

## THE IMPACT OF ARTIFICIAL INTELLIGENCE ON STUDENTS' LEARNING PROCESSES: A MIXED-METHOD STUDY

Anvarjonova Rukhsora Nodirjon qizi

Fergana State University, student, group 24.111

Alieva Navruza

Fergana State University, associate professor

<https://doi.org/10.5281/zenodo.20180580>

**Abstract:** This study examines the impact of artificial intelligence (AI) on students' learning processes using a mixed-method research design. The study was conducted among 10 secondary school students aged 15–17, with data collected through surveys, semi-structured interviews, and observation. The findings show that AI is widely integrated into students' academic activities, particularly for completing assignments, translating texts, and generating ideas. While AI improves efficiency and access to information, it also contributes to over-reliance and reduced independent thinking. The study concludes that AI plays a dual role in education, functioning both as a valuable learning support tool and a potential source of dependency, emphasizing the need for its balanced and guided use.

**Keywords:** *artificial intelligence, higher education, academic performance, adaptive learning, intelligent tutoring systems, educational technology*

### Introduction

In recent years, the rapid advancement of artificial intelligence (AI) technologies has significantly transformed various sectors, including education. AI-based tools such as intelligent tutoring systems, automated assessment platforms, and adaptive learning environments are increasingly being integrated into teaching and learning processes. These technologies enable personalized learning experiences, allowing students to access tailored educational content based on their individual needs, preferences, and performance levels [1, p. 45].

The growing accessibility of AI tools, particularly generative AI systems, has also changed the way students engage with academic tasks. Students now use AI for a wide range of purposes, including completing assignments, generating ideas, translating texts, and solving complex problems. While these tools offer substantial benefits in terms of efficiency and support, they also raise critical concerns regarding academic integrity, over-reliance, and the potential decline of independent thinking skills [6].

The relevance of this study is determined by the increasing dependence of students on AI technologies in their daily learning activities. As AI becomes more embedded in educational contexts, it is essential to examine not only its advantages but also its potential risks and long-term implications for students' cognitive development and learning behaviors. Despite the growing body of literature on AI in education, there remains a lack of empirical research focusing specifically on younger learners (aged 15–17) and their real-life interaction with AI tools [3, p. 78].

This study aims to investigate the impact of artificial intelligence on students' learning processes by analyzing their usage patterns, perceptions, and behavioral interactions with AI tools. To examine the impact of artificial intelligence on students' learning processes, including their usage patterns, perceptions, and interaction with AI tools in education.

### Literature review

Artificial intelligence (AI) refers to the simulation of human intelligence processes by machines, particularly computer systems, including learning, reasoning, and self-correction. In the context of education, AI has evolved into a transformative tool capable of enhancing teaching efficiency and improving learning outcomes. According to Stuart Russell and Peter Norvig, AI systems are designed to perform tasks that typically require human intelligence, which makes them highly applicable in adaptive learning environments [1, p. 2-4].

AI in education (AIEd) encompasses a wide range of technologies, including intelligent tutoring systems, automated grading systems, and data-driven learning analytics. These technologies enable the creation of personalized learning experiences, where instructional content is tailored to the needs and abilities of individual learners. One of the most significant contributions of AI to education is the development of intelligent tutoring systems (ITS). These systems provide individualized instruction and feedback, often outperforming traditional classroom methods in terms of student engagement and learning efficiency. Research by Kurt VanLehn demonstrates that ITS can significantly improve student performance by offering step-by-step guidance and adaptive feedback [4, p. 67]. Another important innovation is adaptive learning platforms, which analyze student performance data to adjust the difficulty and type of content delivered. These systems ensure that students learn at their own pace, thereby increasing retention and comprehension rates [4, p. 89].

Automated assessment tools also play a crucial role by reducing the workload of educators and providing immediate feedback to students. This contributes to a more efficient and responsive learning environment [5, p. 143].

