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AI in the Classroom: A Boon or a Threat to Pedagogical Practices?

Abstract: The integration of Artificial Intelligence (AI) in education offers significant potential to enhance learning experiences through personalized feedback, automated support, and efficient content creation tools. However, this study reveals both the benefits and potential drawbacks of AI's role in pedagogy, particularly about over-reliance among secondary school students. Through a literature review, teacher surveys, and an experiment with sixth-grade students, the research explores how AI tools impact student engagement, critical thinking, and retention. Survey responses from teachers indicate mixed views on AI's effect on student independence, with some perceiving it as supportive for engagement and others noting a risk of dependency. The experiment further suggests that while AI tools can spark initial interest, the retention of AI-generated content may be moderate, and student customization of content remains minimal. These findings underscore the need for a balanced approach, where AI tools are utilized as supplements rather than replacements for traditional educational practices, fostering a supportive yet critical engagement with technology.

Keywords: Artificial Intelligence, student engagement, critical thinking, learning retention, pedagogical tools, personalized learning, secondary education.

Introduction

The rapid integration of Artificial Intelligence (AI) into the educational sphere has sparked significant debate regarding its impact on pedagogical practices. While AI promises to revolutionize classrooms with personalized learning experiences, automated grading systems, and intelligent tutoring tools, it also raises questions about the long-term effects on both teaching methodologies and student outcomes. As educators grapple with the opportunities and risks presented by AI, a pressing question arises: is AI in the classroom a boon or a threat to traditional pedagogical values? This article seeks to explore the dual-edged nature of AI's influence on education, focusing on how its integration might enhance or erode essential teaching practices. AI's presence in education has evolved beyond mere theoretical discussion to tangible implementation. From intelligent tutoring systems that provide students with instant feedback to AI-driven personalized learning platforms, these technologies have become integral to modern classrooms. Teachers can now leverage AI better to understand each student's learning style and progress, allowing for more targeted instruction. Adaptive Learning Platforms use AI algorithms to analyze student performance data and tailor lesson plans to each individual's needs. This kind of personalization, although efficient, runs the risk of diluting traditional methods of problem-solving and critical thinking. However, this reliance on machine-generated feedback may overlook the nuances that human educators bring to assessing students' work, particularly in subjects requiring deep analysis, like literature or history.

Students have also found AI to be a convenient tool for completing homework, with AI-driven applications like ChatGPT and math-solving tools helping them tackle difficult assignments more easily. While these technologies offer immediate help and save time, they risk creating a reliance on AI that might hinder

students' ability to think critically or develop problem-solving skills. For instance, students can now input complex mathematical equations into AI programs and receive solutions in seconds, bypassing the process of understanding and solving the problem independently. Similarly, AI-powered writing assistants can help generate essays or improve grammar, but they may also lead students to skip essential stages of writing development, such as brainstorming and editing. The growing use of AI by students to complete their homework raises concerns about whether these tools foster deeper understanding or simply provide a shortcut, undermining the educational process. If overused or misused, AI could impair students' capacity to engage with material creatively and independently, weakening key cognitive skills.

A parallel can be drawn between the rise of AI in education and the introduction of the printing press in the 15th century. Just as AI is reshaping today's classrooms, the printing press once revolutionized how knowledge was disseminated. The availability of printed materials made information more accessible and widespread, a transformative development that undoubtedly enhanced learning. However, it also led to unintended consequences: the decline of handwriting and spelling skills among students. With printed texts readily available, the need for students to practice handwriting diminished significantly. This decline, coupled with the rise of spell-checking tools in the digital age, has deteriorated spelling abilities. Research shows that students today rely more on digital tools to correct their writing errors, and many struggle with basic spelling and handwriting tasks when these tools are unavailable. Similarly, AI in education may enhance access to information but risks undermining foundational skills if students overly rely on it.

