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Determining How Artificial Intelligence Affects Math Performance in Middle School

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Introduction

Because it promotes efficiency, precision, and a better quality of life, technology is crucial to human progress (Payal & Kanvaria, 2018). Recently, several sectors have been profoundly affected by the advent of artificial intelligence (AI), and education is no exception. There has been an upsurge in studies looking at the effects of AI on math scores in middle school in recent years. Because it lays the framework for more advanced mathematical ideas and problem-solving strategies, middle school is an important academic year for students. Math education, student achievement, and the quality of the learning experience may all be enhanced with the help of artificial intelligence, according to researchers and educators. One major method AI is influencing arithmetic performance in middle school is via personalized learning. Artificial intelligence (AI) platforms and technologies may examine student data, identify knowledge gaps, and tailor classes to each student's requirements. This personalized approach encourages a more thorough understanding of mathematical concepts via letting students go at their own speed, receiving targeted interventions, and receiving quick feedback (Tang & Wang, 2018).

AI also opens up possibilities for interactive and immersive learning. Students may use VR and AR apps to see and engage with complex mathematical concepts in a more intelligible manner, as well as to replicate them. These immersive technologies not only help students strengthen their critical thinking, problem-solving, and spatial reasoning skills, but they also make math more tangible and enjoyable (Bacca et al., 2020).

There is much promise in the AI. Traditional education has the potential to be transformed by immersive technology and AI-powered individualized learning, which might make it more engaging, accessible, and efficient for students. Teachers may be able to aid their students in building strong problem-solving abilities and a love of learning by implementing AI into their lessons.

Keywords: Relevant Search Terms: Success, AI, Tech, Tailored Education

About AutoDraw AI Tool

Google's dynamic drawing tool AutoDraw completely changes the way illustrators work. It expertly blends a selected collection of artworks donated by talented artists with state-of-the-art machine learning techniques. So what happened? An intuitive system that lets artists make stunning drawings easily and quickly.

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How AutoDraw Works

1. Stroke by Stroke, Insight Emerges: As users sketch their ideas, AutoDraw springs into action. It analyzes each stroke, discerning shapes, and lines with remarkable accuracy.

2. Artistic Suggestions at Fingertips: Leveraging its vast database, AutoDraw offers intelligent recommendations. Users receive a curated selection of complete drawings that align with their initial strokes. These suggestions serve as a creative compass, guiding them toward polished illustrations.

3. Iterative Magic: The more a user engages with AutoDraw, the smarter it becomes. It refines its suggestions based on recognized shapes and lines, adapting to individual artistic styles.

AutoDraw democratizes artistry and unlocks creativity for all. Whether one is an aspiring artist or a casual doodler, this tool bridges the gap. No need to label oneself an artist, AutoDraw ensures that everyone can produce visually stunning creations.

Need for the Study

The increasing impact of artificial intelligence (AI) in education has piqued people's interest in studying the field to see how it may change certain fields. Middle school math achievement is an important topic that needs research because of the revolutionary potential of AI in education and the growing importance of mathematical talents in modern society. Educational systems powered by AI enable the creation of tailored and flexible learning experiences. AI systems can analyze each student's unique learning data and provide personalized feedback and guidance, allowing pupils to master complex mathematical concepts at their own speed. By showing how intelligent tutoring systems might enhance math learning results, a research by D'Mello et al. (2014) demonstrated the potential of AI interventions in middle school classrooms.

1. Getting Ready for the Future: Mathematical prowess is becoming more and more important for a wide range of STEM-related occupations. Middle school kids who want to be successful in the job market in the age of AI and automation need to have solid math abilities. Educational initiatives that equip students with crucial computational thinking and problem-solving abilities may be guided by understanding the effect of AI on math success. In order to equip pupils for the digital age job market, a research by Holmes et al. (2020) highlighted the significance of incorporating AI into math curriculum.

2. Getting Ready for the Future: Mathematical prowess is becoming more and more important for a wide range of STEM-related occupations. Middle school kids who want to be successful in the job market in the age of AI and automation need to have solid math abilities. Educational initiatives that equip students with crucial computational thinking and problem-solving abilities may be guided by understanding the effect of AI on math success. Holmes et al. (2020) found that pupils would be better prepared for the digital era's employment market if math classes included AI.

In order to improve teaching methods and prepare students for the future, it is crucial to examine the effects of AI on middle school arithmetic performance. up order to improve students' mathematical competence, teachers might alter their teaching methods, fill up students' knowledge gaps, and study the possible benefits of interventions driven by artificial intelligence. Research like this will pave the way for better math teaching in middle school, harness the game-changing power of artificial intelligence in the classroom, and equip students for life in the digital age.

