Adv Mobile Learn Educ Res, 2024, 4(2): 1135-1148
DOI: 10.25082/AMLER.2024.02.008

RESEARCH ARTICLE

# Student perspectives and impact of AI integration in pedagogical practices in Nigerian tertiary institutions

**Usman Abubakar**[1*] **Samuel Adenubi Onasanya**[2] **Hussaini Aliyu Ibrahim**[3]

[1] School of Education and General Studies, Federal College of Education Gidan Madi, Sokoto State, Nigeria
[2] Department of Educational Technology, Faculty of Education, University of Ilorin, Kwara State, Nigeria
[3] Hilinks Network Solutions Ltd, Abuja, Nigeria



**Correspondence to:** Usman Abubakar, Department of Curriculum Studies and Educational Technology, School of Education and General Studies, Federal College of Education Gidan Madi, Sokoto State, Nigeria; Email: usman4realonline@gmail.com

**Received:** June 10, 2024;
**Accepted:** September 6, 2024;
**Published:** September 12, 2024.

**Citation:** Abubakar, U., Onasanya, S. A., & Ibrahim, H. A. (2024). Student perspectives and impact of AI integration in pedagogical practices in Nigerian tertiary institutions. *Advances in Mobile Learning Educational Research*, 4(2), 1135-1148.
https://doi.org/10.25082/AMLER.2024.02.008



**Abstract:** This study investigates the awareness, perceptions, and challenges of integrating artificial intelligence (AI) into pedagogical practices among undergraduate students at the universities in North Central, Nigeria. Drawing on the Unified Theory of Acceptance and Use of Technology (UTAUT) as a theoretical framework, data were collected through a survey questionnaire administered to 421 undergraduate students from the Faculty of Education. The questionnaire included items designed to measure students' awareness of AI technologies, their views on the potential benefits of AI integration in academic experiences, and the challenges encountered with AI adoption in pedagogical practices. Descriptive statistics were used to analyse the data, including means and standard deviations. The findings reveal a moderate level of awareness among students regarding the potential benefits of AI technologies in education, with a strong belief in the role of AI in improving learning experiences. However, students expressed concerns about technical difficulties, privacy issues, and the adequacy of training and support for AI technologies. The study underscores the need for increased awareness, technological infrastructure improvements, and targeted support services to facilitate the effective integration of AI in pedagogical practices. These findings contribute to the growing literature on AI integration in education and provide valuable insights for educators and policymakers seeking to enhance teaching and learning outcomes through AI-driven innovations.

**Keywords:** Artificial Intelligence, Artificial Intelligence in education, pedagogical practices

## 1 Introduction

The global integration of Artificial Intelligence (AI) in educational systems has opened new avenues for enhancing teaching and learning. Technologies such as intelligent tutoring systems and automated grading have been introduced to personalise education and improve engagement (Hsiao et al., 2018). However, while AI's transformative potential is widely recognised, its implementation in Nigerian tertiary institutions still needs to be explored (Ibrahim, 2024). The unique educational challenges in Nigeria, particularly in the north-central region, require innovative solutions. This study, therefore, aims to investigate the integration of AI within Nigerian universities, focusing on this region where traditional methods struggle to meet the demands of modern educational excellence.

In many Nigerian tertiary institutions, especially in the north-central region, traditional teaching and learning methods rely heavily on manual processes that need to be improved (Eze et al., 2018). Face-to-face lectures, paper-based assessments, and limited access to digital resources are standard practices. These methods often lead to overcrowded classrooms, delayed feedback, and a need for more personalised learning opportunities. The cumulative effect of these challenges is a strained educational system that hampers students' academic performance, making it difficult for them to fully engage with their studies and receive the necessary support to succeed.

Recognising the inadequacies of traditional educational methods, integrating AI and other innovative technologies emerges as desirable and necessary (Parissi et al., 2023). AI offers viable solutions to these inefficiencies by automating routine tasks, enabling personalised learning, and supporting data-driven decision-making (Popenici & Kerr, 2017). AI can significantly improve instructional delivery and student outcomes in north-central Nigeria, where educational resources are often stretched thin, which makes AI an essential tool for enhancing the quality of higher education in this region.

Reflecting this growing need for innovation, universities in north-central Nigeria have shown increasing interest in using technology to augment traditional teaching methodologies (Gyang, 2021). As leading academic centres, these institutions are keen to embrace approaches that enhance educational quality and prepare students for the demands of the digital age. Despite this interest, the degree to which AI technologies have been integrated into pedagogical practices and students' perceptions regarding this integration still need to be explored (Papadakis et al., 2023). Addressing this gap is crucial for understanding the potential impact of AI on educational outcomes (Papadakis, 2024).

