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Artificial Intelligence Experts' Perceptions on the Effective Use of Artificial Intelligence Applications in University Learning Environments

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Abstract

The current study aimed to investigate Artificial Intelligence experts' perceptions on the effective use of artificial intelligence applications in university learning environments. To achieve this, a purposive sample of 33 AI experts from four Arab countries (the UAE, Saudi Arabia, Jordan, and Bahrain) was selected. Data were collected using a qualitative research methodology, specifically through semi-structured interviews, after ensuring the validity and reliability of the tool. Qualitative research steps, including the grounded theory approach, were employed for data collection and analysis. The study revealed that AI experts emphasized the importance of integrating a range of artificial intelligence applications in university learning environments. These applications include implementing automated assessment, utilizing augmented and virtual reality, employing smart educational tools, leveraging personalized learning, applying adaptive learning, utilizing academic data analytics, and supporting academic research. The study also recommended the adoption of these applications in university education environments to enhance learning outcomes and overall effectiveness.

Keywords: *Artificial Intelligence; effective use; university learning environments.*

Introduction

Artificial Intelligence (AI) is a fundamental and rapidly evolving field in computer science dedicated to developing software systems capable of performing tasks that typically require human intelligence. This field emerged from the convergence of several core areas, including systems science, computing, and automatic control, along with a comprehensive understanding of human intelligence derived from logic, mathematics, and linguistics. AI systems rely on advanced algorithms to tackle complex problems and make decisions with unprecedented speed and efficiency, far exceeding human limitations. This capability allows AI to drive significant innovation and enhance productivity across a wide range of sectors, from healthcare and finance to manufacturing and logistics (Bani Irshid et al., 2023; Jiang and Liu, 2021; Tabuenca et al., 2015; Tempelaar et al., 2025).

The essence of AI lies in its ability to simulate human intelligence, making it a crucial component of computer science. These intelligent systems are designed to replicate human cognitive and behavioral patterns, reflecting the multidisciplinary nature of AI. The development of AI integrates insights from technology, psychology, and cognitive science, aiming to create systems that not only perform tasks but also possess the ability to think, learn, and adapt over time. This continuous learning and adaptation distinguish AI from traditional software systems, as AI can improve its performance and decision-making capabilities through experience and data analysis (Lee and Choi, 2023; Sharma et al., 2023; Ghorashi et al. 2023).

Artificial Intelligence (AI) is generally categorized into two main types, each highlighting its diverse capabilities and broad applications. The first type, known as Weak AI or Narrow AI, is specialized in performing specific tasks with high precision and efficiency. Examples of Weak AI include self-driving cars, designed to navigate roads and make driving decisions, and virtual personal assistants such as Siri and Alexa, which handle specific functions like scheduling and information retrieval (Khasawneh et al., 2022; Khasawneh et al., 2023; Fraihat et al., 2022; MacLeod et al., 2019; Pardo et al., 2019; Tempelaar et al., 2021). The second type, referred to as Artificial General Intelligence (AGI), represents the broader and more ambitious goal in AI research. AGI aims to replicate the full spectrum of human cognitive abilities, enabling it to handle a variety of tasks and problem-solving activities. AGI systems are envisioned to understand, learn, and apply knowledge across diverse contexts, exhibiting versatility and adaptability akin to human intelligence. This distinction between Weak AI and AGI highlights the extensive possibilities of

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AI, from specialized applications to comprehensive systems capable of complex thinking and adaptive learning, revolutionizing various aspects of human life and industry (Almasri, 2024; Chiu et al., 2023; Cooper, 2023; Gonzalez et al, 2017; Jiao et al 2022).

It is evident from the above that AI is a technological innovation that has permeated various aspects of human life. The education sector is one of the human domains affected by AI applications in learning and teaching environments, making AI a crucial factor in shaping the future of learning environments. AI represents a significant shift in learning and teaching paradigms, making previous models of learning environments appear outdated compared to AI-driven learning environments that enhance student roles in higher education (Gonzalez et al, 2017; Jiao et al 2022; Nguyen and Tran, 2021; Nja et al., 2023; Patel and Singh, 2022; Zhou and Brown, 2023).

In this context, AI applications have demonstrated a global shift towards integrating them into educational practices. The underlying reason for this trend is to maximize the benefits of AI, particularly regarding ease of use, cost efficiency, and the ability to manage vast amounts of information, by leveraging machine learning and deep learning technologies (Cooper, 2023; Gonzalez et al, 2017; Jiao et al 2022). This implies that employing AI applications in higher education has the potential to revolutionize education by facilitating the creation of personalized learning experiences that cater to individual student needs, thereby achieving learning outcomes for a large number of students and fostering a more accessible and efficient educational environment that places the student at the core of the learning process (Nja et al., 2023; Patel and Singh, 2022; Zhou and Brown, 2023).

