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Fostering or Hindering: A Systematic Review on the Influence of Artificial Intelligence in Education

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Abstract

This review paper aims to examine the influence of Artificial Intelligence in Education (AIED) on the development of 21st century skills. A systematic literature search was conducted using academic databases including Science Direct, Scopus, and Google Scholar, employing keyword combinations such as "Artificial Intelligence", "AI", "6C skills", which cover the publications primarily from 2012 to 2024. Thematic analysis was performed following the Maximum Data Quality Assurance framework to ensure rigorous categorization and interpretation of the selected studies. The findings indicate that AIED significantly affects the 6C skills—namely character, citizenship, critical thinking, creativity, collaboration, and communication. AI technologies are increasingly employed to address diverse educational challenges and enhance learning processes. However, the relationship between AI and skill development is bidirectional: while AI facilitates personalized learning and supports students with learning difficulties, it also presents certain risks. Specifically, overreliance on AI tools may lead to a decline in learners' critical thinking, creativity, and moral reasoning abilities. This review highlights the dual-edged nature of AIED, underscoring the need for balanced integration that maximizes benefits while mitigating potential drawbacks to 21st century skill development.

1. Introduction

The proliferation of artificial intelligence (AI) has become increasingly pervasive across various domains of human activity. With the emergence of sophisticated software capable of generating, synthesizing, and analyzing textual content, the advancement of AI technologies represents an inevitable developmental trajectory. While numerous stakeholders advocate for technological progress given its potential benefits to society, concomitant concerns have arisen regarding possible ethical transgressions, particularly in relation to academic integrity and authentic learning processes. A comprehensive literature search conducted using Publish or Perish software revealed that over the course of one year, 146 scholarly articles addressed the integration of ChatGPT within educational contexts, underscoring the growing academic attention to this phenomenon.

The discourse surrounding the advantages and disadvantages of Artificial Intelligence in Education (AIED) constitutes a complex and multifaceted area of inquiry. Notably, generational differences emerge in educators' responses to AIED integration. Many educators belonging to the Baby Boomer generation (born prior to 1980) have expressed skepticism and resistance toward AI technologies. Rather than investigating how students might utilize AI

software to complete academic assignments, these educators tend to exhibit reluctance in acquiring the competencies necessary to leverage these tools effectively. Conversely, Millennial educators (born between 1980 and 2000) demonstrate greater motivation to capitalize on emerging opportunities rather than maintaining neutral or resistant positions. For scholars and mature users, AI software facilitates academic writing by reducing cognitive load associated with sentence construction and paragraph organization. Millennials, possessing both developmental maturity and adequate digital literacy, appear better positioned to manage AIED tools productively. However, this raises a critical question: What implications arise for students who are still developing both cognitively and in terms of academic proficiency?

Concurrently, contemporary learners require deliberate preparation in 21st century learning skills—commonly conceptualized as the 6C skills (Bulkis et al., 2025) encompassing critical thinking, creativity, collaboration, communication, citizenship (culture), and connectivity. These skills are essential for thriving in an era of rapid technological and social transformation. The implementation of 6C skills represents a pedagogical shift from mere content mastery toward fostering holistic educational experiences that integrate values, character development, and ethical reasoning. This humanistic approach aims to prepare students not exclusively as future workers but as responsible citizens capable of contributing meaningfully to society. Given this educational imperative, a fundamental question emerges: Does the current trajectory of AIED development positively influence learners' acquisition and cultivation of 21st century skills? This inquiry forms the central focus of the present research.

2. Methodology

The present study employed a systematic literature review as its primary research methodology. This approach was selected as the most appropriate means of achieving the research objective, namely, to synthesize and critically evaluate existing empirical and theoretical scholarship concerning the influence of AIED on the cultivation of 21st century competencies. A systematic review methodology enables the consolidation of findings from disparate studies, facilitating the identification of prevailing trends, thematic convergences, and research gaps within a rapidly evolving interdisciplinary field. By aggregating and analyzing a broad corpus of scholarly work, this review aims to provide a comprehensive and nuanced understanding of the complex relationship between AIED implementation and the development of essential skills for contemporary learners.

The process of identifying and selecting relevant literature was conducted through a rigorous and structured search strategy. To ensure comprehensive coverage of the multidisciplinary landscape encompassing educational technology, artificial intelligence, and skills development, three primary academic databases were utilized: Science Direct, Scopus, and Google Scholar. These databases were selected for their extensive repositories of peer-reviewed journals, conference proceedings, and scholarly books, thereby providing a robust foundation for the literature collection process.

The search strategy employed a combination of Boolean operators and keywords to maximize the retrieval of pertinent studies. The primary search string was constructed as follows: "Artificial Intelligence", "AI", "AIED", "21st century learning", "6C". This syntax was designed to capture literature addressing both the technological focus of the investigation (artificial intelligence in educational contexts) and the outcome variable of interest (21st century competencies, conceptualized through frameworks such as the 6C model encompassing critical thinking, creativity, collaboration, communication, citizenship, and character). The search was applied to titles, abstracts, and keywords to ensure relevance.

