

A COMPARATIVE STUDY OF THE IMPACT OF ARTIFICIAL INTELLIGENCE ON
LEARNING OUTCOMES

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Abstract: This study examines the impact of Artificial Intelligence (AI) tools on learning outcomes among students, emphasizing the balance between benefits and drawbacks. With over 70% of participants using AI frequently, many reported developed efficiency and access to diverse ideas. However, concerns emerged regarding the over-reliance on AI, leading to diminished critical thinking and problem-solving skills. This research illustrates the importance of integrating AI thoughtfully in educational practices to foster cognitive development while maintaining essential skills, providing crucial insights for educators and policymakers in shaping effective learning environments.

Аннотация: Это исследование изучает влияние инструментов Искусственного Интеллекта (ИИ) на результаты обучения среди студентов, подчеркивая баланс между преимуществами и недостатками. Более 70% участников часто используют ИИ, и многие отметили повышение эффективности и доступ к разнообразным идеям. Однако возникли опасения по поводу чрезмерной зависимости от ИИ, что приводит к снижению критического мышления и навыков решения проблем. Это исследование демонстрирует важность разумной интеграции ИИ в образовательные практики для содействия когнитивному развитию при сохранении основных навыков, предоставляя важные идеи для педагогов и политиков в формировании эффективной образовательной среды.

Annotatsiya: Ushbu tadqiqot sun'iy intellekt (SI) vositalarining talabalar o'quv natijalariga ta'sirini, foyda va kamchiliklar o'rtasidagi muvozanatni ta'kidlagan holda o'rganadi. Ishtirokchilarning 70% dan ortig'i SI dan tez-tez foydalanishlari tufayli samaradorlik ortgani va turli xil g'oyalarga kirish imkoniyati paydo bo'lganini ta'kidlashgan. Biroq, SIga haddan tashqari bog'lanib qolish, tanqidiy fikrlash va muammolarni hal qilish ko'nikmalarining susayishiga olib kelishi borasida xavotirlar paydo bo'ldi. Ushbu tadqiqot, o'qituvchilar va siyosatchilar uchun samarali ta'lim muhitini shakllantirishda muhim ma'lumotlar berib, asosiy ko'nikmalarni saqlab qolgan holda kognitiv rivojlanishga ko'maklashish uchun SI ni o'quv amaliyotiga ehtiyotkorlik bilan integratsiya qilish muhimligini ko'rsatadi.

Key words: AI tools, learning outcomes, problem-solving skills, critical thinking, education

Ключевые слова: инструменты ИИ, результаты обучения, навыки решения проблем, критическое мышление, образование

Kalit soʻzlar: SI vositalari, oʻquv natijalari, muammolarni hal qilish koʻnikmalari, tanqidiy fikrlash, taʼlim

Introduction

The use of AI in learning is quickly becoming popular among institutions as it replaces traditional learning models by delivering customized content, increasing the students' access to information, and providing prompt feedback. While using these technologies as educators rise steadily to enhance the student's get-as, AI remains a prospective path to enhancing learning attainment; however, several limitations associated with these technologies have been raised. However, more concern that has recently arisen is that the over-reliance on AI may hamper core learning skills and analytical thinking in learners. This problem is more acute at present when it is essential to use AI in the process of educating individuals adequately while preserving their ability to think independently. The outcome of this study of a sample of students from around the world will be to establish exactly how much or to what level the application of AI influences learning outcomes and therefore has warning signs for practice and policymaking. It is the hope of the current research that by looking at the numerous pros and cons of adopting AI in learning, future decision-making towards its use in learning will be made effectively to ensure that proper learning continues to be attained without compromising on cognitive development.

In the contest of Australia, Farhood et al. analysed diverse educational backgrounds, specifically using two public datasets: from two schools in Portugal: the Math dataset and xAPI-Edu-Data which contains the data of 480 students from different countries and levels of education. Some of the findings include that machine learning models and deep learning models predict student outcomes. Additionally, the study identifies random forest and XGboost as the accurate machine learning models. This study reveals that Lasso feature selection's efficacy varies in accuracy, although hyperparameter tuning improves the flexibility and accuracy of AI prediction models in education settings¹.