Many researchers (Popenici and Kerr, 2017; Singh and Gupta, 2021; Tan and Kumar, 2020; Zhai et al., 2021; Zhai et al., 2022) indicate that Artificial Intelligence (AI) has the potential to enhance students' efficiency in performing a variety of educational activities, ensuring equal learning opportunities for all students in higher education environments. In this context, previous studies (Almasri, 2024; Chiu et al., 2023; Cooper, 2023; Gonzalez et al, 2017; Jiao et al 2022; Nguyen and Tran, 2021; Nja et al., 2023; Patel and Singh, 2022; Zhou and Brown, 2023) have demonstrated AI's contribution to enriching the educational experience by developing interactive and engaging educational games. This enhances student interaction with the learning process, improves interaction between students and educational programs, fosters empathy between students and their teachers, and simplifies the use of educational technologies.

Given the importance of AI applications in higher education learning environments, numerous previous studies (Johnson and Kumar, 2022; Kiemde and Kora, 2022; Kim and Lee , 2021MacLeod et al., 2019; Pardo et al., 2019; Tempelaar et al., 2021) have highlighted the need to leverage the advantages of AI to improve the quality of learning outcomes, enhance educational practices, assessment strategies, and administrative processes. AI also plays an effective role in advancing the teaching of physical and natural sciences in many countries worldwide (Nja et al., 2023; Jiao et al., 2022; Page et al., 2021). In this context, Almasri's study (2024) emphasized the importance of a fundamental understanding of the evidence-based interaction between AI and science education. More specifically, results from previous studies (Nja et al., 2023; Jiao et al., 2022; Page et al., 2021) revealed that enhancing learning environments with AI tools integrated into physical and natural science education environments contributed to multiple pedagogical benefits, including improving the learning environment, creating tests, evaluating student work, and predicting academic performance.

Furthermore, previous studies findings (Chu et al., 2022; Huang, 2018; Papadopoulos et al., 2020; Piasecki et al., 2018; Popenici and Kerr, 2017; Timmers et al., 2015) have shown that AI applications in education are crucial for renewing and enhancing learning environments. More specifically, the use of AI in university teaching has become increasingly common, with growing interest in applying machine learning techniques to education in general. This includes using AI to automate assessment procedures and provide immediate, detailed feedback to students on their work in science education (Huang and Chen, 2016; Qian et al., 2021; Popenici and Kerr, 2017; Timmers et al., 2015). Researchers (Johnson and Kumar, 2022; Kiemde and Kora, 2022; Kim and Lee , 2021; Nja et al., 2023; Jiao et al., 2022; Page et al., 2021) have pointed out the positive effects of AI in facilitating the teaching and learning process in higher education environments by enhancing students' role in knowledge construction through self-directed activities and independent study. These results illustrate AI's role in modernizing student learning through contemporary technological methods, as opposed to traditional educational practices based on rote memorization without a proper understanding of scientific knowledge.

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The above highlights the importance of transitioning AI applications in higher education from a transmission model to a constructivist model, which is essential for enhancing the educational process and achieving the best academic outcomes (MacLeod et al., 2019; Pardo et al., 2019; Tempelaar et al., 2021)

Employing a constructivist model through AI has the potential to improve educational quality by providing intelligent interactive tools that help students understand course material in innovative and effective ways. This underscores the importance of personalizing the educational experience for each student based on their needs and academic level, thus increasing the effectiveness of the educational process (Arrieta et al., 2020; Martin, F., & Whitmer, 2016).

Moreover, with intelligent data analysis, AI can provide detailed reports on student performance, assisting professors in identifying each student's strengths and weaknesses and developing personalized educational plans to enhance their performance (Kim and Lee , 2021; Nja et al., 2023; Jiao et al., 2022; Page et al., 2021).

In addition, the automation provided by AI facilitates routine tasks such as grading assignments and exams, allowing professors more time to focus on teaching and interacting with students. These technologies also offer immediate support to students by answering their queries and providing educational resources around the clock, ensuring continuous learning without interruption (Arrieta et al., 2020; Martin and Whitmer, 2016). AI platforms also contribute to enhancing collaborative learning among students by providing virtual educational environments that promote teamwork and engagement. These interactive environments stimulate innovation and creativity by offering unique and innovative educational experiences (Alali and Al-Barakat, 2023; Arcos-García et al., 2015; McKenney and Mor, 2015; Topol, 2019)

Specific AI applications in higher education include educational recommendation systems that suggest study materials or personalized learning paths for each student, educational robots capable of interacting with students and answering their questions, and big data analytics used to derive insights and forecasts about student performance and academic futures. Additionally, virtual assistants such as chatbots provide round-the-clock support and assistance to students, while virtual reality (VR) and augmented reality (AR) technologies are employed to deliver immersive and realistic educational experiences (Adadi and Berrada, 2018; Al-Hassan et al., 2023; Arrieta et al., 2020; Martin, F., & Whitmer, 2016)