Understanding student perceptions of AI in education is crucial, as these perceptions significantly influence learning experiences, technology adoption, and overall academic success (Sanasintani, 2023). Study highlights that student attitudes play a pivotal role in the effectiveness of technology adoption in educational settings (Mahyiddin & Amin, 2022). Consequently, this study focuses on assessing student perceptions of AI integration in universities in north-central Nigeria. Such insights are essential for educators and policymakers to make informed decisions about adopting and implementing AI technologies in these institutions.

Examining these perspectives allows the study to identify both the opportunities that AI presents, such as improved learning experiences and personalised education and the challenges it may pose, like potential technical difficulties or resistance to change. These findings are expected to contribute to the broader academic and practical discourse on AI in education, providing valuable recommendations for how universities can effectively integrate AI into their pedagogical practices. The ultimate goal is to ensure that AI is a supportive tool that enhances educational outcomes without disrupting the traditional academic framework, leading to more effective and inclusive learning environments.

Ultimately, this study explores how AI can address the educational challenges faced by tertiary institutions in north-central Nigeria. The research will identify the benefits and barriers to AI adoption by investigating students' perceptions. The insights will inform strategies to streamline academic processes, optimise teaching methods, and provide tailored learning experiences. The overarching goal is to contribute to developing more effective and equitable educational practices in Nigerian universities, ensuring that AI integration leads to improved academic outcomes for all students.

## 2 Research questions

The following research questions guide the study:

(1) Are students in Nigerian tertiary institutions aware of the enormous potential that AI technologies offer to enhance education?
(2) What are the students' views regarding the potential benefits of AI integration in their academic experiences?
(3) What challenges do students encounter with AI adoption in pedagogical practices among students in Nigerian tertiary institutions?

## 3 Literature review

Artificial Intelligence is a rapidly advancing field that has gained significant momentum in recent years, with potential applications across various sectors (Aravantinos et al., 2024). The definition of AI has been a subject of ongoing debate and analysis. Venkatasubramanian (2018) presents a simple yet visionary definition of AI as "the study of how to make computers do things at which, at the moment, people are better." This definition implies that AI has the potential to eventually surpass human capabilities, as evidenced by recent achievements such as AlphaGO, which is a type of AI inspired by the workings of the brain. Furthermore, Howard (2019) coined the term AI as the ability of machines to perform tasks that are generally linked to the behaviour of intelligent beings, such as humans. Additionally, Wang (2019) emphasises the significance of defining AI, pointing out that a good working definition of AI should align with typical usage, draw a sharp boundary, lead to fruitful research, and be as simple as possible. This underscores the complexity of defining AI and the importance of a definition that guides meaningful research in the field.

AI in education varies across scholarly works due to the multidimensional nature of AI's role in enhancing teaching and learning processes (Lavidas et al., 2024). According to Siemens (2018), AI in education uses computational techniques to facilitate learning, enabling adaptive and personalised educational experiences tailored to individual learners' needs. Similarly, Greller

and Drachsler (2012) define AI in education as integrating intelligent technologies to support pedagogical decision-making and enhance learning outcomes. Furthermore, AI in education encompasses a spectrum of technologies and methodologies. Baker (2014) defines it as applying machine learning algorithms to analyse educational data and provide insights for instructional improvement. This perspective emphasises the data-driven nature of AI in education, highlighting its capacity to inform evidence-based teaching practices.

In contrast, Chen et al. (2020) emphasise the cognitive aspect of AI in education, defining it as the emulation of human intelligence to simulate learning processes and enable intelligent tutoring systems. This definition underscores the role of AI in replicating human-like cognitive functions to facilitate effective teaching and learning interactions. These definitions underscore the diverse applications of AI in education, ranging from personalised learning support to administrative optimisation, and highlight its potential to revolutionise traditional educational paradigms.

Pedagogical practices comprise various instructional methods, strategies, and approaches educators employ to facilitate teaching and learning processes (Shulman, 2005). These practices include curriculum design, instructional delivery, assessment methods, classroom management techniques, and educational technologies to support learning outcomes. In the context of technology integration in education, pedagogical practices encompass diverse instructional strategies and methodologies that employ technology to enhance teaching and learning processes (Ertmer & Ottenbreit-Leftwich, 2005). The principles of effective pedagogy guide these practices and aim to foster student engagement, promote active learning, and facilitate meaningful educational experiences.

## 3.1 Overview of AI integration in education

The integration of AI in education has a rich history dating back several decades. While early attempts to incorporate AI technologies in educational settings can be traced back to the 1960s and 1970s, significant advancements have been made in recent years, driven by rapid developments in computing power, machine learning algorithms, and data analytics (Holmes & Bialik, 2016). One of the earliest applications of AI in education was the development of intelligent tutoring systems (ITS), which aimed to provide students with personalised and adaptive learning experiences (Woolf, 2010). Early ITS, such as the pioneering work on the "Intelligent Computer-Assisted Instruction" (ICAI) system by Maity (2019), laid the foundation for subsequent research and development in AI-driven educational technologies.

