

THE POTENTIAL OF ARTIFICIAL INTELLIGENCE (AI) IN THE FIELD OF EDUCATION AND PHYSICS LEARNING: A LITERATURE REVIEW

Mohd Zaidi Bin Amiruddin^{1*}, Achmad Samsudin¹, Andi Suhandi¹, Eka Putri Dian Nata Sari², and Wadhifah Qiyyamul Laili Arrafi²

¹Universitas Pendidikan Indonesia, ²Universitas Negeri Surabaya, Indonesia

*mohdzaidi@upi.edu

Articel Received: 25/09/2023; **Accepted:** 10/10/2023

ABSTRACT

This research analyzes potential artificial Intelligence (AI) in education, especially physics learning. The method used in this research is descriptive through literature study. The data obtained in this study came from scientific journals, books, websites, and other linear reference sources. The research results show that AI has great potential in the world of education, one of which is in physics learning. AI can also help improve students' understanding and critical thinking skills through AI-assisted media. The use of AI must also be balanced with the teacher's ability to prevent the negative impacts of using AI. The conclusion is that the potential of AI in education has both positive and negative effects, so it requires more attention when using AI. In the future, there needs to be collaboration between educators and AI developers to produce a product that can support special education in physics learning.

Keywords: Artificial intelligence; education; physics learning.

INTRODUCTION

One of the key elements in a nation's development is education. Physics learning is a crucial component of advancing science and technology (Coccia, 2020; Duit, 2014; Shishigu et al., 2017). However, the challenge faced in teaching physics effectively is reconciling personal learning needs and limited human resources, especially in crowded classes with students with varying levels of understanding. In recent years, artificial intelligence (AI) has experienced rapid progress (Li et al., 2017; Shi et al., 2020; C. Zhang & Lu, 2021). According to Alam (2021); Chen et al. (2020); Paschen et al. (2019); Salehi and Burgueño (2018) AI refers to the ability of a computer system to extract knowledge, learn and adapt to solve problems independently. In the context of physics learning, AI offers excellent potential to increase learning effectiveness and efficiency.

One of the main potentials of AI in physics learning is its ability to provide a personalized and adaptive learning experience. Using intelligent algorithms, AI systems can analyze data and understand individual student learning patterns (Abbas et al., 2023; da Costa et al., 2020; Pardamean et al., 2022; Waladi et al., 2023). In this way, AI can adjust the material's content, teaching methods, and difficulty level to meet each

student's needs and understanding. This can help students understand physics concepts better and improve their academic performance.

The supercomputer is the first thing that comes to mind when considering artificial intelligence. Supercomputers are computers with massive processing capacity, adaptive behavior (such as using sensors), and other cognitive and functional capabilities similar to those of humans. These features greatly enhance the interaction between supercomputers and people (April, 2021; Dhiman, 2022; Limna et al., 2022; Pramanik et al., 2018; Zhu et al., 2023). Several movies have been made to show what AI is capable of. For instance, technology in intelligent buildings may regulate temperature and air quality and play music based on how the building's residents feel (Allam et al., 2022; Kaklauskas et al., 2020; Ma et al., 2022). The use of AI in education is growing beyond the conventional idea of a supercomputer, embracing embedded computing devices.

Additionally, AI can also provide instant and accurate feedback to students. The AI system can detect students' understanding errors in real-time and provide appropriate explanations and suggestions for improvement (Chen et al., 2020; Ouyang et al., 2022; Yu & Guo, 2023). With timely and personalized feedback, students can improve their understanding quickly and overcome any difficulties they encounter in learning physics. In addition to the benefits of personalization and feedback, AI also has the potential to analyze learning data (Baidoo-Anu & Ansah, 2023; Bhutoria, 2022; Z. Chen, 2023). Using intelligent data analysis techniques, AI can identify student learning patterns, identify weaknesses in the curriculum, and optimize teaching strategies. This information can help teachers and educational institutions design more effective and efficient learning programs.

However, applying AI in learning, especially physics learning, also has challenges and considerations (Chaudhari et al., 2021; Cheah, 2021; Imran & Almusharraf, 2023). One is access to adequate technological infrastructure, such as a stable internet connection and sufficient hardware. Additionally, adequate teacher training and in-depth research are needed to understand and effectively utilize AI in physics learning (Ahmad et al., 2022; Essel et al., 2022; Kim et al., 2022). Ethical and privacy aspects must also be considered when using student data in AI systems.