Overall, the list of AI applications provides a framework to help universities select the most suitable applications to enhance the educational process and improve the student experience, leading to the achievement of higher education goals with the highest levels of efficiency and quality. This highlights the importance of integrating AI to develop interactive and immersive learning environments, making higher education more engaging and accessible to students with diverse learning styles and needs. As AI technologies continue to advance, the potential for their integration into higher education is expected to grow, opening new avenues for transforming and improving student learning experiences at all levels (Khasawneh et al., 2022; Fraihat et al., 2022; MacLeod et al., 2019; Pardo et al., 2019; Tempelaar et al., 2021).

Statement of the Study

Given the importance of artificial intelligence (AI) applications in university learning environments, understanding these applications through surveying the perspectives of AI experts in education presents a valuable opportunity to identify a list of AI applications that faculty members can use in educational settings. This is particularly relevant as some may lack ideas on how to integrate AI into university education.

In this context, the input from these experts provides valuable insights that can guide the development and implementation of AI technologies in ways that enhance their effectiveness and educational benefits. Furthermore, this offers a precise and comprehensive view of AI applications, especially considering that AI experts possess a deep understanding of educational requirements, technical challenges, and ethical considerations. Thus, understanding the experts' opinions is crucial to ensure that these technologies are used to their full potential in higher education.

Therefore, this study aims to survey the perspectives of experts in the field of AI in education to identify the applications through which AI can be utilized in university learning environments. The current study poses the following research question: What are the AI applications from the perspective of AI experts?

Method

Study Design

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To achieve the study's objectives, a qualitative methodology was employed by exploring the experiences of participants and their perspectives regarding the phenomenon under investigation. This approach allows study participants to express their opinions and perceptions by delving deeper into the topic, encompassing all aspects that can be discussed. This helps in obtaining more accurate and detailed information and data, particularly since the semi-structured interview protocol relies on probing questions during interviews to understand respondents' thoughts, experiences, opinions, and behaviors, with the goal of obtaining a comprehensive view of the studied phenomenon.

Study Sample

The study sample consisted of 33 experts in AI in education. Participants were selected using purposive sampling, which is characterized by its ability to meet the research needs efficiently and effectively, given the participants' willingness to collaborate with the researchers. Qualitative research theorists suggest that for research studies relying on interviews, it is preferable to select study participants in semi-structured interviews based on personal willingness and cooperation from those willing to participate. Table 1 illustrates the demographic characteristics of this sample.

Table 1: Demographic Characteristics of the Study Sample

Variable	Variable Categories	No.	Percentage
Academic Rank of Experts	Assistant Professor	6	18.18%
	Associate Professor	9	27.27%
	Full Professor	10	30.30%
	Honorary Professor	8	24.24%
Total		33	100.00%
Country of Expert	United Arab Emirates	9	27.27%
	Saudi Arabia	9	27.27%
	Jordan	10	30.30%
	Bahrain	5	15.15%
Total		33	100%

Study Instrument

The study employed a qualitative methodology for data collection, utilizing semi-structured interviews. This method is suitable for deeply understanding the studied phenomenon as it is based on reflective thinking principles, which allow the researchers to pose various probing questions during the dialogue. This type of questioning enhances the deep understanding of the research topic and helps in identifying and understanding issues that may arise during the interview. To ensure proper execution of this process, an interview guide (protocol) was used as a directive tool for the researcher during the interviews. The interview guide was developed based on the authors' experience as faculty members in higher education, leading to the creation of an initial interview guide consisting of six questions.

Validity of the Semi-Structured Interview

The face validity of the interview guide was verified by presenting it to thirteen (13) specialized reviewers. Based on the reviewers' comments, two questions were removed, and two others were revised. Consequently, the final version of the interview guide consisted of four questions. This procedure ensures the validity of the tool.

Reliability Procedures for the Semi-Structured Interview

Following the qualitative research methodology outlined by qualitative research theorists, the reliability of the semi-structured interview was ensured through three sequential stages:

1. **Pre-Application Reliability:** Verification of the tool before the commencement of data collection.
2. **Data Collection Reliability:** Achieving high levels of reliability and credibility during data collection to enhance transparency and professionalism in data gathering and documentation.
3. **Data Analysis Reliability:** Ensuring accuracy in data analysis by calculating inter-coder agreement. This procedure enhances the credibility of the analysis and reduces potential personal biases in individual analysis. The agreement between coders also improves the accuracy of the results derived from the data analysis.