The 1980s and 1990s witnessed a surge of interest in AI applications in education, with the emergence of expert systems, educational simulations, and computer-based training programs (Venkatasubramanian, 2019). These developments led to the widespread adoption of AI technologies in various educational contexts, including K-12 schools, universities, and corporate training programs. In the early 21st century, machine learning and natural language processing advancements fueled a new wave of innovation in AI-driven educational technologies. Platforms such as Khan Academy, Coursera, and edX pioneered using AI algorithms to personalise learning experiences, deliver adaptive assessments, and provide real-time feedback to students (Holmes & Bialik, 2016). These platforms used data analytics and predictive modelling techniques to analyse learners' behaviours and preferences, enabling instructors to tailor instructional content and interventions accordingly.

In recent years, the integration of AI in education has expanded beyond online learning platforms to include intelligent tutoring systems, virtual reality simulations, educational chatbots, and automated grading systems (Anderson & Anderson, 2017). These AI-driven educational technologies offer the potential to transform traditional pedagogical practices by providing personalised learning experiences, enhancing instructional efficiency, and fostering deeper engagement among students. Overall, the historical overview of AI integration in education underscores the transformative potential of AI-driven educational technologies in enhancing teaching and learning outcomes. By building on the foundations laid by previous research and development efforts, educators and policymakers can harness the power of AI to create more inclusive, adaptive, and student-centered learning environments.

## 3.2 Current trends in AI integration in pedagogical practices

In recent years, there has been a growing emphasis on integrating AI into pedagogical practices, with educators and researchers exploring innovative ways to use AI technologies to enhance teaching and learning outcomes. This section provides an overview of current trends in AI integration in pedagogical practices, drawing on recent research and developments in the field.

One of the prominent trends in AI integration in pedagogical practices is the emphasis on personalised learning experiences. AI-driven educational technologies, such as intelligent tutoring systems and adaptive learning platforms, use algorithms to analyse individual learners and provide personalised instructional content and interventions (Aggarwal, 2023). Adapting to students' learning styles, preferences, and pace of learning, these technologies can improve learning outcomes and promote student engagement and motivation (Pramesworo et al., 2023). This personalised approach enhances the learning experience and helps educators deliver more effective instruction.

AI technologies also enable educators to decide on student data by analysing large datasets to identify patterns, trends, and insights related to student performance and learning outcomes. Machine learning algorithms can predict students' future performance, identify at-risk students needing additional support, and recommend personalised interventions to improve learning outcomes (Ofori et al., 2020). Harnessing the power of data analytics can help educators optimise instructional strategies, allocate resources more effectively, and support student success. This approach seamlessly connects to developing intelligent tutoring systems, further enhancing personalised learning.

Intelligent tutoring systems represent a significant area of research and development in AI integration pedagogical practices. ITS uses AI algorithms to simulate one-on-one tutoring interactions, providing personalised instruction, feedback, and student support (Alam, 2023). These systems can adapt to students' needs, identify learning difficulties, and provide targeted interventions to address misconceptions and gaps in understanding (Dzikovska et al., 2015). Integrating ITS in educational practices highlights the importance of automating critical aspects of the learning process, extending to the automation of assessment and feedback.

AI technologies are increasingly being used to automate the assessment and feedback process in educational settings. Automated grading systems powered by machine learning algorithms can analyse students' responses to assignments, quizzes, and exams, providing immediate feedback and assessment scores (Ramesh & Sanampudi, 2022). By streamlining the assessment process, these technologies enable educators to focus on providing personalised feedback and support to students, which will help to improve the overall learning experience. This automation is complemented by integrating virtual and augmented reality technologies, which offer immersive learning opportunities.

Virtual reality (VR) and augmented reality (AR) technologies are being integrated into pedagogical practices to create immersive and interactive learning experiences. AI algorithms can enhance VR and AR simulations by providing intelligent feedback, adapting to students' actions and choices, and personalising learning experiences based on individual preferences (Coelho & Reis, 2023). These technologies offer new opportunities for experiential learning, exploration, and engagement in diverse educational contexts, representing the future of interactive and adaptive learning environments.

## 3.3 Exploring AI integration in education: Awareness, perceptions, and challenges

AI integration in education presents transformative opportunities, offering personalised learning experiences and enhanced educational outcomes. However, successfully adopting AI requires a comprehensive understanding of its potential, addressing students' perceptions, and overcoming challenges such as high costs, privacy concerns, and potential biases. This exploration delves into the critical aspects of awareness, student views, and the obstacles to AI adoption in education.

