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The Effect of Using an AI-Based Adaptive Learning Platform on Improving Students' Mathematics Learning Outcomes

Reno Purnomo[a,1,*], Sovian Sauri[a,2], Tomy Ariq[a,3], Salwa Rania[a,4]

[a] Universitas Mataram, Mataram, Indonesia
[1] renopurnomo290904@gmail.com*; [2]soviansauri03@gmail.com; [3]ariqtomy@gmail.com; [4]salwarania14122004@gmail.com
*Corresponding Author

ABSTRACT

This research investigates the impact of using AI-based adaptive learning platforms on improving student learning outcomes in Computer Networks at SMK Negeri 2 Mataram. The study is prompted by the rapid advancements in information and communication technology, which have led to the integration of AI in education, particularly in adaptive learning platforms that can tailor learning materials and methods to individual student needs. Initial observations at SMK Negeri 2 Mataram revealed limited use of AI-based learning, resulting in students being passive with conventional teaching methods. This descriptive qualitative research was conducted in the even semester of the 2024/2025 academic year at SMK Negeri 2 Mataram. The subjects included Computer Networks teachers and 10 tenth-grade students. Data were collected through semi-structured interviews, essay tests, and documentation, then analyzed by data reduction, data presentation, and conclusion drawing. The findings reveal an interesting paradox. Although the school administration and teachers still restrict AI usage due to concerns about student dependency and a decline in critical thinking skills, experimental essay test results showed a significant improvement in the quality of student answers when AI was utilized. Responses became more comprehensive, structured, and demonstrated a deeper understanding of concepts. This suggests that AI can serve as an effective tool to enhance comprehension and boost student motivation. However, it is crucial to balance AI integration with the development of AI literacy and an emphasis on independent learning, ensuring students use this technology wisely as a support, not a replacement for their own thinking processes.

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Introduction

The rapid development of information and communication technology has brought significant changes to various aspects of life, including education. One promising innovation is Artificial Intelligence (AI), which is beginning to be integrated into various fields, including learning platforms. AI-based adaptive learning platforms have the potential to tailor materials, methods, and learning pace to individual students' needs, thus improving learning effectiveness and learning outcomes (Cholis et al., 2019). Effective student learning is expected to improve students' understanding of the learning process in Computer Networks, a key competency in Vocational High Schools (SMK), particularly in Computer and Network Engineering. A deep understanding of computer networking concepts and practices is crucial for students to prepare themselves for the increasingly complex world of work. However, students often struggle to grasp abstract and dynamic material.

The use of AI-based adaptive learning platforms in Computer Networks learning provides an opportunity to address these challenges. With the ability to tailor materials and learning approaches based on individual student needs, these platforms can help students

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understand abstract concepts more deeply and interactively. This technological integration is expected to significantly improve student motivation and learning outcomes, particularly in mastering complex technical and conceptual material. The results of the improvement in learning show that students who use AI assistance are able to produce more structured, accurate, and in-depth answers compared to when they work on questions without AI assistance Heri, S.H (2023). This improvement indicates that the appropriate use of AI can have a positive impact on improving student learning outcomes, especially in understanding concepts and conveying ideas systematically in the Computer Network subject.

Observations at State Vocational High School 2 Mataram indicate that the use of AI-based learning is very limited, potentially impacting student learning outcomes, as students become too passive when using conventional learning. Therefore, researchers are interested in examining the impact of AI-based learning on conventional learning.

