

THE ROLE OF AI IN MATHEMATICS EDUCATION: ASSESSING THE EFFECTS OF AN 'AUTO DRAW' WEBTOOL ON MIDDLE-LEVEL ACHIEVEMENT

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ABSTRACT

This study investigates how artificial intelligence (AI) affects middle school students' academic performance. Although AI has the potential to revolutionize education, obstacles including poor data quality and a lack of skilled employees prevent its integration. The study examines the impact of an AI-based web tool called Auto Draw on maths success, identifies integration issues, and establishes the skills required for productive AI use in classrooms using a combination of methodologies. The quantitative research shows that employing Auto Draw has significantly improved students' learning outcomes. The qualitative investigation emphasizes the necessity of teacher preparation programs, and legislative frameworks, and acknowledges AI as a supplementary tool while valuing the human component in education.

INTRODUCTION

Technology has been a key factor in the evolution of humans throughout recorded history, transforming us from cavemen to the technologically dependent people we are today (Smith, 2018). technology has permeated every facet and aspect of our lives, finding applications in a wide range of areas (Payal & Kanvaria, 2018). The internet, which has radically changed communication and information sharing in what is now known as the Information Technology Age, is without a doubt the most important modern development.

We have reached the apex of human technological development in the twenty-first century. Our progress from making tools out of bones and stones to building robots that are capable of thinking and reasoning like humans are best illustrated by the development of driverless cars (Anderson, 2020). Artificial intelligence (AI), which includes cognitive functions like problem-solving, learning, and judgment that are similar to those of the human brain, has permeated every aspect of our daily life. Personalized search engines and location-based suggestions are two examples of AI technologies that impact our behaviour and have the capacity to make complex decisions on our behalf, so influencing our future experiences. We are witnessing the dramatic impact of technology in revolutionizing numerous sectors, with AI already making important contributions to sectors including senior care, retail, and education (West, 2019).

NEED FOR STUDY

Implementation goals, usage contexts, deployment, and the levels of application among persons, institutions, and larger educational networks are just a few of the critical variables that must be taken into account in order to fully realize AI's potential in education. "Learning with AI," "Using AI to learn about learning," and "Preparing for AI" are the four key subcategories of the integration of AI in education (Rawson et al., 2019).

Technology has always been essential to education, enhancing accessibility and fostering more stimulating learning settings (Nath, 2022). Radio and television increased educational options, while the Gutenberg press revolutionized how books might be obtained. The ability for pupils to learn at their own pace thanks to the Internet has further changed education. AI has recently become an effective tool in education, with the potential to improve administrative procedures and instructional techniques.

AI may help with a variety of administrative chores, including course recommendations based on student profiles and student registration. Additionally, it can pinpoint students' weak points and offer specialized assistance. AI may also analyse the demands of the labour market and assist organizations in creating courses that place a strong emphasis on employability. The UN Sustainable Development Goal 4, which aspires to promote high-quality, egalitarian education by utilizing technology, is in line with integrating AI into education.

It's critical to understand cognitive development and the competencies required to use AI in education in order to completely comprehend the impact of AI on student learning results. However, there is little study on how AI affects teaching methods and how it is incorporated into different disciplines (Klutka et al., 2020). The effects of AI-based tools in classrooms on student learning outcomes require more investigation.

AI has had a big impact on education, opening up access and changing the way people study. The adoption of AI in education holds forth hope for improving operational procedures and instructional strategies. Understanding how AI affects students and examining its potential in many academic areas can open up new avenues for a comprehensive and successful educational system.

THE OBJECTIVES OF THE STUDY

As Researcher is seeking to measure the learning achievement of students when they receive instruction from AI tools in the classroom. As a result of this study, we will be able to:

1. Assessing student math learning with AI.
2. Examine teachers' awareness of AI.
3. Identify challenges in AI integration.
4. Determine essential skills for AI implementation.

THE HYPOTHESES OF THE STUDY

Various hypotheses laid down to study the level of achievement in students are as follows:

1. H1: There is no significant difference in the post-test result of the control and experiment groups.

REVIEW OF LITERATURE

The integration of AI in education has garnered significant attention in recent years. The CBSE Academic publication (2018) emphasizes the inclusion of AI as a subject in the secondary school curriculum to equip students with essential AI skills. Jaiswal and Arun (2021) emphasize the transformative potential of AI in providing personalized and inclusive learning experiences that cater to individual student needs. Sandu and Gide (2019) discuss the use of AI-based chatbots in higher education to enhance student support and engagement. Yadav (2020) compares AI-driven virtual learning with traditional classroom learning, highlighting the benefits of personalized instruction and real-time feedback. Kim, Lee, and Cho (2022) explore pedagogical approaches for student-AI collaboration, fostering personalized and interactive learning experiences. Kaviyaraj and Uma (2021) look at the uses of augmented reality and AI in the classroom. Holmes et al.'s (2021) discussion of the ethical issues surrounding AI in education places a focus on the necessity of ethical behavior. Tewari et al. (2020) talk about AI-enhanced sustainable education in India. An adoption paradigm for AI-based chatbots at higher education institutions is presented by Rahim et al. in 2022. In their study of AI's potential in health education, Sousa et al. (2021).