Data Analysis of the Interview

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The researchers followed the Grounded Theory Approach for analyzing the study data, a globally recognized method for qualitative research data analysis. The analysis was conducted according to the ideas emerging from the study data, leading to the identification of themes (main ideas) or characteristics categorized into main and sub-categories through the following process:

1. **Reviewing Recorded Interviews:** Each response was recorded on a separate sheet.
2. **In-Depth Reading:** The data was read thoroughly and reflectively, with multiple readings of each word, sentence, and phrase mentioned in the interviews.
3. **Coding:** Responses were coded during the second reading, identifying recurring patterns, main ideas, and themes, and representing them with codes and classifications.
4. **Categorizing Ideas:** Similar or related ideas were organized into sub-categories based on the previous coding step.
5. **Classifying Sub-Categories:** Sub-categories were classified into main categories.
6. **Verifying Data Analysis Consistency:** Consistency was ensured as mentioned in the reliability stage during data analysis.
7. **Calculating Frequencies and Percentages:** Frequencies and percentages of responses were calculated according to their distribution across the main and sub-categories.

Results and Discussion

The study aimed to explore the perceptions of artificial intelligence experts in education regarding effective practices for enhancing the quality of university learning environments. To achieve this goal, a qualitative research methodology was employed through semi-structured interviews with 33 experts. The interviews were analyzed using qualitative research methodology, specifically grounded theory approach. The inductive analysis revealed a set of primary and secondary themes indicating the identification of effective practices for improving the quality of university learning environments. These themes are presented in descending order based on their frequency and percentage as shown in Table (1), and Chart 1:

Table 1: Frequencies and Percentages of Artificial Intelligence Experts' Perceptions on the Effective Employment of Artificial Intelligence Applications in University Learning Environments

Rank	main-themes	No.	Percentage (%)
1	Implementing automated assessment in university learning environments	33	100.00%
2	Utilization of augmented and virtual reality in university learning environments	32	96.97%
3	Utilization of smart educational tools in university learning environments	31	93.94%
4	Leveraging personalized learning in university education	30	90.91%
5	Application of adaptive learning in university learning environments	29	87.88%
6	Utilizing academic data analytics to enhance university learning environments	27	81.82%
7	Academic research support in university learning environments	25	75.76%

Moreover, the table above is illustrated in Figure 1.

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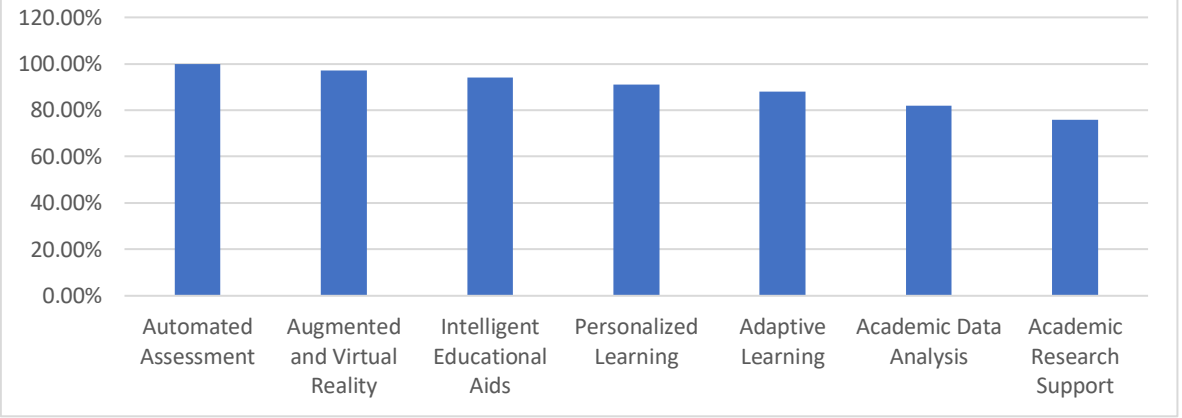
Figure 1: Frequencies and Percentages of Artificial Intelligence Experts' Perceptions on the Effective Employment of Artificial Intelligence Applications in University Learning Environments.



The above illustrates the significance of AI applications in university education environments, as clearly reflected in the responses from the study participants. It reviews the experts' assessments regarding the effectiveness of AI applications, with percentages ranging from 75.76% to 100.00%. The highest percentage, 100.00%, was recorded for "automated assessment," indicating a strong recognition of its effectiveness in streamlining the assessment process while ensuring its integrity and efficiency. The ability to provide accurate and immediate evaluations is crucial for enhancing learning experiences. This technology not only alleviates the burden on faculty but also improves real-time communication with students regarding their performance.

