the data, because only humans are capable of having a complete comprehension (Zawacki- Richter et al, 2019).
4. Following the directions. AI will operate based on the program settings that are created. AI cannot perform jobs beyond those that are programmed in order for it to operate in accordance with data and instructions that have been entered for particular tasks.
5. AI is still not as good as vertical information processing that needs sophisticated senses. Up until now, AI has only been able to perform simultaneous activities that are repetitive or routine. Although AI is capable of learning on its own, it will operate particularly in accordance with the data and input that have been designed. For instance, AI that is designed to improve student learning outcomes is unable to perform other tasks like locating materials and educational resources.
6. Cracking risk is high. AI uses online and digital data and information storage. This increases the likelihood that critical data may be compromised by careless and dangerous individuals.
7. Without a doubt, it will fail. All human-made things, particularly machinery and technology, will eventually break down. Similarly, AI systems are susceptible to disruption or damage that could result in the loss of your crucial data and information. Therefore, always make sure that crucial information and data are copied.

Adopting new innovations in the sphere of education is crucial, but we must acknowledge that everything new, particularly in the context of technology, will always have both positive and negative effects. Therefore, it makes sense for someone who works in education to make good use of the current technologies.

The Influence of AI/ED on 21st Century Skills

With the rise of automation and artificial intelligence in this century, employment requiring hard talents will become less common, and the need for soft skills will increase. In order to succeed in the workplace and in society, people must therefore master soft skills in addition to knowledge and technology. According to Purnami and Rohayati (2013), soft skills are the interpersonal abilities and character attributes that define a person's interaction with another person. Soft skills are collections of socially acceptable personality attributes that define interpersonal connections, such as language, communication, personal routines, friendliness, and optimism.

With regard to Aslan (2015) and Binkley et al. (2012), the 6 Cs of soft skills in the twenty-first century are critical thinking, teamwork, communication, creativity, culture, and connectedness. The process of filtering, analyzing, and challenging all information that one may encounter is known as critical thinking. Collaboration is the process by which individuals use their diverse personalities, skills, and knowledge to cooperate and create something new. The ability to express concepts and information in a meaningful and understandable manner is referred to as communication. The term "creativity" describes a person's capacity to apply their skills and/or knowledge to make something novel or in a novel manner. Culture refers to a person's ability to relate to everything around them, to understand and respect their origins, as well as the values and ideas held by individuals in their society and history. Individuals' connectivity is defined as their ability to stay linked to the world at all times (Rotherham & Willingham, 2009; Scardamalia, 2012; Ananiadou & Claro, 2009).

The 6C skills are extremely useful for success in the workplace and society. Therefore, there should be an organized effort to develop them in schools, particularly at the university level. This is consistent with one of the aims of higher education, which is to develop students' ability to become human beings who believe in and fear God Almighty, as well as noble, healthy, knowledgeable, capable, creative, independent, skillful, competent, and cultured individuals who assist the nation. As a result, the 6C skills must be integrated into instruction so that students may behave appropriately, be prepared to enter the workforce, and be effective and successful.

AI has been employed in a variety of disciplines, including education. However, the advancement of AI technology presents problems to the nation and state. One of the most significant challenges of AI is the loss of jobs. In recent years, AI has taken over routine and easy activities that people used to undertake. It causes many individuals to lose their jobs and creates social and economic concerns. In addition to economic considerations, the deployment of AI raises ethical issues. As a technology capable of making its own judgments, AI must be built with the appropriate moral standards. However, this is not always straightforward to accomplish.

Another issue facing the country and state is the development of local AI technologies. The majority of AI technology today is imported. It results in a lack of creativity in the creation of domestic AI technologies as well as reliance on foreign technologies. Government backing and funding for the study and advancement of regional AI technology are required to meet this issue. As a result, governments can create AI technologies that are more autonomous and creative. cutting-edge AI technology that genuinely enhances 21st century competencies (Anugerahwati, 2019). ... order to prevent advancements in this age of artificial intelligence from upsetting educators and pupils. In particular, students will be prepared to handle this status quo of our society in Morocco.

IV. Conclusion

Government should take initiatives to regulate or restrict the application of AI technology in the field of education. In order to ensure the ethical, open, and lawful use of AI technology while preserving the general welfare, laws, regulations, or safety standards may be implemented. Biased or insufficient data can occasionally be used by artificial intelligence systems. These biases can influence the decision and performance of AI systems. It is possible for humans to become so reliant on artificial intelligence that they lose the ability to think critically and solve problems independently.

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