Benefits of AI-driven learning platform in engineering education context

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ABSTRACT

The AI-driven learning platform acts as a virtual educator in the field of engineering, allowing it to tailor each student's experience for maximum effectiveness. Future engineers across various disciplines will need to possess the crucial skill of effectively utilizing AI tools. This competence will enable them to promote excellence, innovation, sustainability, and productivity in their professional endeavours. Therefore, this study sought to examine the main benefits of AI-driven learning platforms in engineering education context. It explored the benefits of AI in transforming traditional education, how it adapted to individual learner needs, and how it influenced the role of educators.

Keywords: artificial intelligence (AI), engineering education, thematic analysis

1. Introduction

The term "artificial intelligence" is commonly used to describe computing systems that imitate human intelligence and behaviour in order to perform common human tasks [1] which are created as new technologies develop based on existing ones' underlying ideas. Additionally, it aids with working or deciding without human interaction and efficiently [2]. Its primary goal is to improve computers' broadly performance and foster intelligent thought patterns that can bridge the gap between humans and machines [3].

AI may also be reduced to a simple rule that instructs the computer how to act in certain circumstances. This means that AI is equivalent to nothing more than a series of if-then proclamations [4]. It is becoming increasingly clear that AI may improve the odds of success in the conception, design, and management of engineering systems [5]. As a result of advancements in areas such as big data, cloud computing, artificial neural networks, and machine learning, engineers have created devices capable of carrying out jobs formerly reserved for human beings [6]. Several machinery and engineering systems are already benefiting from AI's ability to improve their odds of success. This has been a major factor in the emergence of new paradigms, such as "Industry 4.0," during the past decade, and has caused seismic shifts across a vast array of manufacturing and economic activity [5].

Artificial intelligence technology, which counts among the most cutting-edge information and communications technologies in the world, has changed a range of different fields, including speech recognition, automatic control, enterprise management, and educational platforms, amongst others [7].

The implementation of technology that makes use of artificial intelligence may additionally enhance educational platforms, which comes with several other significant benefits. It helps to boost capacity in a variety of tasks that humans are unable to do, such as analysing the understanding of the learners, providing retrospective communication, assisting in planning for the enhancement of the educational curriculum, and assisting in making teaching and learning more successful [8].

The integration of AI in education has revolutionized traditional learning methods, particularly in the field of engineering education. AI-driven learning platforms are becoming increasingly prevalent, offering a range of benefits that contribute to the overall improvement of the learning experience for engineering students. AI has the potential to transform the current educational system, presenting a promising solution to various challenges. As AI-based educational solutions continue to advance, they can revolutionize the entire teaching and learning process [5]. Besides, future engineers across various disciplines will need to possess the crucial skill of effectively utilizing AI tools. This competence will enable them to promote excellence, innovation, sustainability, and productivity in their professional endeavors [9].

Therefore, the objective of this paper is to investigate the primary advantages of incorporating an AI-driven learning platform within the context of engineering education. This exploration is to identify ways in which the application of AI can be maximized within the specific domain of engineering education. Understanding the full potential and opportunities for AI utilization in this area can contribute to optimizing its impact on learning and educational processes.

2. Materials and methods

This study employed the thematic analysis technique within its qualitative research approach to investigate and identify themes in the literature review. Thematic analysis is a qualitative method that analyses and reports the theme of the qualitative data [10].

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Therefore, to pinpoint themes relevant to the paper's keywords, the data were gathered from both print and digital sources, including books, journal articles, and proceeding papers. The search strategy involved querying electronic databases, such as IEEE Xplore, ACM Digital Library, ScienceDirect, and Google Scholar, using a combination of keywords related to engineering education and artificial intelligence. The inclusion criteria encompassed articles published between 2010 and 2023, written in English, and directly addressing the relationship between artificial intelligence in the engineering education context.

This study adopting [10] recommended a step-by-step process as a framework to analyze the diverse themes present in the collected data. It listed a six-phase approach to thematic analysis, involving: (a) familiarizing oneself with the data, (b) generating initial codes, (c) identifying themes, (d) reviewing the identified themes, (e)defining and labeling the themes, and (f) composing the final report.

Specifically, fifteen chosen articles, including journal papers, underwent thorough examination to identify recurring themes. The detailed implementation of each phase of thematic analysis in this study, along with the findings, was expounded upon in the results and discussion section.