Conversely, "academic research support" received the lowest percentage at 75.76%, suggesting a lesser recognition of the importance of this application compared to others. Nevertheless, these applications remain fundamental in accelerating and increasing the efficiency of research processes. Between these two extremes, the responses show varying degrees of impact of AI applications in universities. For instance, "personalized learning" and "smart educational tools" received high percentages of 90.91% and 93.94%, respectively, reflecting a significant appreciation of their role in tailoring learning experiences and providing individual support to students. Meanwhile, "augmented and virtual reality" received a high percentage of 96.97%, highlighting how these technologies can create immersive and effective educational environments.

In light of the above, the results can be presented and discussed as follows:

Implementing Automated Assessment in University Learning Environments

The study results revealed that 100% of the responses affirmed the importance of implementing automated assessment through the integration of AI tools into Learning Management Systems (LMS) used in universities. These tools include algorithms for test correction, essay grading systems, and automatic assessment tools for practical tasks, which facilitate the grading of assignments and exams, ensuring consistent and unbiased evaluation. In this context, one participant stated:

> *"It is indeed necessary to employ automated assessment in university education environments. Universities should integrate these tools within their LMS to automate the grading of multiple-choice tests, essays, and even complex problem-solving tasks."*

This quote underscores the significance of automated assessment through AI technologies, as the study sample justified that this application significantly contributes to providing students with immediate feedback, helping them understand their mistakes and learn more effectively. Faculty members can use the time saved from grading to focus on providing more personalized support to students.

Furthermore, the study sample emphasized the importance of focusing on automated assessment because these systems are capable of evaluating student performance accurately and efficiently, especially since students need immediate feedback. Consequently, universities can use software such as AI-based test correction tools for multiple-choice exams or text analysis tools for essay evaluation. These findings are consistent with previous studies (Huang and Chen, 2016; Qian et al., 2021; Papadopoulos et al., 2020; Piasecki et al., 2018) that revealed automated assessment plays a pivotal role in improving the quality of university education by enhancing the student learning experience through accurate and rapid evaluations. Moreover, these tools help reduce human bias, ensuring a more precise and objective assessment.

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Additionally, these results align with previous studies (Khasawneh et al., 2023; MacLeod et al., 2019; Pardo et al., 2019; Tempelaar et al., 2021), which indicate that automated assessment saves faculty time, allowing them to focus on providing more personalized support and enhancing educational interaction with students. This is consistent with what participants in the current study noted, as they confirmed that automated assessment provides teachers with a greater opportunity to support students rather than being occupied with routine grading.

Utilization of Augmented and Virtual Reality in University Learning Environments

The data analysis results revealed that 96.97% of the respondents emphasized the significance of utilizing Augmented Reality (AR) and Virtual Reality (VR) technologies to create immersive and interactive learning experiences in university education environments. This high percentage reflects a strong recognition of the potential of AR and VR to enhance educational practices. Many participants highlighted the necessity for universities to implement AR/VR labs, where students can engage with 3D models, conduct virtual experiments, and explore simulations of real-world scenarios. For example, one participant noted:

> *"Many applications of augmented and virtual reality should be integrated into university education environments. For example, medical students might use virtual reality to practice surgical procedures, while engineering students could use augmented reality to visualize complex structures. These technologies make learning more interactive and engaging, helping students understand challenging concepts more effectively."*

Another participant added:

> *"Certainly, why not? As faculty members in higher education, we should implement augmented and virtual reality technologies by establishing AR/VR-equipped educational labs. Universities can create interactive educational experiences using VR headsets and AR applications that allow students to interact with 3D educational content. For instance, VR can be used in medical studies to train students in surgical procedures within a simulated environment, or in the arts to provide immersive experiences in virtual art galleries."*

These responses illustrate the importance of integrating AR and VR technologies into the educational environment. By providing students with the opportunity to interact with 3D models, conduct virtual experiments, and explore realistic scenarios, AR and VR can significantly enhance the learning experience. The findings align with previous studies (Hsu et al., 2018; Kakish et al., 2019; Lee and Choi, 2023; Lin et al., 2019), which emphasize the role of AR and VR in improving engagement and interaction within educational settings, making learning more effective and enjoyable.

Additionally, numerous researchers (Al-Hassan et al., 2023; Arcos-García et al., 2015; Arrieta et al., 2020) have stressed the necessity of incorporating AR/VR applications into university learning environments. They argue that these technologies play a crucial role in deepening students' understanding of complex concepts through immersive simulations and interactive 3D content.

In short, AR and VR technologies are instrumental in advancing the educational experience by offering more interactive and immersive learning opportunities. They enhance students' ability to grasp difficult concepts and develop their skills more effectively, establishing themselves as essential tools for improving the quality of higher education.