The scope of the literature search was delimited to a specific temporal frame to ensure the currency and contemporary relevance of the findings while allowing for the identification of developmental trends in the field. The review period primarily encompassed scholarly works published between the years 2013 and 2023. This decade-long timeframe was strategically

selected to capture the period of most significant acceleration in both the development of AI technologies applicable to education and the corresponding scholarly discourse on their pedagogical implications.

The analysis of the collected literature was conducted using thematic analysis, a qualitative method well-suited for identifying, organizing, and interpreting patterns of meaning within a body of textual data. To enhance the rigor and trustworthiness of the analytical process, the study employed the Maximum Diversity Qualitative Analysis (MAXDQA) approach. This methodological framework guided the systematic categorization and interpretation of key themes emerging from the literature. The MAXDQA approach is particularly appropriate for literature reviews in emerging and interdisciplinary fields, as it encourages the inclusion and synthesis of diverse perspectives, methodologies, and findings.

3. 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 one of them. This latter 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 benefit several facets of life. While AI has the potential to improve productivity and efficiency, it can also make certain employees under a jeopardize risk. AI is in its path to replace some occupations and skills.

4. Literature Review of the AIED toward 21st Century Skills

4.1 The Use of AI in the Learning Process

According to Chiu et al. (2023), the application of AI to 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 personalized utilizing AI-powered settings. The major 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 research used interactive books and AI chatbots to promote human-machine dialogues, in which students 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 communication abilities through continuous interaction. A question-and-answer structure was used to engage pupils with AI bots. For most students, this was a pleasant and practical approach to find answers to basic issues.

Regarding feedback, Fu et al. (2020) and Porter & Grippa (2020) note that feedback analysis of student work is another prominent feature of AI. In other words, AI provides students with timely guidance and feedback by evaluating their work and learning processes. Bonneton-Botte et al. (2020) employed an AI notebook application to recognize and learn about kindergarten kids' handwriting 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. To enhance the attention of 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, AI technologies have been employed to gather information on student learning and facilitate interactions. Samarakou et al. (2015) developed an innovative e-learning environment for engineering students. To profile learners, Westera et al. (2020) employed strategies such as face emotion recognition, stealth evaluation, and automatic difficulty adaptation. 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, with little investigation into their impact on student learning outcomes.

Beyond personalization and feedback automation, research in Artificial Intelligence in Education (AIED) emphasizes the importance of pedagogical alignment, ethical oversight, and human-centered design. Zawacki-Richter et al. (2019) found that much of the literature prioritizes technological efficiency over long-term learning outcomes and social implications. Similarly, Holmes et al. (2019) argue that AI should augment rather than replace human teaching, highlighting the need for transparency and teacher oversight. From a learning sciences perspective, Roll and Wylie (2016) caution that excessive automation may limit the development of students' self-regulation skills. In the same vein, Luckin et al. (2016) advocate for AI systems that enhance creativity, collaboration, and critical thinking while preserving learner autonomy. Together, these perspectives suggest that the value of AI in education depends not only on technological sophistication but also on thoughtful, human-centered implementation.

4.2 The Use of AI in the Teaching Process

According to Chiu et al. (2023), AI serves three main roles in education: assisting instructors with their professional growth, improving their teaching skills, and offering flexible teaching methods in the classroom. AI has been utilized both to enhance professional development for instructors and to support instruction (Gunawan et al., 2021; Lampos et al., 2021). Teachers received feedback on their instruction from AI agents that examined real-time classroom data, including their responses to diagnostic assessments of their pedagogical material understanding as well as their behavior and questioning skills.

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. Nevertheless, AI applications in teacher professional development are still in their infancy, as only one of the reviewed studies primarily focused on this area (Gunawan et al., 2021).

AI and computer-assisted instruction have also been utilized to help teachers manage classroom instruction, thereby improving their teaching abilities (Yang, Oh, & Wang, 2020; Jaiswal & Arun, 2021; Nabiyev et al., 2013; Wang & Zheng, 2020; Zhang, 2021). AI technology has been used across various subject classrooms (such as physical and linguistic education) by effectively uploading, assigning, and distributing learning materials and tasks, as well as by vocalizing text-based difficulties. These applications have significantly improved teachers' abilities to manage classrooms efficiently (Gupta & Bhaskar, 2020; Huang et al., 2021; Jarke & Macgilchrist, 2021).

Intelligent tutoring systems aim to provide adaptable teaching tactics in the classroom by recommending courses and activities suitable for teaching needs. To provide teachers of autistic children with suggestions for effective communication techniques, Lampos et al. (2021) examined student responses and traits. Standen et al. (2018) and Luo (2020) used AI systems and multimodal sensor data to determine students' affective states and help teachers choose the best communication, teaching, and content presentation methods. Teachers adjusted their teaching in response to immediate feedback provided by academic writing software on how each student and class processed the course material.