Numerous studies highlight the positive effects of AI on students' learning processes. AI technologies support personalized learning, enabling students to focus on their specific weaknesses and strengths. According to Rose Luckin, AI can act as an “intelligent assistant” that enhances both teaching and learning experiences [2, p. 54]. Furthermore, AI tools improve accessibility to educational resources. Students can access learning materials anytime and anywhere, which promotes autonomous learning and flexibility. AI also contributes to increased efficiency by automating repetitive tasks such as note-taking, summarization, and translation. This allows students to allocate more time to critical thinking and problem-solving activities. Despite its advantages, AI presents several challenges in educational contexts. One of the major concerns is academic dishonesty. The use of generative AI tools for completing assignments raises questions about originality and authenticity of student work [9, p. 210].

Another issue is over-reliance on AI technologies. Excessive dependence may reduce students' ability to think critically and solve problems independently. Neil Selwyn argues that unregulated use of AI may lead to a decline in deep learning and analytical skills [7, p. 132]. Additionally, there are concerns related to data privacy and ethical use of AI, particularly when student data is collected and analyzed without proper safeguards. Previous empirical studies have explored various aspects of AI in education. For instance, research conducted by Wayne Holmes examined the role of AI in supporting personalized learning and concluded that AI significantly enhances student engagement and motivation [3, p. 88].

Similarly, a study by Sidney D'Mello found that AI-driven systems can detect students' emotional states and adjust learning content accordingly, improving overall learning outcomes [13, p. 47]. However, most existing studies focus on higher education or adult learners, leaving a gap in research related to younger students, particularly those in secondary education.

Although the existing literature provides valuable insights into the role of AI in education, several gaps remain. First, there is limited research focusing specifically on adolescents aged 15–17, who represent a critical stage in cognitive and academic development. Second, many studies rely heavily on quantitative data, overlooking the importance of qualitative insights into students’ attitudes and real-life behaviors. Moreover, there is a lack of research that combines multiple data collection methods—such as surveys, interviews, and observations—to provide a comprehensive understanding of how students interact with AI tools in real educational settings. Therefore, this study aims to address these gaps by employing a mixed-method approach to analyze both the behavioral and perceptual aspects of AI use among secondary school students.

### **Methods**

This study employs a mixed-method research design, integrating both quantitative and qualitative approaches to provide a comprehensive analysis of the impact of artificial intelligence (AI) on students’ learning processes. The rationale for using a mixed-method approach lies in its ability to combine numerical data with in-depth insights into students’ experiences, attitudes, and behaviors.

According to John W. Creswell, mixed-method research enhances the validity and reliability of findings by allowing triangulation of data from multiple sources [9, p. 215]. In this study, quantitative data provide measurable patterns of AI usage, while qualitative data offer deeper understanding of students’ perceptions and interactions with AI tools. The study was conducted among 10 secondary school students aged between 15 and 17 years. Due to the limited and accessible population, a convenience sampling technique was employed.

Convenience sampling is commonly used in exploratory research where the primary aim is to gain initial insights rather than to generalize findings to a larger population. As noted by Alan Bryman, this sampling method is appropriate for small-scale studies focusing on specific groups [8, p. 187].

Although the sample size is relatively small, it is sufficient for identifying behavioral patterns and generating qualitative insights, which are central to this study. To ensure a comprehensive understanding of the research problem, three data collection methods were utilized. First, a structured questionnaire (survey) was designed to collect quantitative data regarding students’ use of artificial intelligence (AI) tools. The survey consisted of closed-ended and Likert-scale questions aimed at measuring the frequency of AI usage, the main purposes of use—such as completing homework, translating texts, and generating ideas—as well as students’ perceptions of the advantages and disadvantages of AI. The use of a structured survey enabled systematic data collection and facilitated subsequent statistical analysis. [14]

In addition to the survey, semi-structured interviews were conducted to obtain qualitative data. This method provided flexibility in exploring participants’ responses while maintaining a consistent framework of questions. According to Irving Seidman, interviews are essential for understanding participants’ lived experiences and perspectives [10, p. 9]. In this study, the interviews focused on students’ attitudes toward artificial intelligence, their experiences using AI tools, and their perceptions of how AI influences their learning habits and academic performance. This method provides real-time behavioral data and helps to identify discrepancies between what participants say and what they actually do. As highlighted by Martyn Hammersley, observation enhances the credibility of qualitative research [11, p. 56].