*Awareness of AI Potential in Education*: The transformative potential of AI in education has sparked significant interest. AI technologies, such as intelligent tutoring systems, automated grading, and personalised learning platforms, present exciting opportunities to revolutionise teaching and learning processes. These technologies can significantly enhance educational outcomes by tailoring instruction to individual student needs. They can adapt to learners' strengths and weaknesses, providing targeted feedback that fosters more profound understanding and engagement. The growing body of research underscores the importance of understanding AI's capabilities so that educators and institutions can fully exploit its potential, thereby improving student achievement and narrowing educational gaps. However, the effective adoption of AI in education necessitates a comprehensive understanding of its benefits and limitations, emphasising the urgent need for awareness-building initiatives.

Awareness of AI's potential is also vital in addressing the challenges associated with its integration into educational practices. Investigation shows that AI can enhance educational

efficiency and effectiveness, but its success depends on how educators and students are informed and prepared to use these technologies (Kim, 2024). A lack of awareness can lead to resistance to adoption, underutilising AI tools, or misalignment between AI capabilities and educational goals. Therefore, it is crucial to equip stakeholders with the necessary knowledge through professional development, workshops, and collaborative initiatives to ensure effective integration of AI that aligns with pedagogical objectives and enhances the learning experience (Al-Raimi et al., 2024). This foundational awareness is critical in fostering a culture of innovation and responsiveness within educational institutions.

*Students' Views on AI Integration in Education*: Students' perceptions of AI integration in education are increasingly positive as AI technologies promise personalised learning experiences and enhanced engagement. Students appreciate AI tools for their ability to tailor educational content to individual learning styles and paces, which can lead to improved academic outcomes (Kim, 2024). AI applications like adaptive learning platforms and intelligent tutoring systems provide real-time feedback and support, fostering a more interactive and responsive learning environment (Modén et al., 2021). This personalisation aligns with students' preferences for customised educational experiences, making AI a valued component of modern learning.

However, students also express concerns regarding integrating AI into education, particularly about data privacy and the potential for reduced human interaction. Privacy issues arise as AI systems collect and analyse personal data to optimise learning experiences, leading to data security apprehension (Selwyn, 2022). Additionally, students worry that increased reliance on AI may diminish face-to-face interactions with educators and peers, which are crucial for developing interpersonal skills and receiving personalised support (Mozgalova et al., 2021). These concerns highlight the need to balance AI integration with traditional educational methods to maintain a holistic learning experience.

Despite these concerns, students generally recognise the potential benefits of AI integration, especially regarding academic support and resource accessibility. AI tools can facilitate learning by providing immediate access to educational resources and personalised guidance (Mohammed et al., 2022). Students acknowledge that AI can help bridge gaps in understanding and offer tailored instructional support that may not be feasible in traditional classroom settings (Sarwari & Mohd Adnan, 2024). Educators must use AI tools thoughtfully and complementarily to enhance the educational experience while addressing students' concerns about privacy and interaction.

*Challenges of AI Adoption in Education*: One significant challenge of AI adoption in education is the high cost and complexity of implementing advanced technologies. Educational institutions often need more technical infrastructure to deploy AI systems effectively (Saidakhror, 2024). The initial investment in AI tools and ongoing maintenance can be prohibitive, especially for institutions with limited budgets. Furthermore, integrating AI requires substantial technical expertise and staff training, which adds to the complexity and cost of implementation (Chan, 2023). These barriers can hinder the widespread adoption of AI technologies in educational settings, particularly under-resourced institutions.

Another challenge is the potential for AI to exacerbate existing educational inequalities. AI systems can inadvertently reinforce biases if the underlying data reflects historical inequalities or prejudices (Cevik et al., 2023). For example, AI algorithms used in admissions or grading may perpetuate biases against underrepresented groups, leading to unequal educational opportunities (Kapoor & Xu, 2022). Addressing these biases requires careful design and continuous monitoring to ensure AI applications promote fairness and inclusivity rather than perpetuate disparities.

Privacy and data security concerns are also significant obstacles to AI adoption in education. AI systems often require extensive data collection to function effectively, raising issues about how students' personal information is stored and protected (Strohm et al., 2020). Data breaches or misuse of information can have profound implications for student privacy and trust in educational institutions (Kwarteng, 2022). Ensuring robust data security measures and transparent policies is crucial for mitigating these concerns and fostering confidence in AI technologies within educational environments.