In their theoretical theses, Sasikala & Ravichandran incorporated learners in different learning environments since the work revolves around finding ways through which AI influences learners' academic performance. Therefore, using a systematic approach, the study identifies and synthesizes the literature on personalized learning, engagement, and achievement. Evidence shows that AI is very useful in the supplement of learning that every learner requires since it assists in teaching different contents depending on the learner's needs hence improving learner

¹Farhood H.,Joudah I.,Beheshti A.,Muller S. Evaluating and enhancing artificial intelligence models for predicting student learning outcomes. In Informatics, MDPI. 2024, Vol.11,No.3, pp.13-15

satisfaction levels. For example, students who learn through those self-same AI-based platforms are likely to record better learning results than were they to learn through traditional methods².

AI tools increase the level of engagement through aspects of feedback, which increase students' interest and understanding. Similarly, the study shows a positive relationship between an AI's use in the classroom and academic performance, especially in areas like mathematics and science. In particular, studies prove that students applying AI-based tools like DreamBox show enhanced results in various fields, including mathematics. In addition, the literature examines the new teacher role and how machine learning is imposing some of a teacher's administrative responsibilities. However, fears of over-dependence on AI are expressed while awareness of the human spirit and core profession of education and the teacher-student nexus is reminded³.

On the context of Uzbekistan, Kabilovna & Aleksandrovna have worked with students from two prestigious universities in Fergana City: Fergana State University and the Fergana branch of the Tashkent University of Information Technologies. 14 students in total completed the online survey; 57.1% were students of Fergana State University in the English philology or literature department while 42.9% were students of TUIT, studying IT and telecommunications. The participant's ages were between 19 to 26 years, with an overall mean age of 22 years and male to female ratio of 4:6. Additionally, the study incorporated a focus group discussion with teachers and the participants selected had different ages and teaching experience, which improved the understanding of how Artificial Intelligence teachers affect EFL learner's⁴.

Among the experiences of the learners, the study established full appreciation of the AI tools in the classroom as evidenced by 85.7% of learners having a positive attitude toward them. This positive attitude is associated with the promotion of EFL learners' self-esteem because the use of AI-connected feedback provides them with the opportunity to work at their pace and with as much pressure as they wish. It also shows that 14.2% of the students had a firm or somewhat positive attitude towards AI, and there is a need to pay attention to these feelings based on students' concerns, although these were not extreme, such as fear of the decline in the prominence of traditional learning practices. It is presented that applying the AI tools with the teaching practice to enhance students' learning engagement and motivation is highlighted resulting in the educator's suggestions for professional development⁵.

In another of her work, Aleksandrovna analyzed 3 current students from the ECPC department of Fergana State University. The participants were composed of 92.3% females and 7.7% males, with an average age of 21 years. Of equal importance, 69.2% of the respondents expressed that

²Sasikala P., Ravichandran R. Study on the Impact of Artificial Intelligence on Student Learning Outcomes. Journal of Digital Learning and Education. 2024, 4(2), p.146

³ibid., pp.148-149

⁴Kabilovna A.N., Aleksandrovna S.A. THE POSITIVE IMPACT OF AI ON SELF-ESTEEM AMONG EFL LEARNERS: CASE STUDIES FROM FERGANA STATE UNIVERSITY AND TUIT FERGANA BRANCH UNIVERSITY. INNOVATION IN THE MODERN EDUCATION SYSTEM.2024, 5(45), pp.37-38

⁵ibid., pp.45-47

they had prior teaching experience hence some level of acquaintance with educational practices⁶. Analysis of the results shows that students consider the options offered by online learning platforms as positive in enhancing interaction and engagement rate, with 61.5% of students sharing this opinion. But it outlined worrying behavior also, for instance, 23.1% of the students confessed that they often fell asleep in class meaning that mere enrolment equals participation as students do not guarantee effective learning. Additionally, where 64.6% described self-scheduled programs as flexible, 61.8% regretted poor interaction with peers and instructors who are crucial to learning. An extended relationship between engagement and outcome was identified; 53.8% agreed more engagement had better outcomes while some opposite saw issues such as absenteeism or demotivation. These outcomes indicate the need to liaise between participate engagement or interaction in the online learning environment and the propensity of the learners to disengage or become distracted⁷.