Rane (2023), Celik et al. (2022), Buscher (2020) and Vincent-Lancrin and Van der Vlies (2020) explore the potential of AI in math education, highlighting both its promising benefits like personalized learning and adaptive feedback, as well as potential challenges like ethical considerations and teacher integration. UNESCO report emphasizes the potential of AI to address educational challenges and promote quality learning for all. It provides valuable insights into ethical considerations and responsible AI development in education (UNESCO, 2019). The studies by Park and Baek (2020) and Lagrange, Richard, Velez and Van Vaerenbergh (2023) investigate the impact of dynamic geometry software, another form of technology in math education, on students' spatial reasoning and achievement in geometry. The findings provide valuable comparisons and insights into the potential of AI for similar outcomes. Chiou and Lawson (2015) examine the effectiveness of dynamic geometry software for middle school students' understanding of area and perimeter. While not directly related to "Auto Draw," they provide valuable context for the impact of visual and interactive tools on mathematical learning at this age group. Kanvaria and Suraj (2023) provides an insightful overview of tools in education and management amidst artificial intelligence. Additionally, Kanvaria and Tomar (2023) explore the realm of personalized learning through artificial intelligence. Shulman's framework of pedagogical content knowledge (PCK) (Shulman, 1986) emphasizes the importance of teachers' understanding of both the subject matter and how to effectively teach it. This strengthens the discussion of the role of teachers in effectively integrating technological tool into their pedagogy. Building on Shulman's PCK and Koehler's TPCK framework, Mishra and Koehler (2006) highlights the importance of teachers' understanding of technology to effectively integrate it into their teaching. They stress upon teachers' preparedness and professional development needs for using ICT tool effectively. The studies by Cheng, Lu, Xie and Vongkulluksn (2020) and Ottenbreit-Leftwich, Kopcha and Ertmer (2018) investigate the relationship between teachers' confidence in using ICT tools and student achievement.

The revolutionary potential of AI in pedagogical techniques, student assistance, personalized learning experiences, ethics, sustainability, and health education is generally highlighted by these studies. AI has the potential to improve educational outcomes across a range of educational settings, support inclusivity and personalized learning, and enhance teaching and learning processes.

METHODOLOGY:

Using a Mixed Method approach, the research seeks to investigate how students learn and how they view the role of AI in the learning process. To properly handle the research problem, both qualitative and quantitative methodologies are used.

RESEARCH DESIGN:

For this study, a convergent parallel design was adopted because it enables independent analysis of the research topics before combining the findings. With the use of this approach, it is possible to investigate how students' views towards AI-based tools affect their learning outcomes.

The simultaneous gathering and analysis of qualitative and quantitative data is a component of convergent parallel design. During the interpretation phase, the goal is to synthesise the findings from the two approaches in order to develop a thorough understanding of the research topic.

SAMPLE AND SAMPLING:

In order to choose the study's participants and school, a purposive sampling technique is used. Due to the small number of schools utilizing AI in their teaching processes, a private school was chosen. Using the odd-even method, 70 students are chosen from a group of 152 depending on their performance in prior classes. Due to the small number of schools implementing AI, the perspective of AI among instructors is also evaluated through purposive sampling.

TOOLS OF STUDY:

Tools of all kinds are created to gather data for the investigation. These tools were created with the study process and the necessary data in mind. To ensure unbiased findings, pre- and post-achievement assessments are developed in collaboration with a subject teacher from a different university. A checklist, a semi-structured interview schedule for teachers, focused group discussions (FDG), and other tools are also employed.

PROCEDURE FOR DATA COLLECTION:

A convergent parallel mixed-method design is used in the study. Data that is both quantitative and qualitative is gathered at the same time. Pre-test and post-test achievement tests given to the control group and the intervention group are included in the quantitative data. To ascertain any variations brought about by the use of AI techniques, the same 23-item set of questions is distributed to both groups. The topic instructor in the intervention group uses the offered teaching manual while utilizing AI tools as part of the teaching process.

Utilizing interview schedules and questionnaires, quantitative data also covers gauging how instructors and students feel about the use of AI tools in the teaching-learning process. Focus groups, telephonic semi-structured interviews, and online and in-person questionnaires are all used to obtain qualitative data.