# 4 Theoretical framework

The Unified Theory of Acceptance and Use of Technology (UTAUT), proposed by Venkatesh et al. (2003), offers a robust framework for comprehensively understanding the adoption and acceptance of technology. The model helps managers and decision-makers assess the success of introducing technology to the organisation and motivates users to accept the systems. The theory posits four fundamental constructs: (1) performance expectancy, (2) effort expectancy, (3)

social influence, and (4) facilitating conditions. UTAUT is an appropriate theoretical framework to guide this study because it provides profound insights into understanding users' acceptance and adoption of new technologies in various contexts, including education. Given the focus on exploring student perceptions of AI integration in pedagogical practices at the Universities in north-central Nigeria, UTAUT offers a comprehensive framework to examine the factors influencing students' acceptance and use of AI-driven educational technologies.

*Performance Expectancy (PE):* Performance Expectancy (PE) refers to the degree to which an individual believes that using a technology will help them perform their tasks more effectively (Venkatesh et al., 2003). In the context of this study, Research Question 1 ("Are students at the Universities in Nigeria aware of the enormous potential that AI technologies offer to enhance education?") aligns with Performance Expectancy in UTAUT. This construct examines students' perceptions of the benefits and advantages of using AI technologies in education (Venkatesh et al., 2003).

*Effort Expectancy (EE):* Effort Expectancy (EE) refers to the degree of ease associated with using a technology (Venkatesh et al., 2003). Research Question 2 ("What are the students' views regarding the potential benefits of AI integration in their academic experiences at Nigerian Universities?") relates to Effort Expectancy in UTAUT, focusing on students' perceptions of the ease of use and usability of AI-driven educational technologies (Venkatesh et al., 2003).

*Social Influence (SI):* Social Influence (SI) in UTAUT refers to the extent to which an individual perceives that others believe they should use the technology (Venkatesh et al., 2003). Research Question 3 ("What are the challenges and barriers to the adoption of AI-driven pedagogical practices among students at Nigerian Universities?") corresponds to Social Influence in UTAUT, which considers the impact of social factors, such as peers, instructors, and institutional norms, on students' acceptance and adoption of new technologies (Venkatesh et al., 2003).

*Facilitating Conditions (FC):* Facilitating Conditions (FC) in UTAUT refer to the degree to which an individual believes that organisational and technical infrastructure supports the use of the technology (Venkatesh et al., 2003). Research Question 3 also aligns with Facilitating Conditions in UTAUT, which examines the influence of organisational and technical support on users' acceptance and use of technology. This construct explores the availability of resources, infrastructure, and support systems for integrating AI-driven pedagogical practices at the Universities in North Central (Venkatesh et al., 2003). By applying UTAUT, the study can gain valuable insights into the factors influencing students' acceptance and adoption of AI-driven educational technologies, facilitating the development of effective strategies for integrating AI into education.

The use of AI in education is relatively new in Nigeria and is still in its elementary stage. Despite this shortcoming, some initiatives and research studies have been conducted in that area. The studies reviewed cover various aspects of AI integration in education, including medical education, design education, and K-12 settings. The studies also explore students' and lecturers' knowledge, attitudes, and preferences regarding AI integration. However, these studies have specific areas for improvement in their investigations that must be addressed to understand AI integration in pedagogical practices comprehensively.

Chiu et al. (2022) evaluated a pretertiary AI curriculum, confirming its effectiveness in promoting AI learning. While this study offers valuable insights into AI curriculum effectiveness, it explicitly targets pretertiary education. It may need to directly address university students' perceptions at universities in North Central Nigeria. Similarly, Paranjape et al. (2019) highlighted challenges in integrating AI training into medical education and clinical practice, focusing on broader healthcare contexts rather than explicitly addressing students' perceptions at universities in North Central Nigeria. Tang et al. (2022) explored new strategies and practices of design education in the context of AI technology, emphasising the evaluation of students' perception preferences. However, being specific to design education, this study may not directly align with the pedagogical practices at the universities in North Central, Nigeria. Likewise, Xu and Ouyang (2022) discussed the application of AI technologies in STEM education, highlighting the balance between pedagogical design and technological application. While this study offers insights into AI integration in STEM education, it does not specifically address students' perceptions at universities in North Central Nigeria. Wood et al. (2021) assessed medical student and faculty attitudes toward AI, intending to integrate AI foundations into medical education. Despite providing valuable insights into medical education, this study must explicitly delve into students' perceptions at North Central, Nigeria universities. Finally, the survey by Sapci and Sapci (2020) reviewed the applications and challenges of implementing AI in medical education, emphasising the need for AI training in medical curricula. Although these studies offer significant insights into medical education, they do not directly focus on students' perceptions at the universities in

North Central Nigeria.