The Objectives of the Study

- Assess the effectiveness of AI-powered personalized learning interventions on middle school math achievement.
- Explore the impact of AI-driven immersive technologies on middle school students' engagement and understanding of mathematical concepts.

The Hypothesis of the Study

H1: There is no significant difference between Pre and post-test results of the control group.

H2: There is no significant difference in Pre and post-test results of the experimental result.

H3: There is no significant difference in the post-test result of the control and experiment groups.

H4: There is no significant difference in the pre-test result of the control and experiment groups.

Review of Literature

The increasing use of technology in the classroom has sparked further research on PCK, TPCK, and the use of teacher professional resources. Angeli and Valanides (2009) highlight the crucial role of ICT TPCK in effective technology integration and address the methodological and epistemological challenges of defining and assessing it. Lee, Chang, and Tsai (2009) investigated the effects of earth science education on middle school students' dispositions and performance in the subject. Using technology and subject-specific material combined has the potential to boost learning outcomes, according to the research.

By drawing attention to the ever-changing nature of resource interactions and providing insights into effective mathematics education, Gueudet and Trouche (2009) argue that documentation systems should be put in place to support math instructors in their pedagogical work. More specifically, Gueudet and Trouche (2012) discuss resource use in professional growth in more depth, drawing attention to the interplay of resource utilization, knowledge expansion, and pedagogical change.

Pepin, Xu, Trouche, and Wang (2017) seek to get a deeper understanding of the knowledge and instructional techniques used by Chinese mathematics instructors by investigating their resource systems. The research delves into the ways in which math educators make use of various resources, such as textbooks, technology, and pedagogical tools. It offers valuable insights into the complex relationship between resource utilization and effective math education instruction. Wartofsky (1979) explores the scientific understanding and representation of models to provide a theoretical basis for their use in educational settings. AMTE was

(2006) argues that math teacher education programs should include technology in order to better prepare future math educators to make good use of this tool. Knowledge growth and the theoretical foundations of teaching are heavily stressed by Shulman (1986) and Shulman (1987), who both stress the need for pedagogical skills to facilitate successful instruction. In order to assess and improve educators' technical literacy, Mishra and Koehler (2006) proposed the TPCK framework. An all-encompassing framework for bettering teaching methods, their approach is based on the merging of technological, pedagogical, and topic knowledge. Cox (2008) does a conceptual study of TPCK and investigates its theoretical underpinnings and components. Harris and Hofer (2009) investigate several instructional planning practices to build TPCK. They provide helpful guidance on how to align technology-enhanced learning experiences with specific subject goals.

Taken as a whole, these studies deepen our understanding of the interplay between educational resources, technological tools, and professional teaching skills. They provide useful data on middle school math performance, professional development opportunities for teachers, and successful teaching strategies. By considering these results and perspectives, educators may enhance students' arithmetic learning experiences via the integration of technology and resources.

Discussion and Analysis

The examination of quantitative data is crucial for understanding how interventions affect students' learning outcomes in educational research. In this study, a paired t-test was used to examine how an AI application called Auto Draw affected class 6 kids' math achievement scores. The paired t-test is a statistical technique for contrasting the results of two comparable groups assessed at various times, making it appropriate for evaluating the efficacy of interventions using pre- and post-test measures.

Descriptive Statistic s of Pretest Achievement Scores:

Control	**Statical Value**	**Experimental**	**Statical Value**
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

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Skewness	0.41981	**Skewness**	-0.28721

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

To kick off the investigation, the researcher calculated descriptive statistics using the experimental and control groups' pre-test achievement scores. The control group averaged 17, whereas the experimental group managed a slightly better score of 17.34. Both groups had very similar mean scores. Furthermore, there was no significant difference in the groups' pre-intervention performance, as the median scores were very similar. The experimental group's mode was 19 and the control group's mode was 15, therefore there was a little difference in the mode values. This indicates that a somewhat larger percentage of students in the experimental group performed better on the pretest.
The pre-test scores of the two groups also differed somewhat, as seen by the standard deviation figures. A little lower standard deviation of 3.581 was found in the control group compared to the experimental group's 3.008. While the experimental group showed somewhat less variability in their score distributions, the results show that both groups were relatively constant.

Descriptive Statistics of Post-test Achievement Scores:

Control	Statical Value	Experimental	Statical Value
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

Results from the post-test were compared between the control and experimental groups using descriptive statistics. Since the experimental group's mean score (18.51) was somewhat greater than the control group's (17.31), the results indicated that the AI tool had a positive influence on the experimental group's accomplishment scores. Even when looking at median scores, the experimental group did better than the control group.