Utilization of Smart Educational Tools in University Learning Environments

The results of the data analysis revealed that 93.94% of the study sample respondents highlighted the importance of integrating smart educational tools, such as intelligent teaching systems and chatbots, into university learning environments to provide additional support to students. These tools can answer frequently asked questions, provide explanations, and guide students through complex topics. Many respondents emphasized the importance of these tools, exemplified by some respondents who stated:

> *"Indeed, smart learning tools are very important in university learning environments. For instance, a virtual tutor might help a student solve a difficult math problem by breaking it down into simpler steps... These tools are often available around the clock, providing continuous assistance to students."*
>
> *"It is essential to integrate smart educational tools into the curriculum through intelligent educational platforms that offer individualized support to students. These tools include intelligent guidance systems and chatbots that provide personalized assistance to students... Universities can activate these tools through their digital educational systems, where students can access help at any time through interactive user interfaces... For example, chatbots can be used to answer frequently asked questions and provide additional explanations of complex concepts."*

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In light of the data analysis results, which highlight the importance of employing smart educational tools in university learning environments, these results can be attributed to the fact that these tools allow students to access support at any time, whether during study hours or outside them. This continuous support can be particularly beneficial for students who need additional help at unconventional times.

The results of this section further emphasize the significance of integrating smart educational tools into the curriculum, as it can have positive effects on higher education through:

- **Integration of tools into intelligent educational platforms:** It is crucial to incorporate these tools into the smart educational platforms used by universities. These platforms can provide interactive interfaces that facilitate student access to resources and assistance.
- **Providing individualized support:** Smart tools offer the possibility of providing individualized support tailored to students' needs. This personalization can help address diverse learning needs and enhance the efficiency of the educational process.
- **Improving access to information:** Utilizing chatbots and other smart tools can contribute to improving access to information and educational resources, thereby enhancing the learning experience and making it more interactive and comprehensive.

Thus, these results align with contemporary educational trends that emphasize the importance of employing smart educational tools in university learning environments. By integrating these tools into the curriculum and using them strategically, significant benefits can be achieved in the field of higher education (Kim and Lee , 2021; Nja et al., 2023; Jiao et al., 2022).

Leveraging Personalized Learning in University Education

Analysis of the study sample data revealed that 90.91% of respondents affirmed the significance of implementing personalized learning through artificial intelligence systems. These systems analyze student data to adapt educational content to meet individual needs. In university environments, this approach involves adaptive learning platforms that adjust task difficulty based on student performance, recommend resources tailored to each student's learning style, and provide personalized feedback. Universities incorporate these systems into Learning Management Systems (LMS) to create a more engaging and effective learning experience. In this context, a respondent emphasized the importance of personalized learning, stating:

> *"I believe every faculty member should utilize adaptive learning systems that customize content according to individual student needs. These systems analyze performance data and deliver personalized educational content, such as exercises and additional resources suited to each student's level. Universities can integrate these systems into online learning platforms to offer customized and detailed educational experiences. For instance, the system can tailor practice tests based on the strengths and weaknesses identified through student performance."*

This excerpt underscores the value of employing AI-driven personalized learning in university settings to tailor educational content to individual student needs. The results highlight a shift towards adopting advanced technologies aimed at enhancing the learning experience and increasing its effectiveness within academic institutions. This finding aligns with previous research (Sanchez, 2020; Sharma et al., 2023; Ghorashi et al. 2023), which emphasized the importance of personalized learning in delivering content that matches each student's level more precisely. Such customization enhances learning effectiveness, enabling students to engage with content that meets their specific needs and thereby improving academic performance.

Additionally, these results are consistent with contemporary educational trends that stress the necessity of utilizing AI applications to provide personalized education. These applications adapt to the evolving needs of students and offer content appropriate for their varying levels. Previous studies (Dounas et al., 2019; Drissi and Amirat, 2016; Dry et al., 2018; Gebhardt, 2018) have shown that such personalization can lead to improvements in academic performance, helping students better address educational challenges and achieve their learning goals more effectively.

Overall, the findings suggest that AI-supported personalized learning can significantly enhance the educational experience in higher education. By utilizing adaptive systems that analyze performance data and integrating these systems with LMS platforms, academic institutions can offer a more interactive and effective learning experience. This shift towards adaptive education represents a crucial advancement in improving learning outcomes and enhancing the overall effectiveness of the educational process.

Application of Adaptive Learning in University Learning Environments

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The data analysis results showed that 30 interviewees, representing 90.91%, emphasized the importance of implementing adaptive learning techniques to monitor students' progress and dynamically adjust content and task difficulty based on actual performance. Adaptive learning, as an application of artificial intelligence, is an educational approach aimed at customizing the learning experience to meet each learner's individual needs. In university learning environments, the interview results indicated that participants emphasized the following:

