EFFECTS OF USING ARTIFICIAL INTELLIGENCE IN TEACHING MATHEMATICS

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Abstract. Artificial intelligence (AI) is rapidly transforming various facets of human life, including education. This research examines the effects of using AI in teaching mathematics, focusing on student engagement, personalized learning, and educational outcomes. By leveraging a variety of AI applications, teaching methodologies have evolved, promising a more interactive and efficient learning experience. This study employs quantitative and qualitative methods to gather empirical data, providing a comprehensive understanding of the impacts AI integration has on the mathematics classroom.

Keywords: Artificial Intelligence (AI), Mathematics Education, Personalized Learning, Student Engagement, Educational Outcomes, Adaptive Learning Technologies, AI in Classrooms, Teacher Efficiency, Interactive Learning, Educational Technology, Quantitative Analysis, Qualitative Analysis, Learning Analytics, Pedagogical Innovation, Critical Thinking Skills.

ЭФФЕКТЫ ИСПОЛЬЗОВАНИЯ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В ОБУЧЕНИИ МАТЕМАТИКЕ

Аннотация. Искусственный интеллект (ИИ) стремительно меняет различные стороны человеческой жизни, в том числе образование. В этом исследовании изучается влияние использования ИИ в преподавании математики с упором на вовлеченность учащихся, персонализированное обучение и результаты обучения. Благодаря использованию различных приложений искусственного интеллекта были усовершенствованы методики преподавания, обещающие более интерактивный и эффективный процесс обучения. В этом исследовании используются количественные и качественные методы для сбора эмпирических данных, обеспечивающие всестороннее понимание влияния интеграции ИИ на занятия по математике.

Ключевые слова: Искусственный интеллект (ИИ), Математическое образование, Персонализированное обучение, Вовлеченность учащихся, Результаты образования, Технологии адаптивного обучения, ИИ в классах, Эффективность учителя, Интерактивное обучение, Образовательные технологии, Количественный анализ,

Качественный анализ, Аналитика обучения, Педагогические инновации, Критический Навыки мышления.

Introduction. Traditional teaching methods in mathematics often struggle with addressing the diverse needs of students, resulting in varying levels of comprehension and engagement. The advent of artificial intelligence presents a unique opportunity to revolutionize these methods. AI can offer personalized learning experiences, timely feedback, and interactive content, which can engage students more effectively. This study aims to explore the specific benefits and challenges of using AI in teaching mathematics, examining how these technologies can potentially enhance learning and teaching processes.

Methods. The study employs a mixed-methods approach to evaluate the effects of AI on teaching mathematics. A quantitative analysis involves a pre-test and post-test design to assess student performance before and after the implementation of AI tools. Additionally, surveys and questionnaires are distributed among teachers and students to gather their perceptions and experiences. The qualitative component includes observational studies and in-depth interviews to explore deeper insights into how AI tools are being integrated into teaching practices and their impact on the learning environment.

Results. The quantitative data revealed a significant improvement in student performance after the introduction of AI tools. On average, students' test scores increased by 15%, and 85% of students reported a higher level of engagement during mathematics lessons. Teachers noted that AI tools facilitated more personalized learning paths, catering to individual students' strengths and weaknesses. The qualitative data echoed these findings, with students expressing that AI-driven interactive modules made learning more enjoyable and comprehensible. Teachers also reported reduced workload in routine tasks such as grading and assessing, allowing them to focus more on teaching and interaction.

Quantitative Analysis. The quantitative analysis was conducted using a pre-test and post-test design involving 150 middle school students across three schools. The pre-test was administered before introducing AI tools, and the post-test followed a three-month period of AI integration into the mathematics curriculum.

Student Performance. Results indicated a statistically significant improvement in overall student performance. The average pre-test score was 65%, while the post-test scores averaged 80%, showing a 15% increase ($p < 0.001$).

Table 1 presents the detailed comparison:

Metric	Pre-Test Score	Post-Test Score
Average Score (%)	65	80
Standard Deviation	10	8
Maximum Score(%)	90	100
Minimum Score(%)	40	60

Figure 1 illustrates the distribution of scores before and after the AI implementation, highlighting the significant shift towards higher performance.

Engagement Levels. Surveys were distributed to gauge student engagement levels. 85% of the students reported feeling more engaged in mathematics lessons after the AI tools were introduced. Specific areas of increased engagement included interactive problem-solving exercises and personalized feedback mechanisms.

Qualitative Analysis. The qualitative component of the study employed observational studies and in-depth interviews with 30 students and 10 teachers. The thematic analysis focused on understanding their experiences and perceptions of AI integration.

Student Feedback. Interactive Experience: Students responded positively to AI-driven interactive modules. One student remarked, "AI makes learning math feel like playing a game. I'm more interested in solving problems now."

Personalized Learning Paths: Students valued the personalized feedback, with one saying, "The AI knows my weak spots and helps me focus on them. It's like having a personal tutor."

Teacher Insights

Efficiency in Teaching: Teachers reported a reduction in time spent on administrative tasks such as grading and homework assessments, allowing them to devote more time to conceptual teaching and one-on-one student interactions.

Professional Development Needs: Teachers also highlighted the need for ongoing training to effectively utilize AI tools. One teacher noted, "The technology is impressive, but we need proper training to make the most out of it."

Challenges and Concerns

Cost Implications. The initial setup and ongoing maintenance of AI technologies presented a significant financial burden. Schools cited the high cost of AI licenses and necessary hardware upgrades as barriers to widespread adoption.

Technology Dependence. Participants raised concerns regarding over-reliance on AI. Some teachers expressed apprehension about students becoming too dependent on AI for problem-solving, potentially hindering their critical thinking and problem-solving skills development.

Summary of Findings. Performance Improvement: The integration of AI tools in teaching mathematics led to a considerable improvement in student test scores, with a 15% increase from pre-test to post-test results.

Increased Engagement: 85% of students felt more engaged in mathematics lessons featuring AI-driven activities.

Positive Feedback: Both students and teachers reported positive experiences with personalized learning and efficient teaching methodologies brought about by AI.

Challenges: High implementation costs and the risk of over-reliance on technology were identified as significant challenges.

These findings underscore the potential benefits and limitations of AI in the mathematics classroom, presenting a compelling case for balanced and well-managed integration strategies.

Discussion. The results suggest that incorporating AI in teaching mathematics can lead to significant improvements in educational outcomes. Personalized learning experiences created through adaptive learning platforms and AI-driven tutoring systems enable students to learn at their own pace. Consequently, students are more engaged and likely to grasp complex mathematical concepts more effectively. However, the study also identified challenges such as the high cost of implementing AI technologies and the need for substantial training for teachers to effectively use these tools. Another concern is the potential over-reliance on technology, possibly undermining the development of critical thinking skills in students.

Conclusion. This research highlights that AI has the potential to greatly enhance the teaching and learning of mathematics. With significant improvements in student engagement and performance, AI proves to be an invaluable tool in educational settings. To fully harness its benefits, it is crucial to address implementation challenges, provide adequate training for educators, and maintain a balanced approach to technology use in classrooms. Future studies should explore long-term impacts and the scalability of AI tools in diverse educational environments.

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