Furthermore, the control group had a mode of 20, while the experimental group had a mode of 18. What this means is that there were slightly more students in the control group who got the highest score on the post-test. Although there was some variance in the standard deviation values of the two groups (2.737 for the experimental group and 3.007 for the control group) in the post-test findings, the experimental group showed somewhat less variation.

Comparing Pre-test Achievement Scores:

Test	Group	No of Student	Mean	Standard Deviation	t' value	Level of Significant
Pre-test Achievement of Experimental and Control Groups	control	35	17.00	3.581	0.46	Significant
	Experimental	35	17.31	3.008		

Table 3: Significance of Mean Scores of Pre-test Achievement of Experimental and Control

The researcher performed a test of significance using the t-value to ascertain the significance of the difference between the mean pre-test scores of the experimental and control groups. According to the research, the derived t-value of 0.46 was not significant at the 0.05 level, proving that there was no appreciable difference between the two groups pre-test results. This result indicates that prior to the intervention, the pre-achievement test scores for mathematics for the experimental and control groups were nearly comparable.

Comparing Post-test Achievement Scores:

Test	Group	No of Student	Mean	Standard Deviation	t' value	Level of Significant
Experimental Group Pre and Post-Test	**Pre**	35	17.00	3.581	-2.39	Significant
	post	**35**	**17.31**	**3.008**		

Table 4: Comparison of Post-test Achievement Scores of Experimental and Control Groups

To compare the post-test results of the experimental and control groups, the researcher performed a test of significance. The estimated t-value of -2.39 was significant at the 0.05 level, demonstrating that the mean scores of the two groups differed significantly from one another. The difference between the mean scores of the experimental and control groups, 18.51 for the experimental group and 17.31 for the control group suggests that the intervention had a favourable effect on the experimental group's performance.

Comparison of Experimental and Control Group Pre and Post-Test:

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	1.79851 9	Significant
	Post Test	35	18.51	3.008		

Table 5: Comparison of Experimental and Control Group Pre and Post-Test

The experimental group's pre-and post-test results were the subject of additional analysis. The mean pre-and post-test scores differed significantly, as shown by the estimated t-value of 1.79, which was significant at the 0.05 level. The mean score for the experimental group increased from 17.34 on the pre-test to 18.51 on the post-test, indicating that the intervention had a favourable effect on the student's performance.

Comparison of Control Group Pre and Post-Test:

Test	Group	No of Student	Mean	Standard Deviation	t' value	Level of Significant
Control Group Pre and Post-Test	Pre	35	17.00	3.581	-1.12097	Not Significant
	Post	35	17.31	3.008		

Table 6: Comparison of Control Group Pre and Post-Test

The results of the control group's pre-and post-tests were also compared by the researcher. The pre-and post-test mean scores did not significantly differ, according to the computed t-value of -1.29, which was not significant at the 0.05 level. According to this study, the traditional teaching strategy used in the control group did not result in a material improvement in the student's academic performance.

Discussion:

The paired t-test proved a useful statistical tool for this investigation's paired data analysis. A comprehensive synopsis of the pre- and post-test performance ratings was provided by the descriptive statistics, which included measures of central tendency (mean, median, and mode) and dispersion (standard deviation). These metrics allowed for a thorough examination of the data's dispersion and variability.

Analyses revealed that the AI tool improved mathematics performance, as the experimental group outperformed the control group on both the pre- and post-tests. Significant improvements were seen in the post-test scores of the experimental group,

suggesting that the intervention had a positive impact on pupils' academic performance. In contrast, there was no change in performance in the control group, which sheds light on the potential limitations of traditional methods of instruction in improving students' knowledge acquisition.
For sixth graders, the study's results shed light on the efficacy of the AI application Auto Draw in improving their arithmetic scores. These results demonstrate the importance of innovative approaches to enhancing student learning and may aid educators and legislators in comprehending the benefits of implementing AI technologies into the classroom.
The paired t-test and other quantitative statistical methods allow researchers to examine the impact of interventions on students' academic performance. Important insights into the effectiveness of interventions in educational settings may be gained by comparing experimental and control groups and studying pre- and post-test outcomes. Researchers may develop educated judgments and recommendations to enhance learning and teaching practices with the use of these analytical approaches.