The studies above provide valuable insights into AI integration in various educational settings. However, they have certain limitations in directly addressing the assessment of student perceptions of AI integration in pedagogical practices at universities in North Central, Nigeria. Therefore, there is a need for empirical studies specifically focused on the perceptions of students at universities in North Central, Nigeria, regarding the integration of AI in pedagogical practices to fill this gap in the existing literature.

# 5 Methodology

The study employed a descriptive survey research design to assess student perspectives and the impact of AI integration in pedagogical practices in Nigerian tertiary institutions. This design facilitated data collection to describe the population's characteristics, aligning with the study objectives. Given the substantial population size, questionnaires were deemed appropriate to elicit respondents' responses. According to Baburajan et al. (2022), descriptive survey research involves collecting representative sample data from a larger population and using the sample to infer population attributes. The research employed a quantitative research method to gain a better understanding of students' attitudes about the integration of AI in pedagogical practices. The general population of the study was comprised of undergraduate students from universities in north-central Nigeria. The study population comprises undergraduate students in the education faculty at University B, in Kwara State. The breakdown of the population is presented in Table 1.

**Table 1** Population of the study

| S/No | Departments | UG 1 | UG 2 | UG 3 | UG 4 | TOTAL |
|---|---|---|---|---|---|---|
| 1 | Educational Technology | 358 | 277 | 478 | 430 | 1543 |
| 2 | Adult and Primary Education | 178 | 179 | 388 | 278 | 1023 |
| 3 | Science Education | 207 | 233 | 429 | 473 | 1342 |
| 4 | Art Education | 475 | 652 | 386 | 462 | 1975 |
| 5 | Health Education | 213 | 152 | 303 | 227 | 895 |
| 6 | Counsellor Education | 121 | 164 | 290 | 247 | 822 |
| 7 | Human Kinetic Education | 137 | 134 | 263 | 220 | 754 |
| 8 | Educational Management | 245 | 337 | 484 | 411 | 1477 |
| 9 | Social Science Education | 215 | 184 | 204 | 223 | 826 |
| | Total | 2149 | 2312 | 3225 | 2971 | 10657 |

**Source**: Academic Office of the institution (2024).

This study employed a structured multi-stage probability sampling technique to ensure a representative and unbiased selection of respondents. Initially, University B was randomly chosen from universities in north-central Nigeria. The Faculty of Education was selected within the university using a stratified random sampling technique, ensuring a systematic and inclusive selection of the diverse academic departments. The students across all levels within the faculty were then treated as separate clusters, as shown in Table 1. Third-year (UG 3) students from each department were randomly selected to achieve balanced representation. From a target population of 3,225 students, a sample size of 346 was determined using the Research Advisors' (2006) sampling table. This rigorous approach ensures the study accurately reflects the population, enhancing the reliability of findings on AI integration in pedagogical practices.

The instrument used for data collection in this study is the AI Integration Perception Survey (AIPS) questionnaire. The researcher chose this method because, as Creswell (2018) highlights, questionnaires facilitate the collection of substantial information from a large population in a shorter time frame, allowing for quicker analysis. The data gathered from this instrument were used to answer the research questions raised in this study. The instrument, AIPS, is a self-constructed questionnaire to elicit students' responses to AI integration in pedagogical practices. Each is a four-point Likert's Scale structured questionnaire drawn to obtain information from the respondents. The questionnaire was made up of four sections: "A" to "D". Section "A" seeks out the personal data of the respondents.

In contrast, sections "B" to "D" seek out respondents' opinions or statements used to answer the research questions. The Likert Scale in sections B to D, which measures awareness of AI potential, views on AI integration, and challenges to AI adoption, ranges from: "Strongly Disagree" (SD) 1 point, "Disagree" (D) 2 points, "Agree" (A) 3 points, and "Strongly Agree" (SA) 4 points. Respondents will be guided to respond to the questionnaire items accordingly.

To validate the research instrument, it must comprehensively cover all the contents to be

measured, and the instrument's items should accurately reflect the problem under study. The AIPS instrument used in this study was subjected to validation by measurement experts to critically examine the instrument to ensure that all contents are measured and the items in the instrument reflect the problem under study before the questionnaire is administered. Thirty-two items of the instrument were vetted. The remaining items irrelevant to the research or repeated questions were dropped. After all the adjustments were made, the instruments were adjudged to have met content validity.

To assess the reliability of the AIPS instrument, a pilot study was carried out at a university in Sokoto State, involving the random selection of 30 students who were then administered the instrument. The collected data was subjected to the Cronbach Alpha reliability test, resulting in a reliability index of 0.913, which is high enough to ensure the instrument's reliability. As highlighted by Koo and Li (2016), an instrument is considered reliable if its calculated reliability coefficient is closer to 1 and less reliable when the calculated reliability coefficient is closer to 0.

