
Identifying the use of artificial intelligence in math learning based on learning outcomes

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Abstract: In an era of rapidly developing technology, the need to simplify and improve the learning process of mathematics is increasingly urgent. One emerging solution is the utilization of Artificial Intelligence (AI) in mathematics education. AI provides learning content that is tailored to students' needs, creating a relevant and engaging learning experience. An understanding of AI and the ability to interact with technology is important, helping students face the challenges of the digital age. Understanding math concepts is the foundation for logical thinking, problem solving and critical thinking. Research shows that some students do not fully understand mathematical concepts. Therefore, this study aims to identify the impact of using AI in mathematics learning on student learning outcomes. The preliminary study data showed the prevalence of AI use in mathematics learning. The results show a very strong positive correlation between the use of AI and mathematics learning outcomes, where student learning activities observed during learning using AI (Artificial Intelligence) based on observation sheets include several indicators, with the following results: 1) Visual indicators of 88%, 2) Listening indicators of 84%, 3) Oral indicators of 72.5%, and 4) Mental indicators of 84.5%. The results showed that learning activities were in the high category with a percentage of 82.25%. This shows that during learning activities, there is a good stimulus for students.

Keywords: Artificial intelligence, learning outcomes, mathematics learning.

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Introduction

Along with the rapid development of technology, there is an increasingly urgent need to simplify and improve the learning process of mathematics (Saputra et al., 2023). One way that has emerged as a potential solution is the utilization of Artificial Intelligence (AI) in mathematics education. Artificial intelligence is one of the media offered at this time that has been familiarly used in various layers of learning activities (Panglipur et al., 2024). Artificial intelligence provides content that matches students' learning levels, methods, and styles to provide relevant and engaging learning experiences. (Mambu et al., 2023). The use of AI in learning is very important to study the results. In the learning that is organized, of course, requires an evaluation of how students are involved in their activities in the classroom, especially when using AI assistance. So it is important to know the activities during the learning process (Bond et al., 2020).

Understanding AI and its capabilities in technology interaction is becoming more important. Users who utilize AI technology in learning can help learners become accustomed to facing challenges in the digital era (Suardi, 2022). Understanding mathematical concepts is the main basis in forming the basis of logical thinking, problem solving skills, and critical thinking skills (Masitoh et al., 2015). Research conducted by (Mambu et al., 2023) "Utilization of Artificial Intelligence (AI) Technology in Facing the Challenges of Teaching Teachers in the Digital Age" Using AI in education can increase

overall effectiveness. With its ability to analyze student data, AI helps teachers identify relevant learning strategies. AI can better understand student needs, learning preferences, and areas that require special attention in this process.

Based on research conducted (Mayya, 2021) “Analysis of the Ability to Understand Mathematical Concepts of PGMI Students in Basic Mathematics Concepts Course” shows that the understanding of mathematical concepts of 2nd semester students in Class 2C does not fully understand mathematical concepts. Only some students can understand mathematical concepts in number material and there are only 20% of students who answer without any errors and can proceed to the next stages of problem solving. This study aims to identify the use of artificial intelligence (AI) in mathematics learning on student learning outcomes. By utilizing AI in the context of mathematics learning, this research aims to uncover how this technology can improve student learning outcomes and academic achievement. This research provides insights for education policy makers, teachers, and participants in mathematics education. Insights such as knowledge as a basis for implementing the use of AI in curriculum design activities and the learning process. for learners as an insight into alternative technologies that can help understand the material in learning (Huang & Shimizu, 2016).

Based on the results of preliminary studies, data obtained through PDDikti, East Java Province Education Statistics, based on a survey of the Indonesian internet service user association in 2024 as many as 79.5% of Indonesians use various platforms on the internet. Preliminary studies conducted using the method of filling out a questionnaire through the google form platform, obtained the results of 25 students filling out the questionnaire and obtained the results of 92% of Jember students have used artificial intelligence in math learning activities, 80% of students have used artificial intelligence. 60% of students commonly use IA (ChatGPT & Google Scholar). The prevalence of the use of artificial intelligence in the description above can be concluded that the issue needs to be examined, for that the author will solve the problem using quantitative research methods. By understanding the problem, the author is motivated to complete this thesis assignment with research activities with the title “Identifying The Use Of Artificial Intelligence In Math Learning Based On Learning Outcomes”.

