MaPan : Jurnal Matematika dan Pembelajaran
p-ISSN: 2354-6883 ; e-ISSN: 2581-172X
Volume 12, No 1, June 2024 (160-170)
DOI: https://doi.org/10.24252/mapan.2024v12n1a11

OPTIMIZING MATHEMATICS LEARNING OUTCOMES USING ARTIFICIAL INTELLIGENCE TECHNOLOGY

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Received May 08, 2024; Revised June 22, 2024; Accepted June 24, 2024

Abstract:
The use of technology in learning has become inevitable in modern education. It plays an important role in optimizing the learning process, including in the context of mathematics learning. This study aims to describe the optimization of mathematics learning outcomes using Artificial Intelligence technology. This research uses a qualitative method with a descriptive approach. The instruments used were tests and interviews. The data collected was then analyzed using the interactive model analysis flow developed by Miles and Huberman, namely reducing data, presenting data, and verifying/concluding. The results showed that by using Artificial Intelligence (AI) technology in the learning process, lecturers can provide experiences tailored to students' individual needs, improve their understanding of mathematical concepts, and provide fast and precise feedback. Thus, the use of AI technology can optimize mathematics learning.

Keywords: Optimization, Learning Outcomes, Mathematics, Artificial Intelligence

OPTIMALISASI HASIL PEMBELAJARAN MATEMATIKA MENGGUNAKAN TEKNOLOGI *ARTIFICIAL INTELLIGENCE*

Abstrak:
Penggunaan teknologi dalam pembelajaran telah menjadi suatu hal yang tak terhindarkan dalam pendidikan modern. Pendekatan ini memainkan peran penting dalam mengoptimalkan proses pembelajaran, termasuk dalam konteks pembelajaran matematika. Tujuan dari penelitian ini adalah untuk mendeskripsikan optimalisasi hasil pembelajaran matematika menggunakan teknologi Artificial Intelligence. Penelitian ini menggunakan metode kualitatif dengan pendekatan deskriptif. Instrumen yang digunakan berupa tes dan wawancara. Data yang dikumpulkan kemudian dianalisis dengan menggunakan alur analisis model interaktif yang dikembangkan oleh Miles dan Huberman, yaitu mereduksi data, menyajikan data, dan verifikasi/menyimpulkan. Hasil penelitian menunjukkan bahwa dengan menggunakan teknologi Artificial Intelligence (AI) dalam proses pembelajaran, dosen dapat memberikan pengalaman yang disesuaikan dengan kebutuhan individual mahasiswa, meningkatkan pemahaman konsep matematika, serta menyediakan

umpan balik yang cepat dan tepat. Dengan demikian, penggunaan teknologi AI dapat mengoptimalkan pembelajaran matematika.

Kata Kunci: Optimalisasi, Hasil Pembelajaran, Matematika, Artificial Intelligence

How to Cite: Tulak, T, Rubianus, & Maramba', S. (2024). Optimizing Mathematics Learning Outcomes using Artificial Intelligence Technology. *MaPan : Jurnal Matematika dan Pembelajaran*, *12*(1), 160-170. https://doi.org/10.24252/mapan.2024v12n1a11.

INTRODUCTION

Math education is an important part of the education system that has a major impact on students' intellectual development and cognitive skills. However, teaching mathematics is not an easy task. Many students have difficulty understanding complex mathematical concepts, and educators often face challenges in creating effective learning environments (Tulak, Rianto, Stevania, & Rubianus, 2022; Tulak, Tangkearung, & Selin, 2022). In addition, each student has a different learning style, which requires a diverse approach to teaching (Tulak, 2017).

As time goes by, technology is currently developing. One of them is the society 5.0 Industrial Revolution. As a refinement of the 4.0 era, technologies such as AI and robots are present to work together with humans (Zhou, Liu, & Zhao, 2022). The Industrial Revolution 5.0 encourages efficiency and productivity thanks to the technology utilized by human intelligence (Roihan, Sunarya, & Rafika, 2020; Santoso, 2023). For example, many people use an AI technology called ChatGPT to find out and do things. However, ChatGPT would not be able to function optimally without the support of human intelligence in giving the right commands (Siagian, 2023).

In recent years, the development of artificial intelligence (AI) technology has opened up great potential for optimizing the learning process of mathematics (Sadewo, Purnasari, & Muslim, 2022). AI technology offers a wide range of possibilities to improve the efficiency and effectiveness of mathematics teaching, both at primary and secondary levels (Rulyansah, Mardhotillah, Budiarti, Afandi, & Aisah, 2023). For this reason, we must be able to adapt to current technological developments.

Optimizing the mathematics learning process by using artificial intelligence technology is very relevant and important because so far there are

several obstacles faced by both teachers and students in learning mathematics, namely difficulties in understanding mathematical concepts where many students have difficulty in understanding abstract and complex mathematical concepts (Tulak, Langi, Hakpantria, & Rante, 2023). Educators often face problems in explaining these concepts in a way that all students can understand. The a need for an individual approach where each student has a different learning speed, different levels of understanding, and different learning styles (Tulak, Tangkearung, Tulak, & Paseno, 2023). Therefore, integrating technology into mathematics learning can be a more engaging method for students (Cantos, Giler, & Magayanes, 2023).