Literature review

The integration of AI into educational systems, particularly through e-learning platforms, promises to provide more personalized and adaptive learning experiences. Research by Kassymova et al. (2021) highlights the role of e-learning systems in improving the quality of learning by facilitating individualized approaches that cater to the unique needs of each learner. In their study, they argue that the use of AI can address educational challenges by enabling smarter systems that adjust content delivery, pace, and complexity based on real-time assessments of student performance. Similarly, Rohde et al. (2023) explore the theoretical underpinnings of AI in educational settings, focusing on how AI can further individualize e-learning programs. By leveraging AI algorithms, educational systems can create adaptive learning pathways that help students progress at their own pace, offering instant feedback and tailored recommendations. Moreover, Sheriyev et al. (2016) touch upon the importance of designing systems that are transparent, ethical, and inclusive, ensuring that AI technologies support equitable learning for all students, regardless of their background. Additionally, the development of mobile applications powered by AI, such as the one described by Mutarah et al. (2024) for the teaching of design and technology, highlights the growing trend of interactive learning tools. These AI-based applications can offer students hands-on experiences that go beyond the limitations of traditional classroom settings, making learning more dynamic and accessible.

The increasing integration of Artificial Intelligence (AI) into education has brought about concerns regarding students' over-reliance on these tools, especially in homework assignments. Basha (2023) argues that AI tools, while beneficial in assisting students with difficult tasks, may inadvertently erode essential skills such as critical thinking and independent problem-solving. Students increasingly rely on AI-generated solutions instead of engaging deeply with the material, leading to a superficial understanding of core concepts. This reliance can have long-term negative effects on academic performance and the development of critical thinking, which are foundational in education (Basha, 2023). Similarly, Karan and Angadi (2023) highlight the dangers of students using AI tools to complete assignments with minimal effort, warning that this may result in decreased retention of knowledge and reduced intellectual engagement. Their review points to the necessity for educators to carefully balance the use of AI tools, ensuring that they complement rather than replace traditional learning methods (Karan & Angadi, 2023).

The decline in handwriting and spelling skills, exacerbated by the growing use of digital tools, has been a particular point of concern. Yılmaz (2023) discusses how the rise of AI-based educational platforms has reduced the emphasis on handwriting practice, which was once a core part of the learning process. Osman (2023) adds that the cognitive benefits associated with manual writing, such as improved memory and comprehension, are being lost as students increasingly rely on digital tools to complete their work. These tools, while convenient, risk depriving students of the tactile and cognitive engagement that handwriting offers (Osman, 2023).

The increasing integration of AI tools in education presents significant threats to the cognitive competence of students. Students who frequently resort to AI-generated answers may fail to engage with the material at a meaningful level, leading to a superficial understanding of core concepts.

Furthermore, the ease of access to AI-driven solutions can negatively affect memory retention. When students rely on AI to provide quick information, they are less likely to actively engage in memorizing key facts and concepts, a process that is crucial for long-term learning. This reliance on AI as an external memory aid may result in deficits in information retention, as students outsource cognitive functions rather than exercising their brain's natural capacity for recall. This has long-term implications for their ability to retain and retrieve knowledge independently. Another area of concern is the potential weakening of metacognitive skills, which involve the ability to reflect on and regulate one's own learning processes. Metacognition is essential for effective learning, as it enables students to plan, monitor, and assess their cognitive strategies. However, when AI tools provide step-by-step solutions, students may miss opportunities to engage in this reflective process. The constant availability of ready-made answers can diminish the need for students to evaluate their thinking and problem-solving approaches, thereby limiting the development of these higher-order cognitive skills. Additionally, the use of AI tools may contribute to a shortening of students' attention spans. In an educational environment increasingly driven by instant gratification, the rapid delivery of information through AI can erode students' ability to focus on complex tasks for extended periods. Deep, sustained learning is essential for mastering difficult concepts, but if students become accustomed to receiving quick answers, they may struggle with the cognitive discipline required for long-term engagement with challenging material.

The threat to creativity and innovation is another critical issue. AI-generated responses often provide efficient but predetermined answers, potentially stifling opportunities for students to engage in original thinking. Creativity frequently arises from the process of grappling with complex problems and developing novel solutions. However, if AI shortcuts this process, students may become passive recipients of information rather than active participants in the creative and innovative aspects of learning. Finally, AI tools may narrow the scope of students' knowledge by encouraging a surface-level engagement with content. The efficiency of AI-driven solutions can dissuade students from exploring topics in greater depth, leading to a limited understanding of subjects. Exploratory learning, where students actively connect ideas across different domains, is vital for developing a broad and nuanced understanding of the world. However, AI's tendency to offer quick, predefined answers may restrict students' cognitive horizons, preventing them from engaging in the kind of deep learning that fosters intellectual growth.