Methodology

2.1. Research design

A quantitative approach using a global online survey to examine the hypothesis that students who excessively rely on AI tools for problem-solving will demonstrate a decrease in their fundamental problem-solving skills compared to students who engage primarily with traditional methods. The choice of this method allows for the collection of numerical data that can be statistically analyzed, providing a robust framework for evaluating the research hypothesis.

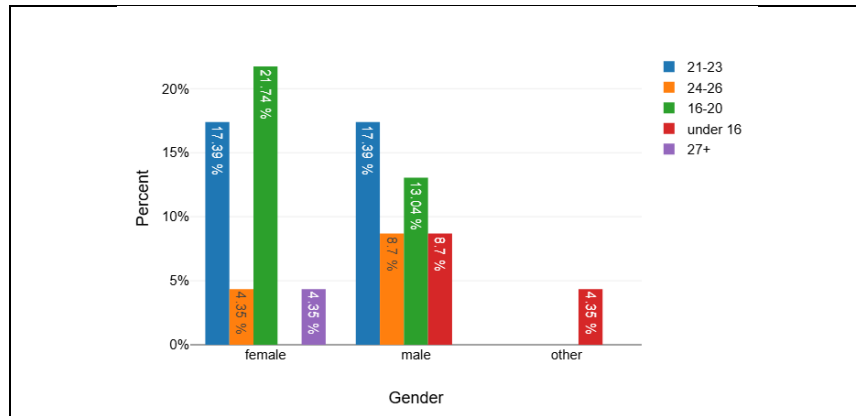
2.2. Participants demographic

Figure 1 illustrates the descriptive statistics of the research participants' age range combining it to their gender distribution. The age distribution shows a predominance of respondents in the 16-20 age range, with 10 out of 20 responses falling within this category, followed by 5 respondents aged 21-23 and 3 respondents in the 24-26 range, indicating a younger demographic overall. In terms of gender, there are 11 females, 8 males, and 1 other, suggesting a slightly higher representation of females in the sample.