For instance, by incorporating AI, computers, and other assistive technologies into robots, robots can be created that enhance students' learning, even in the most fundamental forms of education, such as early childhood education. Timms does promote using robots (cobots) that work in tandem with a teacher or another robot to teach kids fundamentals like spelling and pronunciation while adjusting to students' capacities. Using computing technologies, the use of AI in education is growing (Dhiman, 2022; Jacob et al., 2023; Leoste et al., 2022; Nja et al., 2023). Similarly, online and web-based education has developed from merely giving students access to online or web-based materials to download, study, and complete to graduate to intelligent and adaptive web-based systems that can learn the behavior of teachers and learners and

adapt to improve their learning experience. According to Chen et al. (2020); Fahimirad and Kotamjani (2018); Xia et al. (2022), in the realm of education, artificial intelligence has been included in administration, teaching, and learning. This research focuses on these domains, considered the foundation for examining and understanding artificial intelligence in education.

Analysis of the potential of AI in physics learning can provide valuable insights in developing educational policies and implementing technology in the learning process. Careful research and evaluations need to be conducted to evaluate the effectiveness of using AI in improving student understanding, academic achievement, and overall physics teaching. Here are some questions (Q) that will be answered in this paper as follows:

Q1: How is AI Globally?

Q2: How is AI in Education?

Q3: What is the potential of AI in physics learning?

Q4: What are the advantages and disadvantages of AI?

METHODOLOGY

This research uses descriptive analysis techniques through literature study. Literature studies attempt to describe events that exist in the present and the past. According to Amiruddin et al. (2023); Bartolacci et al. (2020); Gratton and Jones (2004), a literature study is a sequence of tasks connected to library data collection techniques, reading, recording, and processing the findings of earlier research comprising a literature study. The literature study method is based on written works containing published and unpublished research results.

The type of data in this research is secondary data, namely data obtained indirectly (Budianto, 2020; Wichitsathian & Pestonji, 2019). The data obtained in this research came from scientific journals, books, websites, and other linear reference sources. The selection of data sources studied is based on the close relationship to the topic being discussed, namely AI in the world of education. After that, the data is described according to the research objectives being studied.

The data analysis method used in this study is descriptive analysis, which entails presenting a regular explanation based on the data collected before explaining it in detail so that the reader can fully comprehend it. The following Figure 1 presents the flowchart of this research.



Figure 1. Research flowchart

RESULT AND DISCUSSION

1. Artificial Intelligence Globally

Computers and artificial intelligence (AI) are frequently used interchangeably. Although computers may have served as the starting point for the development of artificial intelligence, people no longer regularly consider computers, their hardware and software, or tools to be intelligent. This is according to a survey of several publications. This is undoubtedly true in the context of the education industry. Thanks to embedded computers, sensors, and other cutting-edge technology, machines and other objects, such as robots and buildings, can now possess artificial intelligence (Le et al., 2018; Zhang et al., 2022). According to Alam (2021); Chassignol et al. (2018); Chen et al. (2020), artificial intelligence research aims to address cognitive problems such as learning, problem-solving, pattern recognition, and context adaptation that are typically associated with human intelligence. The theory, known as artificial intelligence, guides the development and application of computer systems that are intelligent and capable of performing tasks that require human intelligence, such as speech recognition, decision-making, and language translation (Adiguzel et al., 2023; Fitria, 2021; Sadiku et al., 2022).

Artificial Intelligence (AI) is defined as a part of computer science that enables machines (computers) to do work as well as humans do (Cope et al., 2021; Geetha & Bhanu, 2018; Hwang & Chien, 2022; Kumar & Thakur, 2012). Therefore, computers are not only computing tools but can also be used to do anything humans can. According to Dash et al. (2019); Duan et al. (2019); Ghosh et al. (2018), AI can represent humans and can replace humans in some ways and also become smarter because it can understand big data, algorithms, or data processing and computing power.

2. Artificial Intelligence in Education

Artificial Intelligence (AI) has great potential in transforming education in Indonesia. By utilizing AI technology, various aspects of education can be significantly improved. According to Chen et al. (2020); Dong et al. (2022); Nguyen et al. (2023), several AI aids such as, intelligent education, advanced virtual learning, data analysis, and predictions are part of AI-assisted education. As learning needs increase, AI-assisted education becomes increasingly important (Alasadi & Baiz, 2023; Hassani & Silva, 2023; Qadir, 2023). Both teachers and students receive timely and individualized training and feedback from an intelligent education system. Various computing technologies, especially those connected to machine learning, are closely related to statistical models and cognitive learning theory (Dunjko & Briegel, 2018; Mahdavinejad et al., 2018). The following are some of the potentials of AI in education presented in Table 1.