Data collected was analysed using Statistical Package for Social Sciences (SPSS). The study employs frequency counts and percentages to explain the respondents' demographic data, and descriptive statistics of MeanMean were used to answer the research questions. The procedure involved a systematic extraction of meaningful insights from the collected data. Descriptive statistics, including means and standard deviations, were calculated for each statement related to the research questions. This step provided a quantitative overview of the central tendencies and variability in the data. Weighted averages were computed to determine an overall score for each research question. Statements with higher mean scores reflected more robust agreement, while lower scores indicated potential areas for intervention. This facilitated a comprehensive understanding of the research landscape.

# 6 Results

## 6.1 Demographic characteristics

The demographic analysis of the sample population reveals that 52.5% of respondents are female, while 47.5% are male, indicating a slightly higher representation of females. The age distribution shows that the majority (65.3%) of respondents are within the 21-25 age range, reflecting a typical undergraduate demographic. The 15-20 age group accounts for 22.8%, followed by 9.0% in the 26-30 age group. Smaller percentages are observed in the 31-35 and 36-40 age groups. These demographic insights are crucial for academic planning, resource allocation, and targeted interventions within the educational institution, as they provide a clear understanding of the student population's composition.

## 6.2 Descriptive analysis

The descriptive analysis was done by way of answering research questions as follows:

This section presents the table containing all the items used to measure the first objective. The research question was analysed using Descriptive statistics of MeanMean as presented in Table 2.

**Table 2** Students awareness of the enormous potential that AI technologies offer to enhance education (n = 421)

| S/N | STATEMENTS | N | Mean | SD | Remark |
|---|---|---|---|---|---|
| 1 | I am aware of the potential benefits of using AI technologies in education. | 421 | 2.91 | 1.057 | High |
| 2 | I understand how AI technologies can improve the quality of education. | 421 | 2.97 | 0.991 | High |
| 3 | I am familiar with the various applications of AI in educational settings. | 421 | 2.77 | 0.946 | Low |
| 4 | I am confident in my knowledge about the potential of AI technologies in education. | 421 | 2.76 | 0.940 | Low |
| 5 | AI can facilitate adaptive learning, catering to individual student needs. | 421 | 2.98 | 0.989 | High |
| 6 | I believe AI can contribute to improving accessibility and inclusivity in education. | 421 | 2.95 | 1.006 | High |
| 7 | AI technologies can provide personalised learning experiences. | 421 | 2.99 | 0.990 | High |
| 8 | AI-powered tutoring systems can supplement traditional classroom instruction. | 421 | 2.75 | 0.999 | Low |
| 9 | AI can assist in identifying students' learning gaps and providing targeted interventions. | 421 | 2.80 | 0.964 | Low |
| 10 | I am interested in learning more about the role of AI in education. | 421 | 2.99 | 1.013 | High |
| | Weighted Average | | | 2.89 | |

**Source**: Field Survey, 2024.

The weighted average for Research Question One is 2.89, indicating a moderate awareness among students regarding the potential benefits of AI technologies in education. Areas of success include students' recognition of AI's general benefits in improving the quality of education and facilitating adaptive learning experiences. However, areas requiring interventions include

enhancing students' familiarity with specific applications of AI in educational settings, addressing gaps in knowledge about AI technologies, and providing targeted education and awareness programs to improve overall awareness levels.

This section presents the table containing all the items used to measure the second objective. The research question was analysed using Descriptive statistics of MeanMean as presented in Table 3.

**Table 3** Students' views regarding the potential benefits of AI integration in their academic experiences (n = 421)

| S/N | STATEMENTS | N | Mean | SD | Remark |
|---|---|---|---|---|---|
| 1 | Integrating AI technologies into academic activities can enhance learning experiences. | 421 | 2.82 | 1.015 | Low |
| 2 | AI integration can make learning more engaging and interactive. | 421 | 2.85 | 0.957 | Low |
| 3 | I am interested in using AI-powered tools and resources for my academic tasks. | 421 | 2.92 | 0.946 | High |
| 4 | AI integration is a valuable addition to traditional teaching methods. | 421 | 2.89 | 0.915 | High |
| 5 | AI technologies can enhance collaboration and communication among students. | 421 | 2.81 | 0.988 | Low |
| 6 | I am excited about the potential of AI to enhance my academic performance. | 421 | 2.84 | 0.953 | Low |
| 7 | AI technologies can foster creativity and innovation in academic projects. | 421 | 2.87 | 0.917 | High |
| 8 | AI integration can personalise learning experiences to suit individual needs. | 421 | 2.92 | 0.867 | High |
| 9 | AI-powered analytics can help in tracking students' progress and performance. | 421 | 2.79 | 0.944 | Low |
| 10 | I am open to exploring new ways of learning through AI integration. | 421 | 2.91 | 0.964 | High |
| | Weighted Average | | | 2.86 | |

**Source**: Field Survey, 2024.

The weighted average for Research Question Two is 2.86, reflecting a balanced perspective among students regarding the potential benefits of AI integration in their academic experiences. Areas of success include students' interest in utilising AI-powered tools and resources for academic tasks and their acknowledgement of AI's potential to foster creativity and innovation. However, areas requiring interventions include addressing concerns about the impact of AI on critical thinking skills, resistance to change from traditional teaching methods, and ensuring that AI integration aligns with students' educational goals and preferences.

