



The Role of Artificial Intelligence (AI) in Mathematics Learning

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Abstract

Mathematics learning facilitates the development of students' critical, creative, innovative, logical thinking and problem-solving skills. These abilities can be supported by AI, where AI is an artificial intelligence that can help lecturers and students in planning, implementing and understanding mathematics learning. In other words, learning mathematics with AI is able to produce students who are capable of receiving, analyzing, and applying information in accordance with the demands of the current digital era. This study aims to describe several roles of AI in the mathematics learning process. The research method used in this study is qualitative with the type of literature study. The results of the study show that the role of AI in mathematics learning includes: a. can check the answers to student problem solving; b. overcoming the use of notation, symbols and images in mathematics learning; c. facilitate a deeper understanding of mathematical materials; d. motivate students in the process of learning mathematics. The use of AI in mathematics learning in the current digital era needs to be recommended to develop mathematical abilities while still using relevant signs.

Keywords: Mathematics Learning, AI, Mathematical Ability

Introduction,

Mathematics education is a compulsory subject at every level of educational institutions. Mathematics instruction should be implemented with real-world contexts and contextual problems. The process of mathematics learning requires high-level thinking skills. These skills are crucial for the advancements in 21st-century technology. Instruction that allocates artificial intelligence technology in the mathematics learning process can enhance understanding and curiosity in learning the concepts of mathematics being studied (Setiawan et al., 2024).

The purpose of learning mathematics is for students, as future teachers, to have the ability to understand mathematical design models, commonly applied mathematical concepts in everyday life, and to possess basic skills in logical, creative, and critical thinking in understanding problems, communicating issues, providing reasoning for problems, and connecting problems. Mathematics students, as future teachers, are agents of change in the field of education. Therefore, students need to

play a key role in learning and applying AI technology in the process of mathematics education. (Harnawati & Hidayati, 2024).

Good mathematics learning planning should align with the achievement of mathematics learning objectives. Mathematical concepts that require a high level of understanding should be practiced in order to achieve the learning goals. When planning the presentation of mathematical material, educators can utilize various educational technologies to support the achievement of these objectives. As educators in the field of education, it is important to wisely approach the development of technology in the era of society 5.0 (Saputra et al., 2023). AI technology assists educators in preparing learning materials effectively and efficiently, enabling teachers to optimize themselves in the teaching process and achieve the predetermined learning objectives (Januar & Burhan, 2024).

Innovation in mathematics education needs to be implemented for the effectiveness and efficiency of dense mathematical concepts. The use of technology in teaching is an innovation that can enhance students' skills. Internet-based learning processes are essential in the era of Society 5.0, therefore, instructors should encourage teaching methods that utilize technology to support students' skills in the Society 5.0 era (Mursyidah & Muhammad, 2023).

AI is a technology in the 21st century that is frequently used by society in various daily activities. Similarly, in the field of education, AI technology is widely applied in the educational process, including planning, implementing learning, and evaluation. AI technology also automates tasks assigned to instructors, such as providing feedback, selecting appropriate learning materials, designing learning activities based on student abilities, and aligning the curriculum with student needs. The emergence of AI is a significant part of the development of educational technology and will clearly impact human work activities in the future. (Abidin, 2023).

The use of AI technology in mathematics education can facilitate both professors and students in understanding complex mathematical concepts. This technology assists in various aspects of mathematics learning, including lesson planning by professors, concept comprehension by students, evaluation of learning outcomes by professors, and more. Research by Irawan concluded that the use of AI-Learn instructional media can help improve students' mathematics learning outcomes (Irawan & Irawan, 2014). Additionally, students' creativity can be enhanced through integral learning using the photomath application, allowing them to expand their knowledge and develop mathematical problem-solving skills (Tejawiani et al., 2023).

AI plays a crucial role in the process of learning mathematics. The role of AI assists both professors and students in achieving the maximum learning objectives in mathematics. AI technology provides the capability to support learners in solving various mathematical problems and offers in-depth and individual explanations. AI can monitor the progress of students, provide relevant learning recommendations, develop relevant learning systems, and personalize the experience for each student. (Sinaga, 2024). Students can independently manage their learning at home and on campus, with the

support of parents and professors, to navigate the faster pace of life in the era of artificial intelligence. Students can understand and manage their limitations during their studies.