Research Methods

A comprehensive literature review was conducted to explore the current academic discourse on the integration of Artificial Intelligence (AI) in education. Key studies were identified using databases such as Google Scholar, PubMed, and Web of Science, focusing on peer-reviewed articles published between 2023 and 2024. The primary focus of the review was on how AI influences students' cognitive skills, critical thinking, and engagement with learning materials. Sources that specifically discussed AI's impact on problem-solving, creativity, and traditional skills like handwriting and memory retention were prioritized, including works by Karan & Angadi (2023), Basha (2023), Yılmaz (2023), Osman (2023), Hernández (2024), and others.

Survey of Teachers - A survey was administered to a sample of teachers from schools in Almaty to gather insights into their perceptions of students' motivation and academic progress when using AI tools. The survey included both quantitative and qualitative questions designed to explore:
- Teachers' observations of students' engagement with assignments completed with the help of AI tools.
- The perceived impact of AI on students' critical thinking, creativity, and problem-solving abilities.
- Teachers' views on how AI tools influence traditional learning methods. The survey responses were collected and analyzed qualitatively to identify common themes and patterns regarding AI's influence on student motivation and progress.

An experiment was conducted with 6th-grade students to assess their comprehension and retention of AI-generated content. Students were tasked with writing a short story using AI tools, with the requirement to customize the setting, characters, and plot. The experiment aimed to evaluate two key factors:

Comprehension and Retention: After writing the AI-assisted story, students were asked to read and familiarize themselves with it. One week later, they were asked to retell the story to measure how well they retained the AI-generated content.

Engagement with AI-generated Content: Following the retelling exercise, brief interviews were conducted to assess whether students had engaged with the AI-generated story, including whether they had made efforts to understand or modify the content.

Research Results

Survey results

Teachers' Observations of Students' Engagement with Assignments Using AI Tools (Figure 1): When asked how often students appeared more engaged with assignments using AI tools as opposed to traditional methods, teachers' responses were varied. The largest portion of respondents (41.7%) rated students' engagement at level 3, indicating moderate engagement. Meanwhile, 33.3% rated it at level 4, and 16.7% rated it at level 2. Only a small percentage (8.3%) observed consistently high engagement (level 5). These results suggest that, while AI tools generally increase student engagement to some extent, not all teachers perceive a significant difference compared to traditional methods.
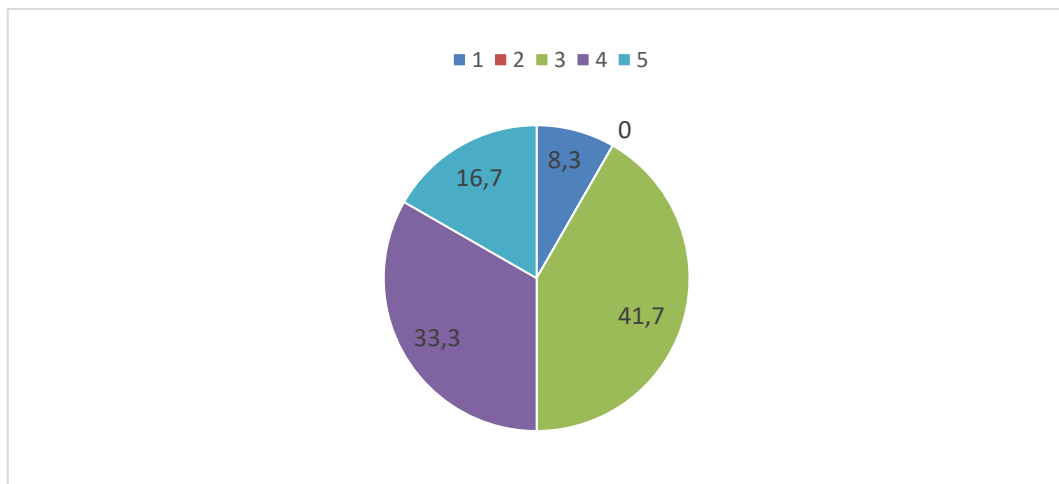