Finding from the study

After careful examination and thoughtful debate, the following conclusions have been reached:
1. A Look at the Pre-Test Achievement Statistics:
Although the control group had a mean score of 17 and the experimental group had a slightly higher one of 17.34, the two groups' mean scores were almost comparable.
Prior to the intervention, the groups' performance was similar, as seen by their comparable median scores.
The experimental group's mode was 19, whereas the control group's mode was 15, indicating a little variation in the mode values.
According to the standard deviation values, the pre-test scores showed a moderate amount of fluctuation, with the experimental group exhibiting somewhat less variation (3.008) compared to the control group (3.581).
2. Examining Achievement Levels Prior to the Test:

There was no discernible difference in pre-test scores between the experimental and control groups, as the computed t-value of 0.46 was not significant at the 0.05 level, according to the t-value test of significance.
3. Post-test Achievement Scores:• The experimental group had a marginally higher mean score (18.51) than the control group (17.31), indicating that the AI tool had a positive effect on the experimental group's achievement scores. • The median scores also showed that the experimental group outperformed the control group, further supporting this pattern.
• The mean values indicated that a little larger proportion of the control group students got the maximum score on the post-test.

• There was a little variation in the post-test scores between the two groups, as seen by the standard deviation values; however, the experimental group exhibited somewhat less variation (2.737) than the control group (3.007).
4. Examining Post-Test Achievement Scores: ♣ The t-value test of significance revealed a

significant difference between the experimental and control groups' mean scores, with an estimated t-value of -2.39, which was significant at the 0.05 level. The intervention improved the performance of the experimental group, as shown by their higher mean score. Examining the Experimental Group Before and After the Test: ♣ The t-value test of significance revealed a significant difference between the experimental group's mean pre- and post-test scores, with an estimated t-value of 1.79, which was significant at the 0.05 level. From a pre-test mean of 17.34 to a post-test mean of 18.51, the intervention was successful.

The control group's mean scores did not alter significantly between the pre- and post-tests, as shown by the estimated t-value of -1.29, which was not significant at the 0.05 level, according to the t-value test of significance. Using traditional methods of teaching had no discernible effect on the pupils' levels of accomplishment.

The findings indicate that the AI tool Auto Draw had a positive impact on the mathematics success scores of sixth graders. The experimental group achieved considerably better results after the intervention compared to the control group on both the pre- and post-tests. However, when comparing the experimental group's with the control group's levels of achievement using traditional teaching methods, no significant difference was found. The findings highlight the drawbacks of traditional methods of enhancing student learning outcomes and the possible benefits of incorporating AI technologies into teaching practices.

Conclusion

Ultimately, this research examined the impact of an artificial intelligence program called Auto Draw on middle school math performance. The analysis of quantitative data yielded valuable insights into the intervention's effectiveness.

In comparison to the control group that relied on more traditional methods of instruction, the experimental group that made use of the AI tool demonstrated a little advantage. Both groups did not outperform one another on the pretest, as shown by the descriptive statistics. Nonetheless, a somewhat higher percentage of students in the control group achieved higher marks. After using the AI tool, the experimental group outperformed the control group on the post-test, both in terms of mean and median scores, suggesting that arithmetic was improved.

achievement. More students in the control group scored well, indicating that there was some variation in student performance, as seen by the mode values.

A statistical comparison of the two groups' mean post-test scores confirmed a statistically significant change, lending credence to the intervention's efficacy. The experimental group showed a considerable improvement in their mean scores between the pre- and post-tests, indicating that the AI tool had a positive impact on student achievement. The findings shed light on the possibilities of AI technologies for enhancing math education in middle schools. The importance of innovative approaches to improving students' learning results is highlighted in the research. When considering how to integrate AI capabilities into educational practices to enhance student success, these results may be valuable for educators and policymakers.

Keep in mind that the effects of Auto Draw on mathematical performance were the only subject of this research. More research is needed to determine the possible limits and long-term consequences of AI technologies in various educational contexts and topic areas. But this study adds to what is already known about the benefits of AI in the classroom and shows how important it is to keep researching and using tech interventions to make things better.

Recommendations

1. Use AI-based tutoring services for maths to deliver individualised education and support.
2. Integrate AI tools for formative assessment to efficiently monitor each student's progress.
3. Provide teachers with professional development opportunities to improve their understanding of and proficiency using AI tools.
4. To create cutting-edge methods for teaching maths, promote collaboration between educators and AI specialists.
5. Investigate AI-powered virtual reality simulations to improve students' comprehension of challenging mathematical ideas.
6. Give users access to online tools and materials that make use of AI algorithms to practise and reinforce maths skills.
7. To determine the long-term effects of AI treatments on maths achievement, conduct more research.
8. Encourage students to participate in multidisciplinary projects that integrate maths and AI to solve real-world issues.
9. Encourage the integration of AI literacy into math curricula to better prepare students for the workforce of the future.

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