3. Results and discussion

Thematic analysis technique was applied by the researcher to analyse the documents including articles and journals. Figure 1 shows steps the researchers applied in analysing the data using thematic analysis.
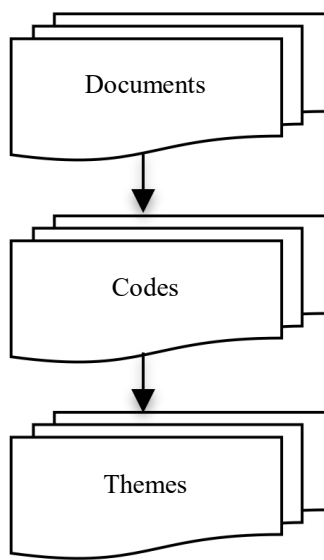
Figure 1. Thematic analysis applied in analysing documents data.

Referring to Figure 1, the researcher's analysis of the gathered journals and articles data is depicted. A comprehensive examination of all the data was conducted to identify and categorize the pertinent codes found within the content of the journals or articles. During this phase, the identified codes are organized and summarized in theme form. The identified codes are presented in Table 2, and the identified themes are listed in Table 3.

Table 2. Identified codes from database.

Codes from documents	Reference
- virtual instructor - help monitor the dynamics of groups - provide feedback in real time	[11]
- personalized learning - makes students feel that they are the only ones being taught - boosts level of involvement in their academic	[12]
- in-depth understanding	[13]
- immediately respond - can provide additional or alternative support - present them with more challenging challenges	[14]
- personalized learning 1 - better engagement, tighter connection	[15]
- personalization of education - solve the challenge of individualized instruction - personalised AI tutors	[5]
- intelligent tutoring system (ITS) - provide personalised learning environments - effective learning tool	[6]
- find information, as well as merge, arrange, and reconfigure it - can immediately see where they are in terms of their progress - one to monitor the advancement of the students - platform's intelligent tutoring	[9]
- receive immediate feedback	[16]
- future intelligent tutees	[17]
- foster students' hands-on skills and learning interests	[18]
- provide feedback that was similar to that provided by human graders	[19]
- valuable and convenient resources for Engineering education	[20]
- transcribe and convert human speech into a format that is useful for computer applications - expanding business opportunities	[21]

Table 2 illustrates the coded elements extracted from the descriptions found in the journals and articles. The chosen codes were based on the keyword of this research; AI in the engineering education context.

Hence, this stage necessitates the meticulous refinement and view of the codes to derive the core themes of the data, aligning with [10]. To facilitate the correlation of these codes, the researcher employed a "table-form" method for comparison. An exemplar of this process can be observed in Table 3, demonstrating how each code is systematically compared within the table format. This systematic approach culminated in the development of the primary themes within the dataset.

Table 3. Identified codes and themes.

No.	Codes	Themes	Frequency
1	- virtual instructor personalized learning - intelligent tutoring system - intellect tutoring - future intelligent tutees	Personalized learning	11
2	- provide feedback in real time - immediate response - find information, as well as merge, arrange and reconfigure - received immediate feedback. - provide feedback that was similar	Immediate feedback	8
3	- depth understanding - valuable and convenient resources	Enhancement of fundamental knowledge	3
4	- monitor of group - boost level of involvement	Collaborative learning	2

In conclusion, the thematic analysis of the provided data yielded several key themes. Based on the listed themes in Table 3, the primary or the most benefit that can be gained through the application of AI in engineering education is personalized learning. The predominant theme, "Personalized Learning," emerged with a frequency of 11, highlighting the emphasis on the benefits of AI in tailoring education to individual needs through elements such as virtual instructors, personalized learning approaches, intelligent tutoring systems, intellect tutoring, and the consideration of future intelligent tutees. This shows that this AI technology can be a good helper and excellent facilitator not only for the students but also the engineering educators. These benefits have been discussed by several researchers.

Following closely is the theme of "Immediate Feedback," identified with a frequency of 8, indicating the significance of AI in real-time feedback, quick responses, information retrieval, arrangement, and reconfiguration, as well as the provision of similar feedback. Additionally, the theme of "Enhancement of Fundamental Knowledge" appeared with a frequency of 3, emphasizing the importance of AI technology in fostering depth of understanding and providing valuable and convenient resources. Lastly, "Collaborative Learning" emerged as a theme with a frequency of 2, underlining the value of monitoring groups and boosting levels of involvement in the learning process.

Overall, these reported themes contribute to comprehensive and adaptive info on the application of AI learning technology in engineering educational frameworks. This report also shows the primary potential of AI in optimizing the impact on student's learning and educational processes.

4. Conclusions

In conclusion, AI-driven learning platforms enhance engineering students' learning by promoting engagement, facilitating collaboration, and enabling personalized learning approaches. These platforms offer a range of benefits that contribute to student's academic success and overall learning experience, especially for personalized learning.

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