This study aims to determine differences in student learning achievement and conceptual understanding by comparing the implementation of the adaptive e-learning model with conventional learning. Related research was conducted by Loso Judijanto & Ratna Suhartini (2024 & 2025), who aimed to investigate the impact of Artificial Intelligence (AI)-based adaptive learning on high school students' academic achievement in the digital age. Further research by Muhammad Akbar Gilang (2024) investigated the application of an AI-based adaptive learning system, focusing on its potential to increase student engagement and achievement. The results of this study demonstrate that AI can dynamically adjust learning paths based on individual student performance, providing real-time feedback and tailored instructional materials. This approach not only meets diverse learning needs but also creates a more inclusive and effective educational environment. Rifky Lana Rahardian k & Amelia Putri (2024&2025) This study aims to analyze the effectiveness of using Artificial Intelligence (AI) in school learning and identify challenges and opportunities that arise in its implementation. The results indicate that AI has significant potential to improve learning effectiveness through personalized materials, automation of administrative tasks, and increased student motivation through interactive features such as gamification and simulations.

Based on the explanations above, the researchers are interested in conducting research to examine the effect of using an AI-based adaptive learning platform on improving student learning outcomes in the Computer Networks subject at SMK Negeri 2 Mataram. This study will also explore teachers' perspectives on the implementation of AI technology in learning and how students utilize AI to support their understanding.

Method

This study uses a qualitative approach with a descriptive type, the purpose of this study is to understand in depth the effect of using an adaptive learning platform based on artificial intelligence (AI) to improve student learning outcomes, especially in computer network learning. This research was conducted at SMK Negeri 2 Mataram in the even semester of the 2024/2025 academic year, while the subjects in this study consisted of computer network subject teachers and 10 grade X students who were directly involved in learning and testing activities through two experimental sessions. The data collection techniques in this study were carried out through semi-structured interviews, test questions, and documentation. Interviews were conducted with related subject teachers to explore their potential for AI information. This test aims to see student development in learning, while documentation was carried out to document research activities. While the data analysis techniques in this study were through data reduction, data presentation and drawing conclusions.

Results and Discussion

Results

Based on field interviews, it was discovered that the use of an AI-based adaptive learning platform had not yet been officially implemented at the school. The teacher stated that this decision was based on concerns about preventing students from becoming overly focused on AI. The teacher argued that it was important for students to learn independently and to be able to utilize AI effectively as a tool, not as a substitute for their thinking and learning processes. This view aligns with several studies highlighting the importance of developing critical thinking and problem-solving skills in students, even in the digital age. While AI offers various conveniences, improper integration can hinder the development of student learning independence. The teacher emphasized that the primary goal is for students to deeply understand the material and be able to apply it, rather than simply relying on instant answers from AI.Identify the Headings

Figures and Tables

Results of interviews with teachers:

Q : How is student understanding in learning using AI assistance?
SIG : The use of internet/AI assistance is still limited in schools, because if the use of internet/AI assistance is allowed in all learning processes, it is feared that students will not be able to think critically and will only rely on internet/AI assistance.
Q : Are there any significant changes in student learning outcomes after using this platform?
SIG : Of course there are, but the difference between students who use AI is very clear because they use answers or assistance from AI whose words are very standard, different from students who use their own language or thoughts, because AI language is different from human language.
Q : What are your hopes for the future use of this AI platform?
SIG : There is no hope whatsoever because the use of this AI platform is still limited by the school and the use of AI or similar has been provided access in the LAB, so the use of this AI in the classroom is. still monitored and limited by the teacher, except for school assignments but they are done at home they are free to access anything to find the answer.
Q : What obstacles do students experience when accessing the LAB or using the AI platform?
SIG : There are no obstacles, because the school has provided facilities for accessing the LAB, such as computers, wifi, and a comfortable room, and every student who has a special major that focuses on computers is required to have their own laptop.

Based on the results of field interviews, the use of AI platforms is very influential in assisting the learning process of students, including those majoring in computer science. And for students whose majors are not specifically computer science, the use of AI as an aid in the learning process is still limited and supervised, except for assignments to be done at home, all students are free to access and search for answers on the internet or use AI.

Session 1 (Without AI): In this session, students were asked to answer essay questions in the Computer Networks subject without the aid of AI. Observations showed that students struggled to answer the questions. Their answers tended to be incomplete, inaccurate, and showed a lack of in-depth understanding. This indicated that students may not have fully mastered the material or may have difficulty formulating answers independently.