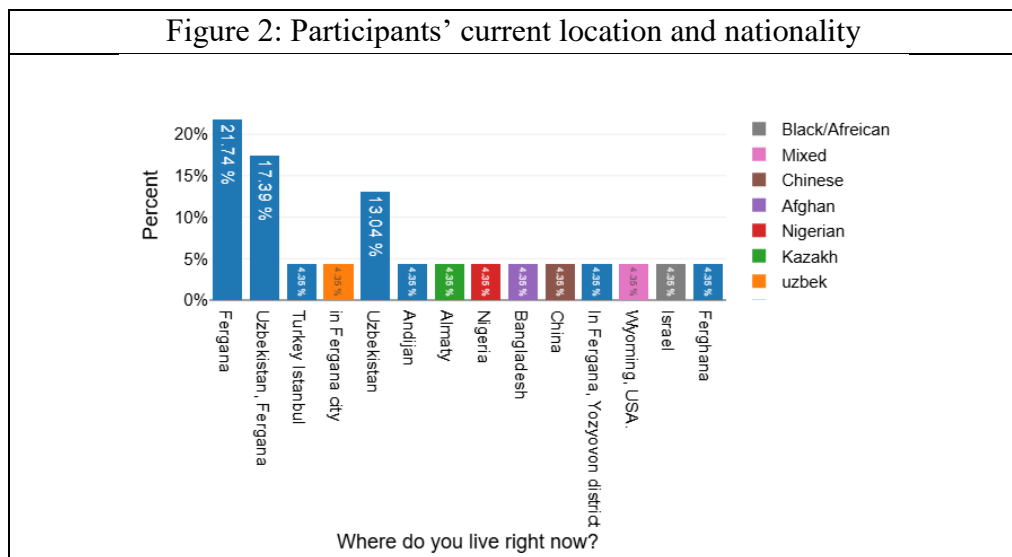
Figure 1: Participants' age and gender

⁶Aleksandrovna S.A.THE IMPACT OF DIGITAL TOOLS IN HIGHER EDUCATION. PEDAGOGIK TADQIQOTLAR JURNALI.2024, 1(2), p.335

⁷ibid., pp.338-339

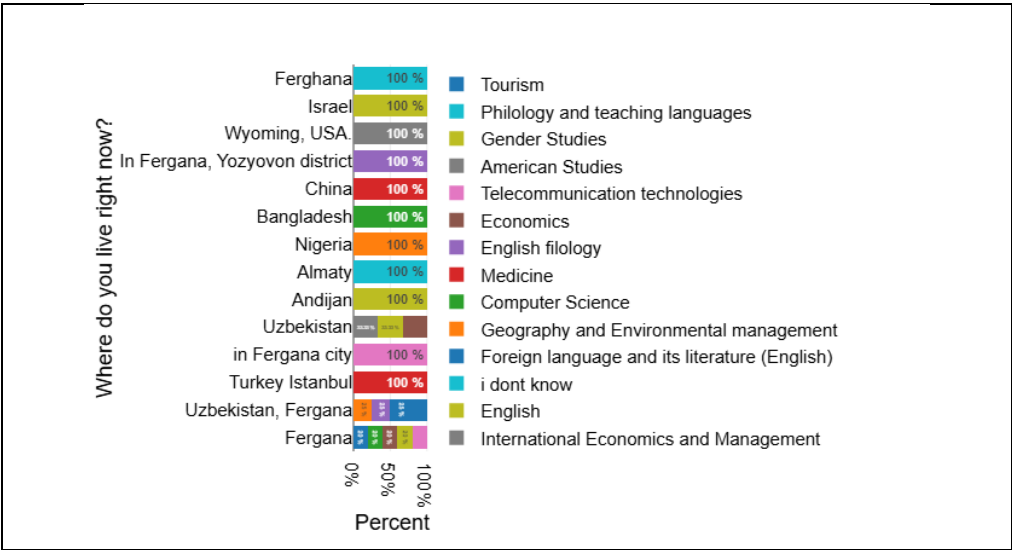


On the second figure where do the participants live and their nationality are shown. The majority of respondents live in Fergana, Uzbekistan, with 12 out of 20 responses indicating this location, while others mentioned cities like Istanbul, Andijan, Almaty, and even countries such as Nigeria, Bangladesh, and China. In terms of nationality, Uzbek is the most common, with 15 respondents identifying as Uzbek, alongside a few others identifying as Kazakh, Nigerian, Afghan, Chinese, and Mixed, reflecting a diverse cultural background among the participants.



The respondents' majors are predominantly focused on language and education, with 10 out of 20 indicating a specialization in English or Philology, while other fields such as International Relations, Economics, Medicine, and Computer Science are also represented, showcasing a diverse range of academic interests, as it shown on the third figure.

Figure 3: Correlation of the major and location



2.3. Survey instrument

The online questionnaire contained 11 questions (6 open-ended and 5 multiple-choice) designed to assess AI usage and problem-solving approaches. The survey questions focused on measuring the overreliance on AI and how it can affect fundamental problem solving skills.

2.4. Data collection procedure and analysis

The Google Forms link was distributed among the current undergraduate and graduate students at FerSU, on Telegram groups with the focus on students as a target group, on social media such as Reddit network, and it was distributed among the participants of the Nobel international internship where the author took part as well. Quantitative data was analyzed using descriptive statistics, while open-ended responses were analyzed using qualitative thematic analysis.