Table 1. AI contributions to education

AI in Education	Explanation
Individual Feedback and Guidance	AI can provide instant and accurate feedback to students in the learning process. Some AI programs with immediate feedback: 1. Knewton, in New York. Technology learning program for students. The program that ALTA uses helps students do exercises tailored to what they need to master (Chan et al., 2022). 2. Cognii in Boston MA. AI program for SMA and PT. It helps students and students to think critically, provide feedback, and guidance based on their needs (Owoc et al., 2019). 3. Blippar, in London. Combines AI skills with real life to help students and students learn directly in the classroom. Interactive learning model in biology, physics and space subjects. For example, regarding volcanic eruptions, the AI program provides a 3D model of the actual eruption (Tkachuk et al., 2020)
Learning Data Analysis	AI can analyze data generated during learning to identify learning patterns, trends, and weaknesses in curriculum or teaching methods. This analysis can provide valuable insights to teachers and educational institutions in improving teaching strategies, designing more effective curricula, and optimizing student learning experiences.
Adaptive Learning	AI can provide adaptive learning experiences tailored to each student's abilities and level of understanding. AI systems can adjust content, challenges, and learning materials based on student responses. In this way, students will engage in learning appropriate to their skill level, increasing their motivation and learning outcomes.
Inclusive Education	AI can help create an inclusive learning environment for students with special needs. With adaptive algorithms, AI can provide specialized support to students with learning challenges or special needs. This can help students of all abilities and ensure that each individual gets an equal learning opportunity.
Virtual Collaboration and Discussion:	AI can be used to encourage collaboration and discussion between students in a virtual environment. With an AI-based platform, students can participate in discussions, ask questions, and share their understanding of physics concepts. This can increase social and collaborative interaction between students, deepening their understanding through discussion and exchange of ideas.
AI (Robot) as a teacher assistant	AI in physics learning has the function of an assistant who helps teachers and students, observes students who do not understand and reports it to the teacher, and provides private learning to students anywhere and anytime.

3. The Potential of AI in Physics Learning

In implementing AI in physics education, it must be acknowledged that AI technology is not a substitute for the role of the teacher. Teachers play an essential role in directing and facilitating effective physics learning (Abdullah et al., 2023; Hajian, 2019; Novak, 2002). The use of AI must be supported by adequate teacher training and

a student-centered approach to maximize the potential of using AI in physics learning. The following Table 2 presents several AI-assisted physics learning media.

Table 2. AI-assisted physics learning

Media AI	Implementation
Robot motor	Used for mechanics experiments, namely practice of speed, acceleration, force, collision, and vectors. With the help of robots, physics experiments become more interesting for students.
Drone	Used to quickly measure temperature in differences in height, pressure, making it easier to learn gas laws. With drones, we can study the climate and natural conditions in real life.
Robot	Used to measure hot temperatures in craters. The advantage of using robots is that they can conduct experiments in dangerous and toxic places.
HP	Used for learning inside and outside the classroom, it is used to make it easier to understand physics, both theoretically and experimentally. School assignments can also be collected via cell phone. Simple experiments in the surrounding environment regarding physical phenomena can be uploaded via cell phone and used as class discussion material. Thus the learning method can be developed.
Chatbot Einstein	Used as an alternative medium in studying physics material using technology from Dialog Flow. Chatbot technology can be an interactive learning solution by conducting questions and answers with students. Students can use the log feature on the chatbot to evaluate learning.
Chat GPT	Can answer questions about a series of obstacles with pictures by entering a good description of the picture in the prompt. However, the answers provided by Chat GPT must be rechecked. This is because GPT Chat cannot read images that are not clear.
Physics learning tutor	AI can be a student's tutor to understand physics material. As has been implemented in England, students carry out science learning with the help of AI. During learning activities, students are given problems that must be solved; then students are asked to solve the problem by looking at existing events. If a student's answer is incorrect, there will be immediate feedback, and students can repeat solving the problem until they are entirely correct. Because there is feedback directly and there are pictures of real events, students can learn easily and understand physics concepts well.

Through the incorporation of artificial intelligence in learning, AI has great potential to improve student understanding, develop critical thinking skills, and help students achieve better academic performance in physics. Through the words "artificial AND intelligence AND in AND physics AND learning" and the help of VosViewer, the following shows the potential of AI in physics learning in Figure 2.