However, research identified two significant challenges in this field. First, there is a lack of real-world testing of these sophisticated systems. Some researchers noted two limitations in their studies: short experiment periods and a shortage of volunteers. Second, the absence of standards for judging these systems' efficacy hinders both objective assessment and the effective development of related technology.

4.3 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). They 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 teachers in distant education, this capability is critical. However, it is challenging to choose data for predictions. Costa-Mendes et al. (2021) contended that AI predictive models may be incompatible with student data utilized in classical statistics.

In terms of accuracy, speed, and safety while grading tests and exams, AI-enhanced grading systems surpassed teachers, even if they offered automatic marking 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 majority of the automated grading and marking was limited to a few disciplines and domains, such as 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 affects 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 to billions of resources. As a result, it becomes easy and simple to judge whether a learner plagiarized. Likewise, assignments with criteria and scales are 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.

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). 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.

4.4 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. Improving 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, 2020; Liu & Wu, 2019; Li, 2020).

AI-powered personalized academic and non-academic recommendations have increased staff efficiency and quality by offering convenient and customized services. AI systems can do some administrative duties in place of employees. However, a recurrent problem in all investigations

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

While AI enhances administrative efficiency and evidence-based decision-making, it also raises concerns regarding fairness, bias, and inclusivity. Predictive algorithms and AI-driven recommendations may unintentionally favor certain student demographics if the training data is incomplete or unrepresentative (Baker & Inventado, 2014; Holmes et al., 2019). To prevent inequitable outcomes, transparency in AI models and continuous auditing are essential, alongside human oversight to validate and contextualize AI-generated insights (Zawacki-Richter et al., 2019). Moreover, AI should be implemented to complement human decision-making rather than replace it entirely. Integrating human expertise ensures that administrative choices are both ethical and contextually appropriate across diverse institutional settings (Cukurova et al., 2019; Tsai et al., 2020).

Table 1. Illustrative Alignment of AI Applications with 6C Competencies

AI Application	6C Skill(s) Supported	Description
Adaptive Learning Systems	Critical Thinking, Collaboration	Personalizes tasks and problem-solving exercises
AI Chatbots for Learning	Communication, Creativity	Enhances human-machine interaction and conversation
Automated Feedback Systems	Critical Thinking, Connectivity	Provides timely evaluation of work
Intelligent Tutoring Systems	Collaboration, Culture	Suggests learning paths tailored to students' needs
AI Administrative Assistants	Connectivity, Citizenship	Manages schedules, personalizes recommendations
Predictive Assessment Models	Critical Thinking, Communication	Analyzes student performance and predicts outcomes

5. The Influence of AIED 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 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 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).

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. Among the main concerns identified in the literature are: teachers and learners becoming less active as the majority of actions are performed automatically by AI (Zawacki-Richter et al., 2019); the elimination of human occupations when AI is utilized for administrative matters at school (Wang & Cheng, 2021); the lack of common sense, as AI simply does not comprehend the reason for the creation of data; the fact that AI will operate only based on program settings and cannot perform jobs beyond those that are programmed; and finally, the high cracking risk, as AI uses online and digital data and information storage, which increases the likelihood that critical data may be compromised.

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.

6. Conclusion

The dynamic nature of AI technology, combined with educational complexity, necessitates ongoing assessment of AI's impacts on learning outcomes and student development. Governments and educational authorities should establish regular monitoring and evaluation frameworks systematically examining how AI integration affects academic achievement, skill development, student engagement, and educational equity. Such frameworks should generate evidence informing continuous improvement of both AI systems and governing policies. Particular attention should prevent overreliance on technology, which may manifest through students becoming dependent on AI assistance for tasks they should learn independently,

educators deferring excessively to AI recommendations, or institutions prioritizing technological solutions over human resource investments.

Longitudinal research designs are essential for understanding how AI integration affects educational outcomes over time, including delayed effects not apparent in short-term evaluations. Research should examine not only aggregate outcomes but also differential impacts across student subgroups, ensuring AI implementation does not inadvertently create or exacerbate educational disparities. Findings should be disseminated widely to inform practice and policy, contributing to an evidence base that grows increasingly robust as AI becomes more prevalent in educational settings.

The integration of artificial intelligence into education represents a transformative development requiring deliberate, informed, and ethically grounded governance. Governments must lead in establishing regulatory frameworks promoting accountability and fairness, addressing algorithmic bias through rigorous data governance, and affirming that AI serves as a supportive tool rather than replacement for human cognition. Through such comprehensive governance approaches, societies can harness AI's educational potential while safeguarding the human development that remains education's fundamental purpose.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article. The research was conducted independently, without any financial or personal relationships that could inappropriately influence the work.

Ethical Approval

This study was conducted in accordance with ethical standards. All participants were informed about the purpose of the research and gave their voluntary consent to take part. Confidentiality and anonymity were ensured throughout the study.

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