1. **Customized assessment**: 27 responses highlighted the importance of using assessment tools to determine students' knowledge levels and educational needs. These assessments can help tailor content and activities to each student's level.
2. **Customized content**: 30 responses showed the significance of developing educational content that adapts to individual students' levels of understanding and interests. This application of artificial intelligence can contribute to providing multiple learning pathways or additional resources as needed.
3. **Adaptive interaction**: 26 responses revealed that the use of artificial intelligence in adaptive learning effectively provides immediate feedback and tailors interactions with students based on their performance.
4. **Smart teaching**: 23 responses indicated that employing artificial intelligence tools to analyze learning patterns and provide timely, relevant content can enhance personalized learning experiences.
5. **Collaborative learning**: 23 responses expressed that adaptive learning aids in encouraging students to work in groups, allowing them to exchange knowledge and learn how to adapt to different learning styles.
6. **Flexibility in deadlines**: 21 responses clarified that adaptive learning contributes to offering flexible options for students regarding project and exam deadlines, allowing them to manage their time according to their individual needs.

The above findings highlight the importance of adaptive learning in improving the quality of education and personalizing the learning experience. This application of artificial intelligence helps in tailoring content and interaction to match each student's level of understanding and specific needs, thereby enhancing learning outcomes. The effectiveness of this application largely depends on the fact that adaptive learning provides immediate and accurate feedback, helping students identify their strengths and weaknesses and continuously improve their performance. These results are consistent with previous studies (Dounas et al., 2019; Drissi and Amirat, 2016; Kakish and Pollacia, 2018; White, 2020)
which confirmed that adaptive learning assists students in gradually and effectively developing new skills. Additionally, adaptive learning enables time efficiency by automating tasks such as assessment and activity customization, and supports self-directed learning by providing flexible and personalized options. In summary, adaptive learning supported by artificial intelligence contributes to achieving a more effective and personalized educational experience, thereby better supporting the achievement of learning goals.

Utilizing Academic Data Analytics to Enhance University Learning Environments

The results of the interview analysis showed that 27 respondents, representing 81.82%, emphasized the importance of universities using artificial intelligence (AI) to analyze academic data to extract insights from large volumes of student data. In this context, some study participants highlighted the importance of integrating AI analytics tools with university data management systems. These tools collect and analyze academic performance data, such as grades, attendance, and student participation. Universities can use these analytics to identify patterns and trends, making data-driven decisions to improve educational strategies. This utilization of AI in university learning environments enables faculty members to use these tools to identify students who may need additional interventions based on academic performance data analysis.

The authors believe that using AI to analyze academic data represents a significant development in higher education, especially since the results obtained indicate a broad consensus among study participants on the importance of this technology in enhancing university learning environments. These results are consistent with previous studies (Dry et al., 2018; Gebhardt, 2018; Kakish and Pollacia, 2018), which emphasized the importance of AI in processing and analyzing large amounts of academic data more effectively than traditional methods. This capability to handle big data allows universities to gain accurate insights into student performance. Furthermore, these results align with contemporary trends in integrating smart analytics tools with data management systems, which improves the ability to track and evaluate students'

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academic performance effectively from multiple sources to provide a comprehensive view of student performance.

In light of these results, it can be said that directing educational strategies using AI to analyze academic performance data is essential. Universities can develop more targeted and effective educational strategies. These strategies may include curriculum development, better allocation of educational resources, and enhancing interaction between students and teachers. Moreover, the study results confirm that AI tools provide faculty members with valuable information to help them identify students who may need additional support, enabling them to provide the necessary assistance more effectively.

In conclusion, the use of AI in analyzing academic data points to significant potential for improving the quality of university education and the student experience by leveraging valuable insights to develop innovative and targeted educational strategies.

Academic Research Support in University Learning Environments

The results of the interview analysis revealed that 25 responses, accounting for 75.76%, emphasized the importance of AI applications in supporting academic research. AI tools assist researchers in literature reviews, data collection and analysis, and identifying emerging trends. Consequently, many universities have adopted AI-driven research platforms capable of filtering vast databases of academic papers to find relevant studies, suggest new research directions, and even generate hypotheses.

The analysis of the 25 responses affirmed that AI supports scientific research in university learning environments in various advanced ways, improving the quality and efficiency of scientific research. One of the most notable methods is big data analysis, which helps process vast amounts of data quickly and accurately. In this context, previous studies (Lin et al., 2019; Ghorashi et al. 2023; Sharma et al., 2023;) have highlighted the importance of using AI techniques in data analysis to help student researchers discover new patterns and relationships that were previously invisible using traditional methods. This enhances deep understanding of scientific topics and contributes to the development of new theories.

Additionally, 24 responses indicated that AI is significantly employed in literature reviews by quickly scanning large volumes of previous research and providing summaries or analytical reports. This reduces the time and effort required for traditional research, allowing researchers to focus on developing their studies. According to previous studies (Al-Barakt et al., 2023; Hsu et al., 2018; Kakish et al., 2019; Lee and Choi, 2023), using AI in literature reviews can reduce the time needed for this process by 60%.