Results and discussion

On the Table 1 the analysis of AI tool usage for homework and assignments shows that 47.83% of respondents use AI tools often (almost daily), while 21.74% report using them always. In contrast, 17.39% use AI tools sometimes (a few times a week), and 13.04% use them rarely (a few times a month). A Chi-square distribution test indicated a significant deviation from the expected distribution, with results showing $\chi^2(3) = \text{Infinity}$, $p = aN$, suggesting that students predominantly rely on AI tools more than anticipated, particularly in daily academic tasks.

Table 1: AI Tool Usage Frequency

Category	N	Observed Probability	Expected valid Probability
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Table 1: AI Tool Usage Frequency

	Category	N	Observed Probability	Expected valid Probability
How often do you use AI tools (e.g., ChatGPT) to help with your homework or assignments?	Sometimes (a few times a week)	4	17.39%	10%
	Always	5	21.74%	70%
	Often (almost daily)	11	47.83%	20%
	Rarely (a few times a month)	3	13.04%	

The analysis of students' initial responses to challenging problems reveals that 39.13% typically attempt to solve it on their own using previous knowledge, while 34.78% opt to ask an AI tool for a solution. Additionally, 26.09% of students prefer to look up information in textbooks or online resources. This indicates a strong inclination towards independent problem-solving, although a significant portion also relies on AI tools, highlighting a blend of traditional and modern approaches in tackling academic challenges as illustrated on the Table 2.

Table 2: Problem-solving strategies

		When faced with a challenging problem in your studies, which of the following do you usually do FIRST?						
		Try to solve it on my own using previous knowledge	Ask an AI tool for a solution	Look up information in textbooks or online resources	Total			
		%	Valid %	%	Valid %	%	Valid %	%
When using AI tools for help with assignments, do you usually...?	Copy the AI's answer directly	8.7%	8.7%	13.04%	13.04%	4.35%	4.35%	26.09%
	Avoid using AI for assignments and try to solve the problems without any external tool	4.35%	4.35%	0%	0%	0%	0%	4.35%

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When faced with a challenging problem in your studies, which of the following do you usually do FIRST?								
	Try to solve it on my own using previous knowledge	Ask an AI tool for a solution		Look up information in textbooks or online resources		Total		
	%	Valid %	%	Valid %	%	Valid %	%	
Use AI to understand the concepts and then solve the problem on my own	17.39%	17.39%	0%	0%	17.39%	17.39%	34.78%	
Use the AI's answer as a starting point to develop my own solution	8.7%	8.7%	21.74%	21.74%	4.35%	4.35%	34.78%	
Total	39.13%		34.78%		26.09%		100%	

The participants' responses to the question, "In your opinion, how has the use of AI tools influenced your capability to solve problems on your own?" indicate a rather binary view in the findings as many students noted the positive aspect while pointing to the negative aspect. Several learner respondents complained about how AI tools can cause laziness and decrease their drive to solve problems on their own, statements like 'make me lazy,' 'reduce their will,' and 'I start to be a lazy student.' On the other hand, several students pointed out that AI tools have enriched their problem-solving potential by making available information and diverse approaches at the click of a button an area of efficiency improvement. Nonetheless, some of these positive responses indicate that the reader understands the downside, stating that turning to the source too much might hamper one's thinking process; several students flatly said that in their view, it did not impact them at all. Few responses were written by students that said "Liked it", AI tools "Improved it" or "It gave more options to think about". The responses overall sum up the idea in an excellent way about how cognitive skills are connected to AI and require equal undertaking and incorporation to be favorable in all aspects.