Method

Methods conducted This research uses quantitative methods. Quantitative research uses data to analyze what you want to know. (Ali et al., 2022). This quantitative research method develops mathematical models, theories, and hypotheses about a phenomenon by establishing the relationship of variables in a population. In this quantitative research, researchers use purposeful sampling or commonly known as purposive sampling when researchers choose topics or research locations based on the similarities or characteristics of groups or populations. (Santina et al., 2021). Thus, purposive sampling helps in ensuring that the sample has experiences or characteristics relevant to the topic being studied, so that the data obtained is more informative and contextual. In addition, this method also helps in identifying specific patterns and phenomena that may not appear in a random sample, thus providing richer and more useful insights to the research.

Based on the explanation of the data collection methods described above, in this research activity will take place at the University of PGRI argopuro Jember, with the subject of students of the Faculty of Teacher Training and Education with Mathematics Education study program. With the number of subjects in this study as many as 13 subjects.

Observation

A technique for collecting data using the senses, rather than just using mat, is observation, which is a type of observation that includes qualitative and quantitative analysis. (Khaatimah et al., 2017). The researcher's cell phone is to obtain information related to what will be researched, meaning observation. The researchers in this study examined the impact of AI on students' math performance.

Questionnaire

The method of data collection other than interviews is questionnaires. this is done to identify student learning outcomes on the use of AI in mathematics learning. This questionnaire data complements the results of other data. Subjectivity may occur because the questionnaire directly concerns individual statements. Questionnaire / questionnaire is a method for collecting data by asking several questions related to research. (Giri et al., 2021). The questionnaire contains basic math questions in lectures. The technical filling of the questionnaire consists of two sessions, namely the post-test session and the pre-test session which will be distributed online in the form of a google form distributed via the Whatsapp application or barcode. The purpose of giving the questionnaire is to find out the subject's understanding from before learning to after learning using AI.

Documentation

Documentation is the next technique used in this research. To collect data, researchers must document events that occur during the research. The documentation in this research is photographs. In this study, data analysis begins with data collection, data simplification, verification and confirmation of conclusions (Permatasari et al., 2023).

This research was conducted by filling out the post-test first in the form of a google form distributed via the Whatsapp application or barcode then given material about the questions contained in the post-test and pre-test in the form of pdf documents distributed via the Whatsapp application or barcode. This technique is used by researchers in analyzing the effect of using AI in learning mathematics.

Results and Discussion

The use of AI (Artificial Intelligence) in mathematics learning, shows the results that the use of AI (Artificial Intelligence), describes individual student learning activities. This is indicated by the results of the data obtained through the observation guideline. The following is a discussion of learning activities obtained from several parts of the learning activity indicators. The following are indicators of student learning activities.

Table 1. Visual indicators

No	Visual	Frequency		Percentage
		Score	Maximum Amount	
1.	Listening to the material in AI (Artificial Intelligence)	12	13	92%
2.	Pay attention to the researcher when giving directions	11	13	84%
Total		23	26	176%
Total Percentage				88%

Table 1 on visual indicators obtained through observation during learning, the indicator listens to the material in AI (Artificial Intelligence) by 92%, then the indicator pays attention to the researcher when giving directions by 84%. Based on this data, an average of 88% is obtained and there is a very high category.

The next indicator measured is listening, here is the listening learning activity data.

Table 2. Listening indicators

No	Listening	Frequency		Percentage
		Score	Maximum Amount	
1.	Listening to the material presented by the researcher	10	13	76%
2.	Listening to the instructions for using AI (Artificial Intelligence) for math learning delivered by researchers	12	13	92%
Total		22	26	168%
Total Percentage				84%

Table 2 on the Listening indicator obtained through observation in the lesson, the indicator listening to the researcher's material is 76%, then the indicator Listening to instructions for using AI (Artificial Intelligence) is 92%. Based on this data, an average of 84% is obtained and is in the high category.

The next indicator measured is the oral indicator, here is the data on the oral indicator.