This research described various roles of AI in mathematics education. It served as a reference and consideration for teachers and students in planning and implementing the mathematics learning process. To what extent can AI assist in the mathematics learning process and what are the ethical guidelines for using AI? So that the learning objectives and desired character values can be achieved together.

Research Methodology,

The research method used in this study is qualitative with a literature study approach. The data used in this research is literacy data. Data collection for this study was done through books related to Artificial Intelligence in mathematics education, research findings, and relevant journals with the same research variables. From this literacy data, the author analyzed various roles of AI in relevant mathematics teaching processes.

Findings and Discussion,

The current advancement in information technology has resulted in many positive impacts on the progress of education worldwide. One such positive impact is the availability of multimedia facilities that can make the learning process enjoyable, visual, and interactive. However, it is important to note that AI cannot fully replace the role and responsibilities of teachers. AI can only assist teachers in carrying out their tasks effectively and efficiently, while teachers must continue to guide students personally (Prameswara, 2024). Below, the researchers explained several roles of AI technology in the process of teaching mathematics.

AI can act as a virtual teacher in mathematics learning, providing personalized, interactive learning experiences supported by engaging visual tools. Students can independently learn to solve given problems. Of course, this requires the support of the facilities they have at home, such as a smooth internet connection.

The use of AI in solving mathematical problems can enhance students' analytical abilities, such as identifying patterns, applying concepts in real-life situations, and following step-by-step approaches. Students should regularly practice to become proficient in solving mathematical problems, thus sharpening their higher-level thinking skills.

AI can assist educators in evaluating automated assessments, providing feedback, and analyzing in-depth student performance data, enabling more effective curriculum adjustments and teaching. However, there is still a possibility of errors in using this application, so instructors should input data accurately and double-check the results from this AI technology. AI holds great promise in mathematics education for:

1. Checking Students' problem-solving answer

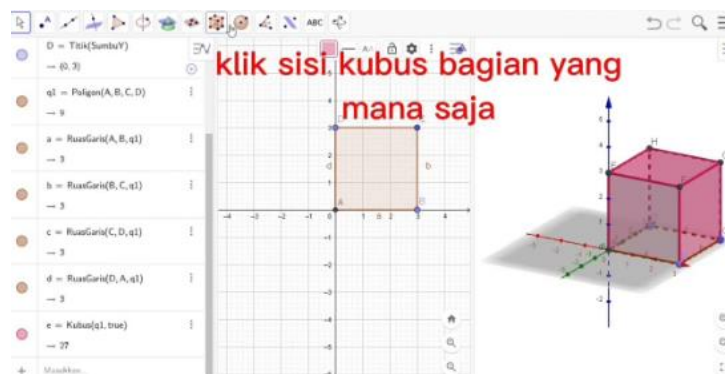
AI algorithms enable students and professors to manage large amounts of mathematical data at a faster pace compared to conventional methods, making mathematics learning more efficient and effective. By inputting the necessary mathematical data into AI software, students experience interactive learning and better understanding of concepts. Incorporating AI technology in lesson planning can also assist in creating teaching modules and expanding knowledge in technology-based learning processes. Additionally, AI plays a role in evaluating assessment questions, as professors can design assessment rubrics beforehand, allowing AI to check student answers according to the input rubric in the software.

The implementation of AI in the field of Education includes virtual mentors, voice assistants, intelligent content, presentation translators, global courses, automatic assessments, and personalized learning. (Luh Putu Ary Sri Tjahyanti*1, Putu Satya Saputra2, 2022). AI can help students verify their answers, thereby enhancing their understanding of the concepts they have learned. It can also identify any mistakes made and measure their individual abilities, which can be used for future evaluations in learning mathematical concepts.

2. Assisting in Overcoming the Use of Notations, Symbols, and Images in Mathematics Learning.

Several AI technologies are widely implemented in education in the current digital era. These AI technologies greatly assist students in understanding concepts and analyzing problems presented by professors. Geogebra software provides many features that can visualize abstract mathematical concepts. There are several uses of Geogebra software in mathematics education, including as a teaching tool, a tool for creating instructional materials, and for solving mathematical problems (Fahmi, 2018).