The participants' replies to the question "Can you provide an example of using AI to solve a

problem?" What was the outcome?" indicates numerous possibilities and performances indicating that AI is very useful in an academic environment. A good number of students mentioned ways they had used it in their research: preparing for presentations, searching for information for a presentation on Physics or Chemistry, or as information for a scientific article on an economics course. The outcomes identified were very positive and often reported as producing ideas, structuring contents, and getting a clearer structure, time saved, and better understanding particularly with subjects not previously studied. Sources also referred use of AI in writing activities including assignments, essays or even mottos for the clubs some of them highlighted creativity in ideas that AI provides. Some participants also applied AI for more mundane uses like planning teaching practices, Maths and Physics assignments, etc., or even composing messages to customers. Some of the students explained how the AI was helpful and others elaborated how the general AI answer was too 'vague' to apply, meaning the students themselves had formulated rather general plans of how they would use the tools, which indicates that many might not use the tools at all. In general, the answers reveal a trend toward employing AI as an all-purposing tool for collecting data, constructing frameworks, and as an auxiliary tool when approaching multiple issues in academic environments.

The responses to "What skills do you think are most helpful to solve problems, and how do you think AI tools affect these skills?" provide a clear focus on critical thinking, creativity, and analysis that are mandatory among problem-solving processes. Similar observations were made regarding the positive and negative uses of AI tools where most of the participants admitted the fact that some AI tools can assist in giving insights, automating some tasks, and giving diverse viewpoints; but the same participants also commented that an over-reliance on AI tools hurts these same skills. Several of the responses highlighted that AI discourages the requirement of independent idea generation or, thinking on one's own. A handful of responses mentioned that one needs to get to grips with the root of the problem before applying technology and having the ability to think on the part of nonhuman actors. Further, several respondents pointed to the significance of developing certain critical thinking skills to be able to differentiate between useful data and mistakes that can often be encountered in the context of AI answers. Such consensus underlines the fact that despite the recognition of AI as a desirable business asset, its incorporation into the problem-solving processes must be reasonable enough so that the skills required for critical and self-directed work are not diminished.

The study revealed that the usage of AI tools is well embraced among the students with over 70% of them using the tools frequently when solving problems. This enunciates the hypothesis that dependence on AI is propagated when students' practical problem-solving skills are deteriorating, because a significant number of respondents complained about 'laziness,' and the degeneration of critical thinking skills. This is also discussed by previous authors, stating that while AI algorithms can improve time and add more options, they can also limit the learning of important features if applied too frequently. For example, research reveals that learners relying on innovations to solve problems demonstrated weaknesses in analyzing and being innovative.

Possible causes for increased reliance on AI instruments may include easy getting to the details and answers, which might be especially valuable for learners on the stress of academic performance. However, this dependence can serve as a negative aspect since it causes a reduction in critical thinking and problem-solving skills. Notably, some participants expressed a belief that AI tools could enhance their problem-solving abilities because those tools present 'new ways of thinking' about the problem, which here revealed another dualistic opinion about the use of AI. Based on this, it was found that there is a need to use AI as a source of additional information and that controlling the use of AI is important because allowing students to solve tasks using AI, but not creating their algorithm themselves inhibits their cognitive growth. While a part of students reported increased performance with the help of AI there is a necessity to focus on the possibilities of utilizing such applications in the educational process without the detriment to key cognitive skills.

Conclusion

In conclusion, this paper establishes the connection between students' use of AI tools and their performance on specific problems that may exist or not exist in their learning process. Major revelations suggest that though more than one participant stated that they often use AI, they also had many objections; one of the most common was the feeling that AI will lead to complacency and reduce critical thinking skills. Overall, these outcomes show that AI should be integrated into educational practices effectively and equitably so that learners do not lose important cognitive skills while learning technological skills. Perhaps, educators and policymakers should set guidelines, that would encourage the use of AI and apply it as a secondary tool, allowing students to practice critical thinking, self-study, and analysis. The study has some limitations that include issues with sample size and matriculation achievements, which call for broader research to identify the impact of AI on learners in different educational settings. Subsequent research should examine whether dependency on AI affects problem-solving abilities and should look into how to implement AI in learning environments while preserving academic skills. Finally, this research establishes the importance of integrating AI tools with other means of training to achieve the proper development of cognition in students.

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