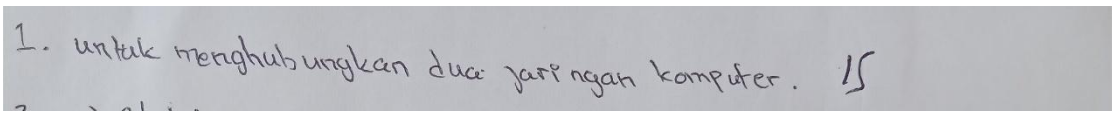


Fig. 1. Without AI

At this stage, students are able to understand how to connect two computer networks, either via a cable or wireless connection, and can understand the basic principles of data communication that occurs between devices.

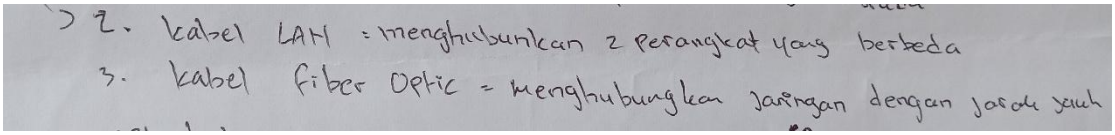


Figure 2 Without AI

At this stage, students understand the difference between LAN cables and fiber optic cables. They know that LAN cables connect multiple devices within a local network, while fiber optic cables connect networks over longer distances. In conclusion, students understand the basic functions of both types of network cables and their uses.

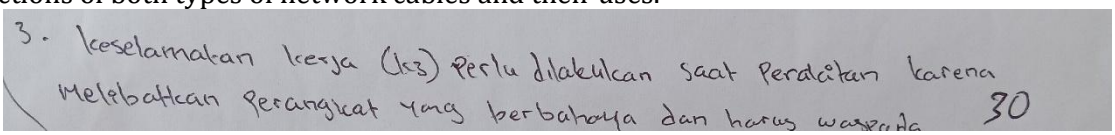


Figure 3 Without AI

At this stage, students already understand the importance of occupational safety (K3) in the work environment, because practice often involves the use of dangerous devices, so vigilance and the implementation of safe work procedures are required.

Session 2 (With AI): In this session, students were allowed to use AI as an aid in answering the same (or equivalent) essay questions. The results showed a significant improvement in the quality of students' answers. The resulting answers were more complete, more structured, and demonstrated a better understanding of Computer Networking concepts. Students were able to utilize AI to search for information and summarize key points.

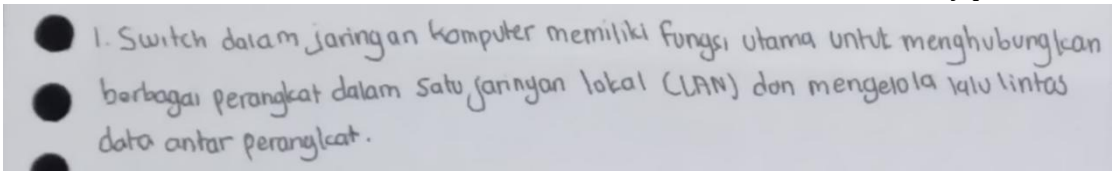
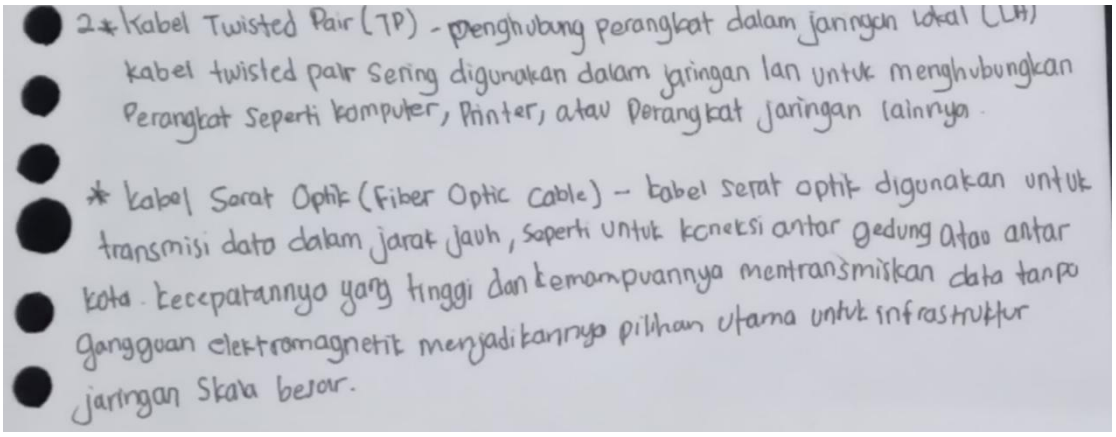