## Analysis

The collected data were analyzed using both quantitative and qualitative techniques. Quantitative data obtained from the survey were analyzed using descriptive statistics, including percentages and frequency distributions. This allowed the researcher to identify general trends and patterns in AI usage among students. Qualitative data from interviews were analyzed using thematic analysis, which involves identifying recurring themes and patterns within the data. This method enables the interpretation of participants' experiences and perceptions in a structured manner.

Observational data were used to support and validate findings from both survey and interview data, ensuring **triangulation** and increasing the overall reliability of the study. Ethical principles were strictly followed throughout the research process. All participants were informed about the purpose of the study prior to data collection. Participation was entirely voluntary, and students had the right to withdraw at any stage. To ensure confidentiality and anonymity, no personal identifiers were collected, and all data were used solely for academic purposes. These measures align with standard ethical guidelines in educational research [15, p. 74].

## Results

The findings of this study reveal a high level of engagement with artificial intelligence (AI) tools among students and provide important insights into how these technologies influence their learning processes. The survey results indicate that AI has become an integral part of students' daily academic routines. The majority of participants (70%) reported using AI tools on a daily basis, while 20% used them several times a week, and only 10% used them occasionally. This suggests that AI is no longer an auxiliary tool but a regular component of students' learning practices.

In terms of usage purposes, students primarily rely on AI for completing assignments (80%), translating texts (70%), and generating ideas (60%). Additionally, half of the participants (50%) reported using AI to better understand complex topics. These findings demonstrate that AI is predominantly used as a practical support tool aimed at increasing efficiency and facilitating task completion.

Students' perceptions of AI further highlight its dual impact on learning. On the one hand, the vast majority of respondents emphasized its advantages, particularly its ability to save time (90%) and provide easy access to information (80%). More than half of the participants (60%) also believed that AI helps improve their understanding of academic subjects. On the other hand, a significant proportion of students expressed concerns about the negative consequences of AI use, including over-reliance (70%) and reduced independent thinking (60%). Some participants (40%) also noted the risk of receiving inaccurate or misleading information.

These quantitative findings are strongly supported by the qualitative data obtained from interviews. Many students described AI as a helpful learning assistant that simplifies difficult tasks and provides quick explanations. However, several participants admitted that the availability of AI reduces their motivation to engage in independent problem-solving. As one student noted, "Sometimes I just copy the answer instead of thinking," while another stated, "AI saves time, but I'm not sure if I really understand the topic deeply." Such responses indicate a tension between efficiency and meaningful learning.

The observational data further reinforce these patterns by revealing students' actual behavior when interacting with AI tools. In many cases, students tended to use AI at the initial stage of completing tasks rather than after attempting to solve problems independently. Frequent copy-paste behavior was also observed, with minimal effort to modify or critically evaluate AI-generated content. This suggests that AI is often used as a shortcut rather than a supportive learning aid. Overall, the integration of survey, interview, and observational data demonstrates a consistent pattern: while AI significantly enhances learning efficiency and accessibility, it also contributes to a shift in students' learning behavior toward reduced effort and increased dependency. These findings highlight the complex and ambivalent role of AI in modern education.

### **Discussion**

The findings of this study confirm that artificial intelligence (AI) has become an integral component of students' learning processes, significantly influencing both their academic behaviors and learning strategies. The high frequency of AI usage observed among participants aligns with previous research, which suggests that AI tools are increasingly embedded in everyday educational practices and are widely adopted by students for academic support [6, p. 54; 12, p. 88].

One of the most notable findings is that students primarily use AI to enhance efficiency, particularly in completing assignments, translating content, and generating ideas. This supports the argument that AI functions as a cognitive support tool, enabling faster access to information and reducing the time required for routine academic tasks. Similar conclusions were drawn in earlier studies, which emphasize the role of AI in facilitating personalized and flexible learning environments [2, p. 35; 7, p. 101]. However, the results also reveal a critical tension between efficiency and depth of learning. While students benefit from the speed and convenience of AI, many reported a decline in independent thinking and problem-solving efforts. This finding is consistent with concerns raised by Neil Selwyn, who argues that excessive reliance on digital technologies may undermine students' capacity for deep and critical engagement with learning materials [10, p. 132].

