

AI IN FUNDAMENTALS OF PHYSICS

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satyajit.chavan@gmail.com**Abstract**

Artificial Intelligence (AI) has brought transformative changes to science education, particularly in the field of physics. The role of AI in understanding fundamentals of physics by analyzing various tools and methods currently applied in learning environments, including intelligent tutoring systems, adaptive learning platforms, and interactive simulations. The study aims to find the benefits and limitations of AI in fundamentals of Physics.

Keywords: Artificial intelligence; Physics education; Adaptive learning; Interactive simulations.

Introduction

Artificial Intelligence (AI) in education has marked a transformative era, significantly influencing the way subjects such as physics are taught and learned. AI's capabilities in personalizing educational experiences enhancing engagement, and facilitating more effective learning have led to its growing adoption across educational system. AI technologies improving Physics learning experience. As Mahligawati discussed [1], the integration of AI in physics has introduced a range of intelligent tools that elevate the learning experience by offering interactive content, which engages students more deeply with the subject matter. Traditional methods of teaching physics have often struggled to convey abstract concepts effectively, but AI-powered tools provide dynamic simulations that bring these concepts to life. Jing [2] highlighted the role of AI-enabled virtual simulations in enhancing traditional resources, thereby facilitating a more interactive, engaging, and informative environment. This improved not only aids students in visualizing complex physics concepts but also encourages critical thinking and application-based learning.

Experimental Technique

This study adopts a Narrative Literature Review (NLR) approach to examine the role of artificial intelligence (AI) in transforming fundamental of physics in educators. [3]

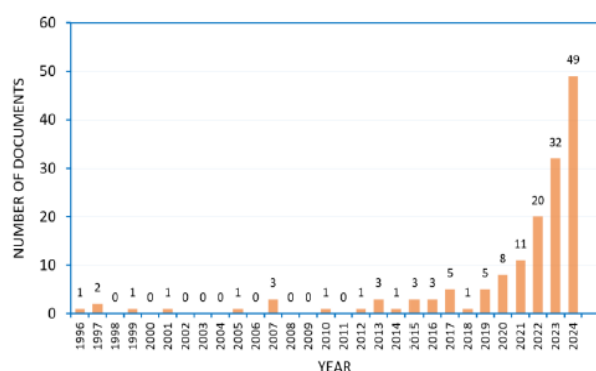
Result and Discussion

Fig.1

The search results from the SCOPUS database, as presented in Figure 1, illustrate the distribution of documents retrieved using the keywords “Artificial Intelligence in Physics Education” with the Boolean string [("Artificial Intelligence" OR "Machine Learning" OR "AI") AND ("Physics Education" OR "Physics Teaching" OR "Physics Learning")]. The trend in publications, shown in Figure 1, indicates a significant increase in research interest, particularly in the last few years, with a steep rise starting around 2020. This surge reflects the growing attention to integrating AI into educational contexts, specifically in the field of physics education. Figure 2 shows that the majority of the documents fall under “Physics and Astronomy” (24.1%) and “Computer Science” (20.6%), followed by “Social Sciences” (15.2%) and “Mathematics” (9.9%). The prominence of physics and computer science aligns with the interdisciplinary nature of AI in physics education, where computational techniques are applied to enhance educational methodologies in physics. In recent years, artificial intelligence (AI) has seen growing implementation in physics education, offering tools that enhance learning engagement, accessibility.

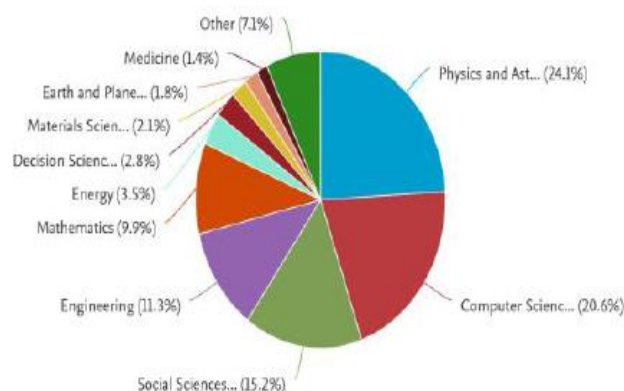


Fig.2

AI-based systems can facilitate the introduction of complex physics concepts by providing interactive simulations, visualizations, and explanatory models

[4]. These tools help students develop a deeper understanding of abstract concepts and improve their problem-solving skills. AI enables personalized learning experiences by adapting instruction based on individual student needs and abilities [5]. These AI-powered tools enable students to explore complex phenomena in a dynamic and intuitive manner, fostering deeper comprehension and critical thinking. Intelligent tutoring systems can provide customized feedback, remediation, and adaptive challenges, promoting effective learning and addressing students' diverse learning styles. AI can support collaborative learning and social interaction by facilitating online discussions, group activities, and peer assessment [6]. Intelligent agents and chatbots can provide real-time assistance, foster meaningful discussions, and promote active engagement among students. AI-based assessment systems offer automated evaluation of students' knowledge and performance, providing immediate feedback and tailored recommendations for improvement [7]. These systems analyze student responses, track progress, and identify areas of difficulty, aiding teachers in monitoring and supporting student learning.

Artificial intelligence has found extensive applications in education, including physics education. Intelligent tutoring systems, adaptive learning platforms, and virtual reality simulations are among the AI tools utilized to enhance student learning experiences [8].

The integration of AI in physics education offers several benefits, including enhanced conceptual understanding, personalized instruction, improved engagement and motivation, and efficient assessment and feedback [9]. The implementation of AI in physics education also poses challenges such as the need for technical infrastructure, training for teachers, ensuring data privacy and security, and addressing ethical considerations [10]. To overcome these challenges, strategies such as providing professional development for teachers, ensuring appropriate data privacy policies, fostering collaboration between educators and AI developers, and addressing ethical concerns through proper guidelines can be employed [11].

Conclusions

The integration of artificial intelligence (AI) in physics education holds significant potential to

revolutionize traditional teaching and learning practices. Through a comprehensive literature review, this study has explored the various applications of AI in physics education, highlighting its benefits, challenges, and future directions. The findings from this review indicate that AI can enhance physics learning experiences in several ways. AI-powered tools, such as intelligent tutoring systems and adaptive learning platforms, enable personalized instruction tailored to individual student needs and learning styles. This individualization fosters deeper conceptual understanding and supports students in overcoming learning barriers.

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