Figure 1. On a scale of 1 to 5, how often do you observe students engaging more with assignments when they use AI tools compared to traditional methods? (1=never, 5= always)
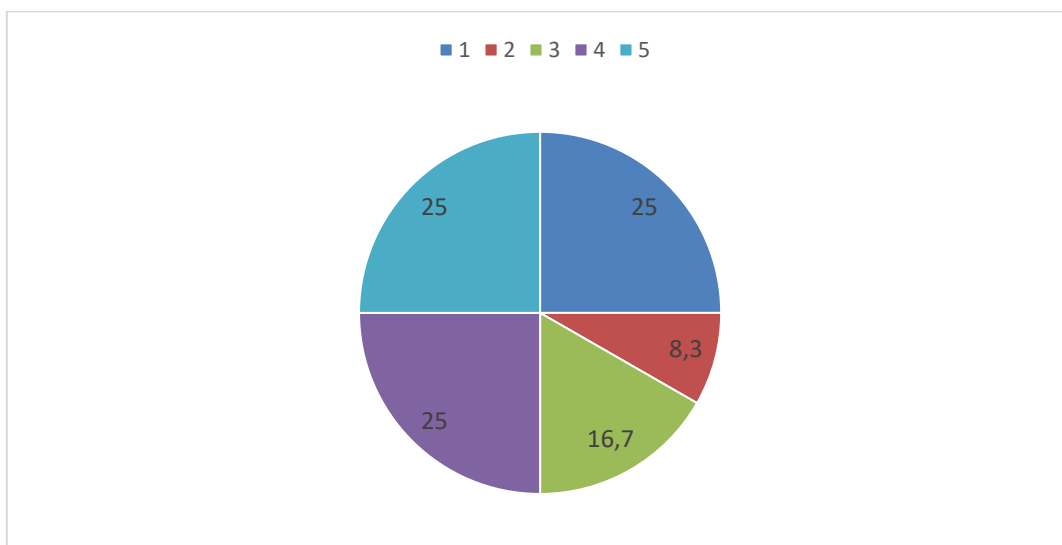

Figure 2. To what extent do you believe AI tools improve or hinder students' ability to complete assignments independently? (1=Significantly hinder, 5 = Significantly improve)

Perceived Impact of AI Tools on Students' Ability to Complete Assignments Independently (Figure 2): Teachers were asked to rate how AI tools impact students' independence in completing assignments. Responses were evenly distributed across the spectrum, with 25% of teachers rating both level 1 and level 5 (indicating opposing views on whether AI tools hinder or improve independence). Another 25% selected level 4, while 16.7% chose level 3, suggesting mixed opinions on whether AI promotes or limits independent learning. This distribution indicates diverse perspectives on AI's role in fostering independence. Some teachers view AI as a supportive tool for self-directed learning, while others express concerns about potential over-reliance.