DISCUSSION AND ANALYSIS

QUANTITATIVE ANALYSIS AND FINDING

In this study, the researcher used a paired t-test to analyze the effect of an AI tool called Auto Draw on the achievement scores of sixth-grade children in mathematics. Quantitative data analysis is a crucial part of the research. When comparing two similar groups at different times, such as students in separate classrooms, students taking pre- and post-tests, or people being evaluated before and after an exercise program, the paired t-test is appropriate.

Control		Experimental	
Mean	17	Mean	17.34286
Median	17	Median	18
Mode	15	Mode	19
Standard Deviation	3.580996	Standard Deviation	3.161746
Kurtosis	-0.69928	Kurtosis	-0.46949
Skewness	0.41981	Skewness	-0.28721

Table 1 Descriptive Statistics of Pre-test Achievement Scores of Experimental and Control

Descriptive statistics of the experimental and control groups' pre-test achievement scores. The mean and median scores for both groups were remarkably similar, indicating comparable performance levels prior to the trial.

However, the experimental group's mode value was somewhat higher, indicating that more students in that group received good marks. The kurtosis values revealed slightly right-skewed distributions, although the standard deviation indicated only minor variation in the pre-test scores.

Control		Experimental	
Mean	17.3142857	Mean	18.51429
Median	18	Median	19
Mode	20	Mode	18
Standard Deviation	3.00755352	Standard Deviation	2.737232
Kurtosis	-0.904942	Kurtosis	-0.53598
Skewness	0.0159896	Skewness	-0.29477

Table 2 Descriptive Statistics of Post-test Achievement Scores of Experimental and Control Groups

The post-test achievement scores were analyzed using similar descriptive statistics. In comparison to the control group, the experimental group performed marginally better, as evidenced by higher mean and median scores. The mode values showed minor variations in the proportion of students receiving high scores. The kurtosis values revealed that both groups' distributions were slightly right-skewed, and the standard deviation suggested that there was only minor variation.

Test	Group	No of Student	Mean	Standard Deviation	t' value	Level of Significant
Experimental Group Pre and Post-Test	Pre	35	17.34	2.737	1.798519	Significant
	Post Test	35	18.51	3.008		

Table 3 Comparison of Experimental Group Pre and Post-Test

T-tests were used to assess the significance of the mean differences in pre- and post-test scores between the experimental and control groups. The findings revealed no discernible change in the pre-test scores across the groups. Although there was a substantial difference in the post-test results, which showed that the experimental group had higher accomplishment levels.

QUALITATIVE ANALYSIS AND DISCUSSION

In this study, the researcher gathered information from instructors to investigate their perceptions of, and expectations for, the integration of AI in the educational environment. A number of themes were found, including the fundamental understanding of AI, applications of AI in the classroom, necessary skill sets, perceptions of AI in the workplace, policy and ground reality mismatches, and integration hurdles. Three qualitative research methods were used by the researcher: surveys, focus group talks, and interviews.

The majority of interviewees struggled to adequately explain AI, frequently conflating it with fundamental technological ideas. Only a small percentage of respondents correctly defined AI as robots' ability to simulate human intelligence. Some people suggested social media sites and AI-based testing when questioned about the applications of AI.

Respondents had trouble naming direct applications of AI in the classroom, although they did highlight indirect ones like employing AI-powered tools for creating presentations and language correction software. They emphasized the advantages of these instruments in terms of time savings and skill development, encouraging their usage.

The study investigated the teachers' technological aptitudes as well. While the majority of respondents had a fundamental comprehension of Google Meet and Zoom, many lacked in-depth technical knowledge. They received little instruction in digital technology throughout their teacher training, and some schools' inadequate infrastructure made it difficult for students to acquire their skills.

The way that teachers viewed AI differed. While many acknowledged its importance and ability to revolutionize education, worries regarding job stability were voiced. Respondents acknowledged the possibility of using AI to help with the workload and personalize learning, but they also voiced concern about being replaced by it in activities like appraisal.

Participants called attention to concerns with insufficient infrastructure, poor connectivity, and insufficient funding for education as well as gaps between policy implementation and the reality on the ground. Lack of knowledge, the stigma attached to technology, and the requirement for structural changes in teacher education were all obstacles to the integration of AI.

Participants in the FGD emphasized the need for a better understanding and training in AI, the influence on teacher positions, and the issues coming from the gap between policy and ground reality, which provided additional support for these findings.

The study shed light on teachers' perceptions, barriers, and expectations regarding AI integration in education, emphasizing the importance of addressing skill gaps, infrastructure limitations, and policy implementation challenges.