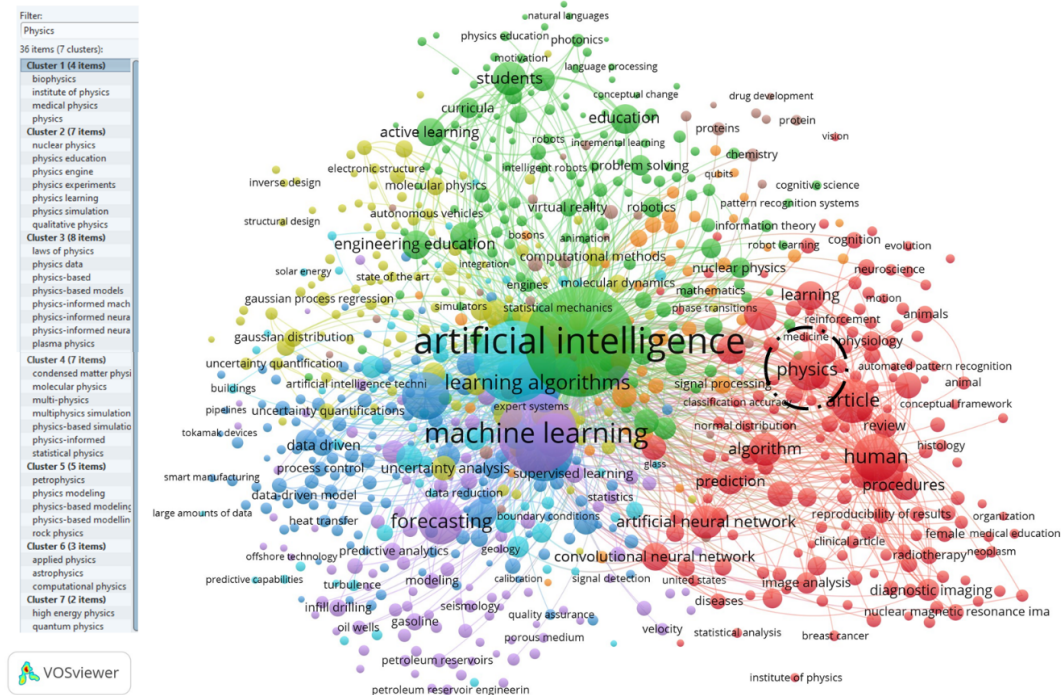


Figure 2. Visualization occurrence AI in physics learning

Based on Figure 2, it can be seen that the potential of AI in learning physics is very large. Referring to the visualization results, there are 7 clusters with a total of 38 items that are closely related to physics. This can be seen when filtering the word physics. Visually, there is a fairly large word physics next to AI and ML, but it cannot be seen clearly in detail. Through bibliometric studies, this shows that there is great potential that can be developed in the future on the topic being discussed, namely the potential of AI for physics learning.

4. Advantages and disadvantages of AI

The use of AI certainly has its own advantages and disadvantages. The following are several advantages and disadvantages of AI in Table 3.

Table 3. Advantages and disadvantages of AI

Advantages		Disadvantages	
• Complete tasks faster than humans	• Stressful and complicated jobs are solved easily	• Sometimes it can be misused	• Resulting in extensive damage.
• Difficult work is completed in a short time	• Multiple functions can be performed at one time	• Program incompatibility and sometimes performed against commands	• Impacting jobs for people
• High success ratio	• Fewer errors in assignments	• The unemployment problem is getting worse	• Programmers are responsible for creativity
• More efficient in a short time	• Less space, less size	• Lacking in human contact	• The younger generation is becoming slow
• Long-term calculations and complex situations	• Discovering unexplored things, namely outer space	• Requires a lot of effort and money	• Increased dependence on technology

Based on Table 3, it can be known that everything has advantages and disadvantages. This needs to be known so that it can be taken into consideration in developing or deciding something that is useful. In this case, the advantages and disadvantages of AI can be a space for researchers to develop and cover existing deficiencies so that it can be used properly according to the wishes of the research conducted.

CONCLUSION

Based on the results of the analysis presented above, it can be concluded that AI has enormous potential in the field of education and one of them is in physics learning. The development of AI has been widely used, both as a learning medium or an AI-assisted learning model. The use of AI is excellent if used in a positive direction and very bad if used in a negative order. Thus, more attention is needed when using AI in learning. In the future, collaboration between AI developers and schools is necessary in an effort to improve quality learning in the era of technological development. Apart from that, research on the impact of using AI in education needs to be explored further so that undesirable things can be anticipated.

Acknowledgments

The authors would like to thank the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia with **Program Magister Menuju Doktor untuk Sarjana Unggul** (PMDSU) Batch VII, which has provided funding support and opportunities.

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