Table 3. Oral Indicator

No	Oral	Frequency		Percentage
		Score	Maximum Amount	
1.	Asking questions during learning activities	9	13	69%
2.	Answering questions or responding in learning activities	10	13	76%
Total		19	26	145%
Total Percentage				72,5%

Table 3 on the Oral indicator obtained through observation in learning, the indicator of asking questions in learning is 69, then the indicator of answering questions or responding in learning activities is 76%. Based on this data, the average is 72.5% and is in the high category.

The next indicator measured is the mental indicator, here are the mental learning activity data.

Table 4. Mental Indicators

No	Oral	Frequency		Percentage
		Score	Maximum Amount	
1.	Completing tasks given by researchers	13	13	100%
2.	Responding to questions given by the researcher	9	13	69%
Total		22	26	169%
Total Percentage				84,5%

Table 4 above shows that the results of mental indicators obtained through observations in learning, the indicator of completing tasks given by researchers is 100%, then the indicator responds to questions given by researchers by 69%. Based on this data, the average is 84.5% and is in the high category.

Indicators 1-4 can be visualized through the following table.

Table 5. Overall Indicators

No.	Indicators	Percentage
1.	Visual	88%
2.	Listening	84%
3.	Oral	72,5%
4.	Mental	84,5%
Total		82,25%

In the results of table 5, it is known that the visual indicator is 88%, the listening indicator is 84%, the oral indicator is 72.5%, and the mental indicator is 84.5% And the average value is 82.25%, so it is categorized as high. From these results the use of AI (Artificial Intelligence) in learning math, can bring up learning activities.

The hypothesis in this study is as follows:

H_0 : There is an influence on math learning after the use of AI (Artificial Intelligence)

H_a : There is no effect on math learning after the use of AI (Artificial Intelligence)

Hypothesis testing was carried out using SPSS 26.00 for Windows and chi-square analysis. The results of the study were analyzed using the chi-square test. If the significance level is <0.05 , H_0 is rejected and H_a is accepted. If the significance level is >0.05 , H_0 is rejected and H_a is accepted. The following are the results of the chi-square test

Table 6. Test Results

	Asym-Sig (2-sides)
Pearson Chi-Square	0,179
Likelihood Ratio	1,00
Linear-by-Linear Association	0,007
N of Valid Cases	13

Table 6 shows the value of Asym-Sig (2-sides) > 0.05 which is 0.179 and H_0 is accepted and H_a is rejected, so there is an influence on learning mathematics after the use of AI (Artificial Intelligence).

In the results of the study it was found that learning activities were classified in the high category, namely 82.25%, this shows that such learning activities provide good stimulation for students. In this study, AI learning materials were used as stimulation. (Artificial Intelligence). This condition is a form of one of the implementations of behavioristic theory.

A.M.Irfan Taufan Asfar et al., (2019) Explain that the environment controls human age. In this level of learning, behavioristic reactions and stimuli have a strong relationship. According to this theory, important learning involves stimulus and response. The process of stimulus and response is not important to consider because it cannot be measured or changed. Because everything given by a scholar and anything received must be analyzed and rejected. According to behaviorist theory, the stimulus in this study is AI media on mathematics learning outcomes. In this condition, AI (Artificial Intelligence) media is suitable for the current learning style of students, so the response shown is the high learning activity of students.

Supported by research by, Mayasari et al., (2023) Shows a strong positive relationship between technology use and efficiency. Regression analysis identified AI and the use of educational technology as predictors of student performance. Study the potential benefits of technology integration and recommend a strategic plan for its implementation. Where it is also aligned in the discussion of the identification of learning outcomes on the use of AI in learning mathematics.

Conclusion

Conclusion

Student learning activities that arise during learning by using AI (Artificial Intelligence) are generated from student observation sheets which include several indicators of learning activities resulting in 1) Visual indicators with a result of 88%, 2) Listening indicators with a percentage of 84%, 3) Oral indicators with a percentage of 72.5% and 4) Mental indicators with a percentage of 84.5%, the total number of learning activities with a percentage of 84.5%.

Suggestions

The expected suggestions in this research are a relatively longer period of research procurement and the application of the use of a more varied AI platform, so that later students can be more free in exploring more in-depth question material later.

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