Overall Perceptions of AI's Impact on Student Motivation and Academic Progress (Figure 3): When evaluating the overall impact of AI tools on students' motivation and academic progress, responses leaned toward a positive perception. Most teachers (41%) rated this impact as 3, suggesting a neutral stance, while 25% rated it as 5 (very positive), and 17% rated it as 2 and 4. These findings imply that, while some teachers observe a strong positive influence of AI on student motivation and progress, others remain neutral or have minor concerns about the overall benefits.
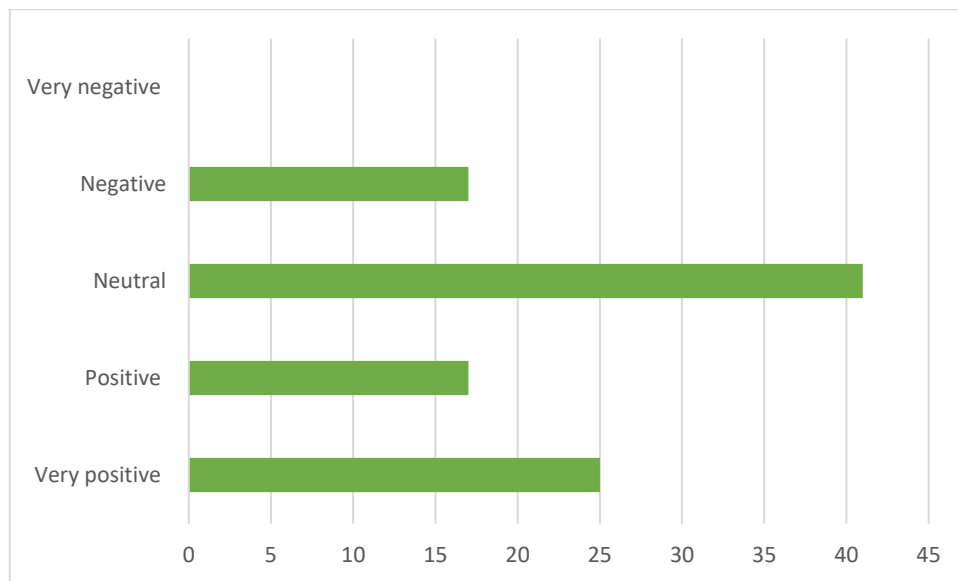

Figure 3. Overall, how do you perceive the impact of AI tools on students' motivation and academic progress?
(1 = Very negative, 5 = Very positive)

Storytelling results

One week after the initial story-writing exercise, students were asked to retell their AI-assisted stories to assess retention. Approximately half of the students were able to recall and retell the stories with reasonable accuracy. This suggests moderate retention of the AI-generated content, with some students demonstrating a stronger grasp of their stories than others. The timing of the experiment, conducted at the end of the term, may have impacted students' ability to focus and retain content. Fatigue from the busy term-end schedule was noted as a possible factor contributing to reduced engagement and retention among some students.

Student engagement with the AI-generated story task was generally low. Several students did not complete the assignment, which could also be attributed to end-of-term fatigue. Among the students who completed their stories, most read them with minimal customization beyond the initial AI-generated suggestions. However, these students demonstrated a basic understanding of the content by answering questions and engaging in a brief Q&A with peers. This indicates that, although customization was limited, students could comprehend and discuss their stories to some degree. During follow-up interviews, students shared that they found the experience of creating stories with AI tools to be interesting. This positive response to the novelty of AI-assisted storytelling suggests that, despite low engagement levels, students

were intrigued by the AI-based approach and may benefit from further structured guidance to maximize their engagement and creativity.

Research Discussion

The findings of this research highlight both the potential benefits and challenges of integrating AI tools into the educational process, particularly for secondary school students. While AI provides an innovative way to enhance learning engagement and aid in content creation, the experiment revealed nuances in how young students interact with AI-assisted tasks and retain AI-generated content.

The results suggest that AI tools have the potential to stimulate initial interest among students, as evidenced by their positive feedback during interviews. This aligns with the broader understanding that novel technologies can increase engagement by making learning activities more dynamic and interactive. The students' interest in AI storytelling points to the value of incorporating such tools to create a more engaging educational experience. However, this engagement may be largely due to the novelty of AI; it remains uncertain whether this enthusiasm will persist once students become more accustomed to these tools. Long-term studies could help determine whether AI maintains its engagement factor or if its appeal diminishes over time.

A key consideration in using AI for educational purposes, especially at the secondary level, is the risk of fostering over-reliance. In this study, many students minimally customized the AI-generated stories, indicating a tendency to rely on the tool's output rather than engaging critically with the content. Compared to university students, who may have a stronger foundation in independent learning and critical thinking, secondary school students might be more susceptible to the passive use of AI, depending on it as a crutch rather than as a support tool. This reliance could undermine the development of essential skills such as creativity, problem-solving, and independent thought if not managed carefully.

The retention results showed that only half of the students could accurately retell their stories after a week. This suggests that while AI can facilitate the creation of content, it does not necessarily ensure deeper learning or retention. It is possible that the students' engagement with the AI-generated stories was surface-level, leading to moderate comprehension but limited long-term retention. These findings raise questions about the depth of learning that AI can support in young learners and suggest that AI-based learning activities need to be designed in a way that encourages active engagement and critical thinking to enhance retention.