Figure 4 Using AI

At this stage, students can formulate answers and understand how two computer networks, both wired and wireless, work, and understand the basic principles of data communication between devices. Because they initially struggled to answer the questions, they used AI to help them find the answers.



At this stage, students have understood the fundamental differences between LAN cables and fiber optic cables. They understand that LAN cables are used to connect multiple devices within a local area network, while fiber optic cables are used to connect networks spanning longer distances.

With the help of AI, students can further explore the characteristics of each cable type. For example, LAN cables are typically more economical and easier to install in local environments, while fiber optic cables offer higher data transfer speeds and greater capacity, albeit at a higher cost and more complex installation.

In conclusion, students have gained a clear understanding of the basic functions of these two types of network cables according to the context of their use.

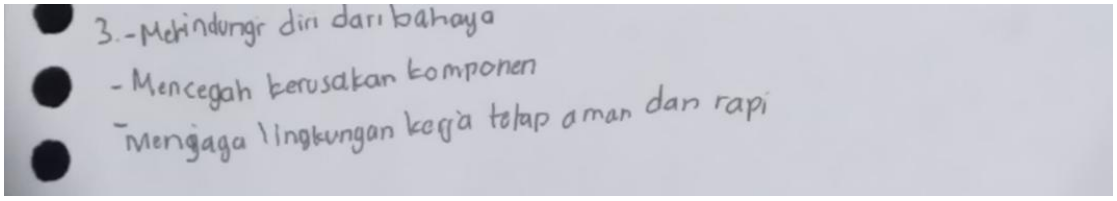


Figure 6 Using AI

At this stage, students have realized the importance of occupational safety (OHS) in the workplace, especially since practices often involve potentially hazardous equipment. Therefore, vigilance and the implementation of safe work procedures are essential to prevent accidents and ensure everyone's safety.

In this context, AI can help by providing information and guidance on good OHS practices, as well as reminding students about safety measures to take when using hazardous devices.

AI can also simulate dangerous situations to train students in making appropriate and rapid decisions in emergencies. Using technology, students can learn about potential risks and how to address them without risking real life.

Interview With Students:

Q: *How difficult is it to answer and there is no help from anything, especially AI help?*

S: *Difficulty in answering questions can suddenly cause me to forget the material that has been explained by the teacher, and when I am given questions related to the material that has been taught, it becomes a bit difficult to answer the questions, but I try to answer and remember the material that has been taught, over time I remember and my answers are correct, but some of my friends keep trying and remembering the material but their answers are still not quite right.*

Based on the results of the interviews with the students above, the difficulty in answering the questions was only Difficulty answering questions is often caused by forgetting the material taught by the teacher, so that when faced with related questions, some students find it difficult. However, some try to recall the material and are finally able to provide the correct answer, while others still have difficulty despite trying to remember .