FINDING AND CONCLUSION

The quantitative findings of the research indicated that the utilization of the AI web-based tool Auto Draw as a teaching aid had a notable positive effect on the learning achievement of students in mathematics. Specifically, there was no significant difference observed in the pre-test scores between the control and experimental groups, suggesting that all students were initially at a similar level. However, there was a significant difference in the post-test scores between the two groups, indicating that the implementation of the AI tool had a positive impact on student achievement. Furthermore, within the experimental group, the post-test scores showed a significant improvement compared to the pre-test scores, indicating that the intervention with the AI tool facilitated better performance in examinations. Conversely, no significant difference was observed in the achievement of the control group between the pre-test and post-test, suggesting that traditional instructional methods did not bring about substantial changes in student achievement.

The research's qualitative findings primarily addressed three goals: the degree of teacher awareness of artificial intelligence (AI), the difficulties in implementing AI in the classroom, and the fundamental skill set required for successfully implementing AI tools in educational settings. The qualitative analysis found that teachers generally had a neutral view about their knowledge of AI, indicating a lack of thorough comprehension of AI ideas and its real-world applications. However, educators admitted that the use of AI-based language tools like Grammarly has increased their productivity. Additionally, they understood how AI could improve lesson planning, cater to the requirements of particular students, and facilitate efficient monitoring and evaluation.

Infrastructure issues including poor internet access and a lack of trustworthy data banks were among the difficulties in integrating AI into the classroom that were discovered. It was also noted that there was no special AI policy for education, highlighting the demand for thorough regulations including ethical and sociological issues. Given the differences in cost and infrastructure across various locations and nations, questions of equity in access to AI education also surfaced. Additional difficulties were recognized, including a lack of qualified AI professionals and probable pushback from educators due to worries about their jobs.

The research found crucial abilities like AI literacy, communication skills, and the inclusion of AI interaction courses in teacher education as part of the skill set needed for successfully implementing AI tools. Teachers showed a desire to learn more about AI and its application in the classroom since they were aware of the possible implications for their profession and the changing nature of education. Although teachers saw AI's potential to revolutionize education favorably, they also expressed scepticism about the technology's drawbacks.

The research demonstrated that the use of the AI web-based tool Auto Draw as a teaching aid positively influenced student achievement in mathematics. The qualitative findings shed light on the level of awareness among teachers, challenges in integrating AI, and the crucial skill set needed for a successful transition to AI tools in the classroom. These insights have implications for educational practice and underscore the potential benefits of integrating AI tools into the curriculum to enhance learning outcomes.

RECOMMENDATION

1. Integrate AI into education: Look into practical ways to use AI tools in the educational system to boost student achievement and the learning process.
2. Promote awareness and training: Through in-service training programs, raise teachers' understanding of AI and its potential in the classroom. To encourage a favorable attitude towards AI integration, address worries and misconceptions.
3. Establish clear AI regulations and guidelines that specify the function of AI in education while taking ethical, sociological, and equity factors into account. Make sure AI is included in a way that benefits society and protects the critical function of human educators.

4. Invest in infrastructure improvements, particularly dependable internet connectivity, to support the use of AI tools in the classroom. To ensure that all students have equal access to technology, address access inequities.
5. Promote research and innovation: Promote the construction of AI research centers that are focused on figuring out how to best apply AI in education. In order to investigate the possible advantages and difficulties of AI integration, encourage continual research and innovation.

These suggestions are meant to encourage the careful incorporation of AI tools into the educational process, making sure that they are used to improve the teaching and learning procedures while taking into account the ethical, social, and practical ramifications. We can maximize the promise of AI in education by embracing it and providing the required infrastructure, support, and knowledge.

CONCLUSION

The effect of AI on middle-level pupils' academic achievement is highlighted in this study. The results highlight AI's potential to revolutionize the learning process while also pointing out integration issues. The study examined the use of the AI-based application Auto Draw in mathematics using a mixed methods approach. Quantitative findings showed a substantial difference in learning accomplishment between the experimental and control groups, illuminating Auto Draw's beneficial effects on students' test scores. The qualitative analysis shed important light on the level of knowledge of AI among teachers, obstacles to its successful integration into the classroom, and necessary skill sets.

The study's conclusions lead to a number of recommendations. Enhancing learning experiences through the use of AI is critical, and teacher education courses must include AI concepts and technologies. Teachers' knowledge and competency in using AI effectively would grow if in-service training were provided. Creating explicit policies for the incorporation of subpar AI is crucial, with an emphasis on AI as a supplementary tool rather than a substitute. Successful AI integration requires infrastructure upgrades, dependable data banks, and enough government financing.

This study highlights the enormous potential of artificial intelligence in education and emphasizes the necessity for proper integration. The guidelines can help educational institutions use AI to improve learning opportunities while preserving the crucial role of human interaction. Learning environments that are more effective and inclusive will result from further investigation and study into AI in education.

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