Given these observations, it may be beneficial to balance AI-driven activities with traditional methods to create a holistic learning experience. AI should be integrated thoughtfully to complement, rather than replace, traditional pedagogical approaches. Teachers play a crucial role in this integration by guiding students to use AI tools as a means of exploration and experimentation rather than as a shortcut to completing assignments. By framing AI as a supplementary tool, educators can help students cultivate the ability to think critically and creatively while using AI.

This study underscores the importance of further research into the long-term impact of AI on younger learners, especially regarding the sustainability of engagement and the potential for over-reliance. Future research could investigate strategies for fostering a balanced approach to AI usage, where students are encouraged to engage critically and creatively rather than passively accepting AI outputs. Moreover, understanding how AI's role in education differs across age groups - such as between secondary school and university students - could provide insights into how to adapt AI integration to various developmental stages.

The integration of AI into education holds immense promise, but it must be implemented thoughtfully to avoid undermining the value of human educators and critical pedagogical practices. As highlighted by the research of Kassymova et al. (2021) and Rohde et al. (2023), AI offers substantial potential to personalize learning and improve outcomes, particularly in online and blended learning environments. However, careful consideration must be given to the ethical implications, such as algorithmic bias and the risk of depersonalizing education.

Conclusion

In conclusion, AI offers valuable opportunities for enhancing educational engagement but also presents new challenges in pedagogy. To maximize AI's benefits while mitigating risks, educators and researchers need to work together to develop structured, balanced approaches that promote meaningful engagement, skill-building, and independence among students. AI in education holds great promise, but its implementation should be carefully managed to avoid undermining essential learning processes. The key to

successful implementation lies in creating a balanced approach that combines the best of AI technology with traditional pedagogical strategies. AI should be seen not as a replacement for teachers but as a tool to empower them, enhancing their ability to support students and address individual learning needs.

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References

Basha, J. Y. (2023). The negative impacts of AI tools on students in academic and real-life performance. Journal of Educational Research and Development, 12(4), 35-52.

Hernández, F. M. (2024). Challenges of technologizing teaching and learning at university. Journal of Educational Transformation and Technology, 15(1), 88-103.

Karan, B., & Angadi, G. R. (2023). Potential Risks of Artificial Intelligence Integration into School Education: A Systematic Review. Bulletin of Science, Technology & Society, 43(3-4), 67-85. https://doi.org/10.1177/02704676231224705

Kassymova, G.K., Vafazov, F.R., Pertiwi, F.D., Akhmetova, A.I., Begimbetova, G.A. (2021). Upgrading Quality of Learning with E-Learning System. Challenges of Science. Issue IV, 2021, pp. 26-34. https://doi.org/10.31643/2021.04

Mutarah, R., Azman, M.N.A., Kassymova, G.K., Kenzhaliyev, B.K. (2024). Android-Based Interactive Application Development in the Subject of Design and Technology for the Topic of Manufacturing Technology. AIP Conf. Proc. 2750, 040065. https://doi.org/10.1063/5.014927222

Osman, W. A. (2023). Detrimental impact of technological tools on handwriting. Journal of Handwriting and Digital Literacy, 19(3), 45-60.

Rohde, N., Flindt, N., Rietz, C., & K. Kassymova, G. (2023). How e-learning programs can be more individualized with artificial intelligence – a theoretical approach from a pedagogical point of view. Muallim Journal of Social Sciences and Humanities, 7(3), 1-17. https://doi.org/10.33306/mjssh/240

Sheriyev, M.N., Atymtayeva, L.B., Beissembetov, I.K., Kenzhaliyev, B.K. (2016). Intelligence system for supporting human-computer interaction engineering processes. Applied Mathematics and Information Sciences, Volume 10, Issue 3, pp. 927-935. https://doi.org/10.18576/amis/100310

Yılmaz, Ö. (2023). The role of technology in modern science education. Journal of Modern Science and Technology, 28(2), 102-120.