Based on observations from previous semesters, the final exam results obtained by students are very low and this is a problem for students and is a matter of consideration for further research. In overcoming this problem, it is hoped that AI technology can be used to identify the areas where students have difficulty in learning and provide specific recommendations to help them improve their academic performance.

Furthermore, some research results show that artificial intelligence (AI) is so extraordinary that AI is even known as a technology that has great potential to change human life in the future because it has been able to rival thinking and even exceed human abilities in various ways. Among them is research conducted by Pardamean, Suparyono, Anugrahana, Anugraheni, and Sudigyo (2022), which provides results that AI models built using collaborative filtering algorithms can predict learning styles based on student behavior in the Learning Management System (LMS), besides that it can also be used in the process of forming study groups so that in the end the implementation of Artificial Intelligence-based online learning can improve student learning outcomes (Pardamean, Suparyono, Anugrahana, Anugraheni, & Sudigyo, 2022). In addition, Muttaqin, Arafah, Jaya, Suryawan, Gustiana, Banjarnahor, and Fajrillah (2023), in his book entitled Implementation of Artificial Intelligence in Life explains that the future of artificial intelligence promises amazing and revolutionary developments. In recent decades, he explains that advances in the field of AI have brought about major changes in many aspects of our lives. From everyday applications such as virtual assistants to advanced technologies such as autonomous cars, AI has proven its potential to change the way we work, communicate, and live our daily lives.

By utilizing Artificial Intelligence technologies, such as Cymath.com, Malmath, Socratic, Mathway, and chatGPT to answer students' questions, pattern recognition systems to identify common errors in mathematical understanding and adaptive learning platforms that tailor materials to students' abilities, we can optimize the mathematics learning process (Hakim, 2022; Hwang, 2022). This can help students overcome difficulties, motivate them to learn mathematics and generate a deeper understanding of important mathematical concepts. Thus, the use of artificial intelligence technology in mathematics learning is a step in the right direction to address the many challenges in mathematics education today (Cormarkovic & Drazeta, 2022).

However, it is important to ensure that the use of AI in mathematics education still goes hand in hand with ethics and regulations and involves teachers as the main support and facilitator in the learning process. Therefore, this research is crucial as it can provide new insights into how Artificial Intelligence technology can be applied to optimize mathematics learning. By utilizing AI technology, more interactive, personalized, and adaptive learning methods can be developed according to the needs of each student. This can help improve understanding, motivation, and learning achievement in mathematics courses.

METHODS

This research uses a qualitative method with a descriptive approach. Qualitative research can be conducted to gain a deeper understanding of students' experiences in using AI technology in mathematics learning (Creswell, 2014). This research was conducted at Campus II UKI Toraja. The research subjects were second-semester PGSD students. Subject selection using random sampling. The research instruments consisted of main instruments and supporting instruments: Supporting instruments are prepared following the instrument grids based on existing theoretical studies in the form of tests and interview sheets. Validation of the instrument is done by asking experienced experts to assess the designed instrument.

The test used in this study was in the form of students' mathematics problem-solving. Then the interview sheet is a list of questions that will be addressed to respondents (students) to confirm the results of solving mathematical problems. The data collected were then analyzed using an interactive model analysis flow developed by Miles, Huberman, and Saldana (2014) which categorizes three interactive flows and takes place

simultaneously, namely reducing data, presenting data, and verifying/concluding (Miles, Huberman, & Saldana, 2014).

RESULTS AND DISCUSSION

This research was conducted at the beginning of the even semester of the 2023/2024 academic year. The first step was to observe learning outcomes before using Artificial Intelligence (AI) technology, as measured by the results of students' end-of-semester exams in the odd semester of the 2023/2024 academic year. In the even semester of the 2023/2024 academic year, the mathematics learning process was implemented using AI-based technology with the Mathway application. Mathway is a very flexible tool that can solve various types of maths problems, including story problems involving fractions. Users can enter the problems manually or use the camera to scan the problems.

Furthermore, in the midterm exam, a written test was conducted on students who had been taught about the utilization of AI technology (Mathway) in learning mathematics, especially on fraction material. The tests were given in the form of fraction problems in the form of stories to determine learning outcomes after using AI technology. In addition, this test also aims to measure students' understanding of fraction material. The test results obtained from 29 students showed a significant difference between the results before and after learning using AI technology as a learning medium.

Table 1. Change in average score

Indicator	Average yield (%)	
	Before using AI	After using AI
Improved retention of material	60	80
Measuring the level of understanding	50	85
Progress in skills	45	85
Improved achievement of learning objectives	65	80

The scores in table 1 are summarised from odd semester data before using AI to even semester 2023/2024 after using AI. Assessment is carried out periodically during the learning process to monitor student development. In the table above, it can be seen that the increase in material retention has

increased significantly from the score before using AI technology with an average score of 60%, and after using AI technology with an average score of 80%. This can be interpreted that students experience a significant increase in remembering and understanding information about fractions taught using AI technology. Furthermore, the measurement of the level of understanding also showed a significant increase from the value before using AI technology with an average score of 50%, and after using AI technology with an average score of 85%. Based on the results obtained, it can be interpreted that students experience a significant increase in understanding the concept of fractions using AI technology.