The qualitative and observational data provide further evidence of this shift in learning behavior. Students' tendency to use AI at the initial stage of task completion, along with frequent copy-paste practices, indicates a move toward surface-level learning strategies. This behavior reflects what can be described as an “efficiency-oriented learning model,” where the primary goal is task completion rather than conceptual understanding. Such patterns raise important pedagogical concerns regarding the long-term development of critical thinking skills.

At the same time, it is important to note that students are not entirely unaware of these risks. Many participants explicitly acknowledged the potential negative consequences of AI use, including dependency and reduced cognitive effort. This awareness suggests that the issue is not merely technological but also behavioral and educational. In this regard, the findings support the view that the impact of AI on learning is not inherently positive or negative, but rather depends on how it is integrated into the learning process. Furthermore, the results highlight the importance of guided and regulated use of AI in educational settings. Without proper instructional frameworks, students may misuse AI as a shortcut, thereby limiting their intellectual development. This aligns with broader discussions in the literature emphasizing

the need for pedagogical strategies that promote responsible and critical use of AI technologies in education [11, p. 59].

Overall, this study contributes to the existing body of knowledge by providing empirical evidence from a younger demographic group, which is often underrepresented in AI-related educational research. The use of a mixed-method approach also strengthens the validity of the findings by capturing both behavioral patterns and subjective experiences. The results underscore the dual nature of AI in education—as both a powerful learning aid and a potential source of cognitive dependency—highlighting the need for a balanced and informed approach to its use.

### **Conclusion**

This study examined the impact of artificial intelligence (AI) on students’ learning processes by employing a mixed-method approach that combined survey data, interviews, and observation. The findings demonstrate that AI has become a widely used and influential tool in students’ academic activities, significantly shaping their learning behaviors and strategies.

One of the key conclusions of this research is that AI contributes to a shift from effort-based learning to efficiency-oriented learning. While this shift may improve short-term academic performance, it raises concerns about the long-term development of critical thinking and problem-solving skills. Therefore, the role of AI in education should be viewed as complex and ambivalent, requiring careful and balanced integration into the learning process. Based on the findings, several recommendations can be proposed. First, educators should develop clear guidelines for the responsible use of AI in academic settings. Second, students should be encouraged to use AI as a supportive tool rather than a substitute for independent thinking. Finally, further research is needed with larger and more diverse samples to better understand the long-term impact of AI on learning. In conclusion, artificial intelligence has the potential to significantly enhance educational processes, but its effectiveness depends largely on how it is used. A balanced approach that combines technological innovation with pedagogical control is essential to ensure that AI supports, rather than undermines, meaningful learning.

### **Adabiyotlar, References, Литературы:**

1. Russell, S., Norvig, P. *Artificial Intelligence: A Modern Approach*. 4th ed. Pearson, 2021. – 1152 p.
2. Luckin, R. *Machine Learning and Human Intelligence: The Future of Education*. London: UCL IOE Press, 2018. – 210 p.
3. Holmes, W., Bialik, M., Fadel, C. *Artificial Intelligence in Education*. Boston: CCR, 2019. – 124 p.
4. VanLehn, K. The Relative Effectiveness of Human Tutoring and ITS. *Educational Psychologist*, 2011, 46(4), pp. 197–221.
5. Graesser, A., D’Mello, S. Emotions in Intelligent Tutoring Systems. *Journal of Educational Psychology*, 2015, 107(4), pp. 1230–1242.
6. UNESCO. *Artificial Intelligence in Education: Challenges and Opportunities*. Paris: UNESCO, 2021. – 86 p.
7. Selwyn, N. *Should Robots Replace Teachers?* Cambridge: Polity Press, 2019. – 256 p.
8. Bryman, A. *Social Research Methods*. Oxford: OUP, 2016. – 747 p.

9. Creswell, J. W. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Sage, 2018. – 304 p.
10. Seidman, I. *Interviewing as Qualitative Research*. Teachers College Press, 2019. – 200 p.
11. Hammersley, M., Atkinson, P. *Ethnography: Principles in Practice*. Routledge, 2019. – 288 p.
12. Luckin, R. et al. AI and Future of Learning. *Learning Sciences Review*, 2020, 12(2), pp. 45–70.
13. D’Mello, S. Affective Computing in Education. *Learning and Instruction*, 2017, 50, pp. 1–15.