Improving high-level student abilities and motivating students to perform better through multimedia-based Geogebra learning. Geogebra can facilitate independent student learning, and its application process is easily understood. Some mathematical features in Geogebra include: creating parallel lines, intersecting lines, sketching functions and graphs, geometric translation, geometric reflection, geometric rotation, geometric dilation, creating 3D shapes, creating 2D shapes, constructing angles, and so on.

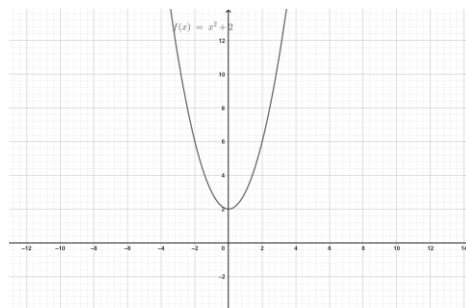


Picture 1. Sketching Cube Nets using Geogebra

Visualizing mathematical concepts using AI technology saves more time in person. Students can also study independently at home, check answers, and solve problems independently. Learning like this can improve students' skills and critical thinking. Thus, it will also have an impact on student learning outcomes. The final grades of students will increase from before. In addition, student motivation has also increased.

3. Facilitates a deeper understanding of mathematical material

There are several AI software that can be used in the mathematics learning process, the purpose of the software is to facilitate students to learn independently. One example of AI software that students can use to learn independently is Geogebra software. Multimedia Geogebra can help students learn independently in navigation, reading activities, answering questions, working on math problems, trying and running simulations of mathematical concepts, and being able to solve mathematical problems. The following is an image of geogebra software in running a simulation of the concept of functions, where you can use geogebra software for students to sketch function graphs.



Picture 2. Sketching Functional Graphs using geogebra software

Mathematics learning should be meaningful and can be applied in students' daily lives, when students are faced with a problem. These problems can be solved using mathematical concepts. The mathematical concepts that are being studied locally should be concepts that are really close to students, mathematical concepts that can be visualized and digested by students. Meaningful learning like this can be applied with an ethnomathematical approach. Where ethnomathematics is mathematics learning that involves the environment around students to facilitate the understanding of the mathematical concepts being studied. In the face of changing times, to produce relevant and effective learning experiences in educating the millennial generation, it is necessary to implement ethnomathematical learning based on artificial intelligence technology. (Wangi et al., 2023)

4. Motivating Students in the Mathematics Learning Process

Mathematical concepts that are complex and require a high level of skill in learning them certainly take a longer time. In order for the mathematics learning process to be designed and implemented effectively and efficiently, media assistance is provided (Supriyadi, 2022). Nowadays there are many technologies that can support the learning process. AI technology today

is increasingly used by students in the mathematics learning process. Of course, this AI technology is only used to facilitate them to understand mathematical concepts.

One of the AI technologies that can help to motivate students in the math learning process is the photomath application. Photomath is an application that can present the results of solving math exercises. With the AI Photomat application, students can understand mathematical concepts in depth, help students understand the problem-solving process, not only the final result, and students can also learn according to their own abilities, repeating steps that are difficult to understand until they really master it. Learning that utilizes AI can adjust the needs and abilities of students personally, thereby improving learning outcomes and the learning process to be effective. (Afrita, 2023).

The development of increasingly sophisticated technology makes children tend to often use modern technology compared to traditional ones, this has a negative impact on children, such as the emergence of indifferent and individualist characters. (Anggreini & Priyojadmiko, 2022). Lecturers need to play their role in facing and overcoming these negative impacts. Lecturers regularly serve as role models for students in managing good social character.

Conclusion

The use of AI technology in education plays a crucial role in making the teaching and learning process more effective and efficient. Complex mathematical concepts require the assistance of AI technology to achieve educational goals. Both professors and students need to carefully choose relevant AI technologies for mathematics education and establish boundaries for their use, ensuring adherence to established rules. Although AI contributes significantly to achieving educational objectives, it cannot fully replace the role of professors in the classroom; their role remains essential and indispensable.

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