Furthermore, 23 responses showed that text mining using Natural Language Processing (NLP) techniques allows for the extraction of essential information and the discovery of recent research trends. Previous research [8888] demonstrated that using NLP could reveal connections between different topics and help identify research gaps that need further exploration.

Moreover, the analysis of 20 responses highlighted the significance of employing AI in predicting future research areas by analyzing current trends. This prediction enables researchers to focus on high-importance topics, increasing their chances of securing funding and high-quality publications. This finding aligns with previous studies (Al-Hassan et al., 2012; Ghorashi et al. 2023; Kakish et al., 2019; Lee and Choi, 2023) that indicated AI prediction models could accurately identify emerging research areas that will be of significant importance in the coming years.

Additionally, the semi-structured interview data analysis emphasized the importance of employing AI in scientific research through the following:

1. Twenty responses highlighted the significance of providing AI platforms as tools for researcher collaboration, such as data sharing, analyses, and models, which facilitates global cooperation and enhances knowledge and experience exchange. In this context, research studies (Kakish et al., 2019; Lee and Choi, 2023Nja et al., 2023; Jiao et al., 2022; Page et al., 2021;) indicated that using these tools could increase research team productivity by up to 40%.
2. Eighteen responses underscored the importance of employing AI in scientific research through the analysis of research images and videos quickly and efficiently, allowing researchers to obtain accurate and reliable results in a short time. This aligns with previous studies (Lin et al., 2019; Sanchez, 2020; Sharma et al., 2023; Ghorashi et al. 2023) that showed AI techniques for image and video analysis could improve result accuracy by 30% compared to traditional methods.
3. Twenty-one responses highlighted the importance of AI-created simulation models in conducting scientific experiments that may be costly or dangerous in reality. These simulations provide a safe and effective environment for hypothesis testing, enhancing the safety and efficiency of the

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research process. This finding aligns with previous studies (Kiemde and Kora, 2022; Kim and Lee , 2021; Nja et al., 2023; Jiao et al., 2022; Page et al., 2021), which showed that using AI simulations could reduce experiment costs by up to 50%.

Conclusions and Recommendations

Based on the results and discussion of the study, it can be concluded that automated assessment significantly enhances learning effectiveness by providing immediate feedback, which helps students identify their mistakes and improve their academic performance. It is strongly recommended that universities adopt automated assessment tools to improve the accuracy of evaluations and enrich the learning experience. This adoption requires investment in technology and appropriate training for faculty members to ensure the effective use of automated assessment techniques.

Furthermore, the study highlights the importance of integrating artificial intelligence (AI) techniques with augmented reality (AR) and virtual reality (VR). The application of AI in this context enhances immersive educational experiences, making complex concepts more accessible and engaging. Based on these findings, universities should invest resources in AR and VR technologies to offer comprehensive and interactive educational experiences, with the necessity of providing financial support and adequate training for instructors to ensure effective use of these technologies.

Additionally, the study underscores the importance of incorporating intelligent teaching systems and chatbots to provide personalized support that caters to diverse student needs, thereby improving the efficiency of the educational process and making the learning experience more interactive and inclusive. Therefore, it is recommended to implement intelligent educational tools in university learning environments, with appropriate training for both teachers and students to maximize the benefits of these tools.

On the other hand, the conclusions indicate that AI-supported personalized learning represents a crucial step towards enhancing the quality of university education. By utilizing adaptive systems based on performance data analysis, universities can deliver educational content tailored to each student's needs, thereby increasing learning effectiveness and student engagement with the material. Based on these conclusions, universities should develop and implement personalized learning systems based on performance data analysis to meet individual student needs and enhance learning effectiveness.

Moreover, AI-supported adaptive learning proves to be an effective tool for improving the quality of university education by providing personalized assessments, adaptive content, and intelligent interactions. This educational model contributes to the gradual and effective development of student skills, enhances scheduling flexibility and collaborative work, and overall improves learning outcomes. Based on these findings, the use of AI-supported adaptive learning should be promoted to enhance the learning experience by providing tailored content and intelligent interactions that cater to diverse student needs.

Finally, the study results indicate that integrating AI tools into academic data analysis can significantly contribute to improving university learning environments. These tools enable universities to derive valuable insights into student performance and make data-driven decisions to enhance educational strategies and identify students requiring additional support. AI also plays a vital role in supporting academic research by improving the quality and efficiency of research, saving significant time and effort, and enhancing research accuracy. Based on these findings, universities should leverage AI tools for academic data analysis, develop educational strategies, and support academic research by providing the necessary infrastructure and training to use these tools effectively.

Declarations

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Data Availability Statement

The data presented in this study are available on request from the corresponding authors.

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Informed Consent Statement

All participants in this study provided informed consent to publish the results anonymously.

Declaration of Competing Interest

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