The findings of this study reveal an interesting paradox. On the one hand, schools, particularly through the views of teachers, demonstrate a cautious attitude in officially implementing Artificial Intelligence (AI)-based learning platforms. This attitude is based on a desire to encourage students' independent learning, so they don't become completely dependent on technology. This concern is understandable, given that the use of AI without appropriate pedagogical strategies has the potential to reduce students' initiative in seeking and processing information independently. Teachers emphasize that students need to be guided to use AI wisely as a supporting tool for the learning process, not as the sole source of knowledge.

However, the results of experimental essay testing indicate that appropriate use of AI can have a positive impact on improving student learning outcomes. In the second session,

where students were allowed to use AI as an aid, a significant improvement in answer quality was observed. Students' answers became more complete, structured, and demonstrated a deeper understanding of the concepts. This indicates that AI can act as a scaffolding that effectively supports student learning, particularly in subjects that require conceptual and elaborative thinking skills such as Computer Networks.

These findings align with a number of previous studies showing that AI has the potential to facilitate personalized learning and assist students in completing complex tasks. Therefore, a more constructive approach is needed, namely by responsibly integrating AI into the learning process. The primary focus should be on strengthening students' AI literacy, enabling them to evaluate the information generated, understand the limitations of the technology, and use it as a means to broaden their understanding, rather than simply to obtain instant answers.

INTERVIEW WITH STUDENTS:

Q: What are the benefits of answering using AI assistance?
S: Benefits of answering using AI assistance When you have difficulty answering, you can directly ask AI and the answer you ask for will immediately come out according to what you asked.
Q: And what are the advantages of answering using AI?
S: The advantages of using AI to answer questions are its speed and accuracy. AI can provide answers quickly, help explain difficult concepts, and provide relevant examples. Furthermore, AI is accessible at any time, so we can learn and seek help without having to wait for a teacher or friend.
Q: Then what are the disadvantages of answering using AI?
S: The downside of using AI assistance is the lack of in-depth understanding. Sometimes, the answers provided can be out of context or too general. Furthermore, relying too much on AI can discourage learning and critical thinking, as we become accustomed to seeking instant answers.

CONCLUSION: The benefit of using AI to answer questions is the ease of getting immediate answers when you're having trouble. AI's strengths lie in its speed and accuracy, as well as its ability to explain difficult concepts and provide relevant examples, which can be accessed anytime without waiting for a teacher or peer. However, the downside of AI is a lack of in-depth understanding, as the answers provided are sometimes out of context or too general. Furthermore, relying on AI can make us reluctant to learn and think critically, as we become accustomed to seeking instant answers.

CONCLUSION FROM BOTH INTERVIEWS WITH STUDENTS RELATED TO NO AI ASSISTANCE AND THOSE USING AI ASSISTANCE: Students' difficulties in answering questions are often caused by forgetting the material that has been taught, although some students try to remember and are finally able to provide the correct answer. On the other hand, AI assistance offers ease and speed in getting answers, as well as the ability to explain difficult concepts, but also has disadvantages such as a lack of in-depth understanding and the potential to make students lazy to think critically due to dependence on instant answers.

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Conclusion

This study shows that the use of an adaptive learning platform based on artificial intelligence (AI) can have a positive impact on improving student achievement, particularly in Computer Networks. Interviews and experiments show that those who use AI assistance are able to provide more complete answers and demonstrate a deeper understanding than students who do not utilize AI. Although schools and teachers still limit the use of AI in the classroom due to concerns about students becoming dependent, evidence from this study shows that the wise use of AI can be a very effective tool. AI not only helps students find

information more quickly, but also plays a role in deepening their understanding of abstract concepts and increasing their enthusiasm for learning.

However, challenges remain, such as the loss of in-depth understanding and a decline in critical thinking skills if students become overly dependent on instant answers. Therefore, the use of AI in the learning process must be balanced with a sound understanding of the technology and learning guidelines that emphasize independent learning. Therefore, the use of AI in education should not be completely rejected, but rather directed towards its wise, controlled use, and appropriate to the conditions and needs of students. This aims to create a learning system that is adaptive, effective, and relevant to current developments.

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