Progress in skills, especially in the ability to solve fraction problems, also shows a significant increase from the value before using AI technology, the average score is 45% and after using AI technology the average score is 85%. From the results obtained, it is known that students have experienced a significant improvement in solving fraction problems using the current AI technology. In addition, the achievement of learning objectives by students also experienced a significant increase from the value before using AI technology with an average score of 65% and after using AI technology the average score for achieving learning objectives was 80%.

The test results above are reinforced by the results of interviews obtained from a randomly selected student with the initials AP. The following is a summary of the results of the researcher's interview with prospective elementary school teacher students in the even semester of the 2023/2024 academic year at UKI Toraja.

Table 2. Student interview answers

Subject	**Response**
Researcher	Have you ever heard of AI technology?
AP	Ever.
Researcher	How do you know?
AP	Friends, Social Media, and Lecturers.
Researcher	What AI technologies do you know?
AP	ChatGPT, Photomath, Canva.
Researcher	Have your lecturers taught you about the use of AI technology?
AP	Already.

Subject	Response
Researcher	For math courses, do the lecturers also use AI technology in teaching?
AP	Yes.
Researcher	What AI technologies have been used?
AP	ChatGPT, Mathway, and Photomath.
Researcher	How often do lecturers use it?
AP	Every problem is usually shown using AI technology.
Researcher	Have you ever tried the app in solving math problems?
AP	Yes, because the lecturer suggested solving difficult problems using AI technology.
Researcher	How often do you interact with AI technology in math learning?
AP	Almost every day because AI makes it easier to solve math problems in a short time.
Researcher	How do you feel about using AI technology in math learning?
AP	It's great because it helps a lot when facing difficult problems without having to scratch, just read and see and understand the process until the end.
Researcher	Have you ever tried solving fractions using AI technology?
AP	Yes, I have.
Researcher	What types of fraction operations have you tried to solve using AI technology?
AP	All types of operations range from addition, subtraction, multiplication, division, and even solving fraction problems of different types.
Researcher	Do you feel AI technology helps you solve fraction problems correctly?
AP	Very helpful.
Researcher	What do you think about the benefits of AI technology in learning math, especially on fractions?
AP	AI makes it easier for me to understand the concept of fractions and even to solve fraction problems.
Researcher	Is solving math problems using AI technology structured according to the rules for solving fractions?
AP	Yes, because in the current era, all you have to do is take a photo, without typing anymore, the results come out systematically and the results are accurate.

Subject	Response
Researcher	Do you feel more motivated to learn math with AI technology?
AP	Yes because now with AI not only math but all subjects are helped by AI technology.
Researcher	Do the facilities and infrastructure on campus support the use of AI technology?
AP	Yes, on campus there is already an internet Pak that can be used, it's just that at certain times sometimes the network is not very good because it may be influenced by the number of people using the internet.

Based on the results of the interviews, it can be concluded that students as the subject of this study gave positive answers and responses to the use of AI technology in optimizing mathematics learning outcomes, especially in fraction material for prospective elementary school teacher students in the even semester of the 2023/2024 academic year at UKI Toraja. With the existence of AI technology, it is very helpful for students to understand the concept of fractions in a structured manner to the stage of solving problems systematically without requiring a long time.

From the test results and interviews above, it can be seen that the use of AI technology by prospective elementary school teacher students in the even semester of the 2023/2024 UKI academic year in learning, especially fraction material, can optimize learning outcomes which can be seen from the average test scores before and after the use of AI technology in mathematics courses in fraction material which is reinforced by the results of interviews. With the availability of supporting facilities and infrastructure on campus in the form of an adequate internet network, it will be very helpful in applying learning media using AI technology effectively and efficiently. This is in line with the opinion of Saputra (2023), who explains that learning mathematics in the new era by using technology that is always developing can help students to learn more effectively, quickly, and interestingly and improve problem-solving skills (Saputra, Utami, & Purwanti, 2023). However, learning mathematics using AI technology, must be properly designed and implemented so that it has a positive impact on students in optimizing learning outcomes.

CONCLUSION

Based on the research results and discussion, it can be concluded that Artificial Intelligence technology offers great potential in improving mathematics learning. By integrating AI into the learning process, lecturers can provide experiences that are tailored to student's individual needs, improve their understanding of mathematical concepts, and provide quick and precise feedback. Thus, the use of AI technology can optimize mathematics learning.

ACKNOWLEDGMENT

I would like to thank the team that has worked hard so that this research is well completed. Thank you to the institution that has provided the facilities and infrastructure needed in the implementation of this research, and thank you to the respondents or research subjects who have been willing to participate and provide the data we need. Hopefully, the results of this research can provide great benefits for science and society in general.

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