This section presents the table containing all the items used to measure the third objective. The research question was analysed using Descriptive statistics of MeanMean as presented in Table 4.

**Table 4** Challenges students encounter with AI adoption in pedagogical practices among students in Nigerian tertiary institutions (n = 421)

| S/N | STATEMENTS | N | Mean | SD | Remark |
|---|---|---|---|---|---|
| 1 | I am concerned about the potential technical difficulties in using AI technologies for learning. | 421 | 2.58 | 0.957 | Low |
| 2 | I am concerned about the potential privacy and data security issues related to AI integration. | 421 | 2.72 | 0.942 | Average |
| 3 | I need adequate training and support to use AI technologies in my academic activities. | 421 | 2.67 | 0.947 | Low |
| 4 | AI integration may increase reliance on technology, affecting critical thinking skills. | 421 | 2.81 | 0.973 | High |
| 5 | There may be resistance to change from traditional teaching methods to AI-driven practices. | 421 | 2.75 | 0.906 | High |
| 6 | I am concerned about the cost and accessibility of AI technologies for all students. | 421 | 2.77 | 0.968 | High |
| 7 | I am still determining the long-term impact of AI integration on educational outcomes. | 421 | 2.78 | 0.893 | High |
| 8 | I worry about the ethical implications of AI-driven decision-making in educational settings. | 421 | 2.71 | 0.910 | Low |
| 9 | AI technologies may only partially align with students' cultural and contextual needs. | 421 | 2.79 | 0.926 | High |
| 10 | I am hesitant to embrace AI integration due to uncertainty about its future implications. | 421 | 2.56 | 1.009 | Low |
| | Weighted Average | | | 2.72 | |

**Source**: Field Survey, 2024.

The weighted average for Research Question Three is 2.72, indicating moderate challenges students encounter with AI adoption in pedagogical practices. Areas of success include students' recognition of the potential technical difficulties in using AI technologies for learning and concerns about privacy and data security issues. However, areas requiring interventions include addressing concerns about inadequate training and support for using AI technologies, overcoming resistance to change from traditional teaching methods, and addressing uncertainties about AI integration's long-term implications and ethical considerations. Additionally, efforts are needed to mitigate potential cost and accessibility barriers associated with AI technologies to ensure equitable access for all students.

# 7 Discussion

The findings of this investigation contribute significantly to the existing body of knowledge on AI integration in pedagogical practices, particularly within the Nigerian educational context. The discussion is organised based on the research questions and objectives.

Research Question 1: Awareness of AI Potential in Education. The results indicate a moderate awareness among students regarding the potential benefits of AI technologies in education. They express an understanding of how AI technologies can improve the quality of education and facilitate adaptive learning. This resonates with the UTAUT model, which posits that perceived usefulness is critical to technology acceptance. This positive outlook aligns with the findings of Chiu et al. (2022), who evaluated a pretertiary AI curriculum and confirmed its effectiveness in promoting AI in learning. Their study targeted pretertiary education, contributing to the broader understanding of AI awareness and integration in education. Their investigation is related to this study as they are both concerned with using AI in education. Still, their investigation is impeded by focusing their investigation on pretertiary education.

In contrast, this study focused on students' awareness of AI potential in pedagogical practices in Universities in north-central Nigeria. However, areas such as enhancing students' familiarity with specific applications of AI in educational settings, addressing gaps in knowledge about AI technologies, and providing targeted education and awareness programs to improve overall awareness levels received lower mean scores, indicating potential areas for improvement through enhanced collaboration and institutional support. These results suggest a need for targeted educational initiatives to improve students' awareness and understanding of AI technologies in education.

Research Question 2: The findings of this investigation revealed that students hold generally positive views regarding the potential benefits of AI integration in their academic experiences. They believe AI integration can enhance learning experiences, make learning more engaging and interactive, and foster creativity and innovation in academic projects. Additionally, they perceive AI integration as a valuable addition to traditional teaching methods and believe it can personalise learning experiences to suit individual needs. This is in line with Effort Expectancy from the UTAUT model, which states that students are more likely to adopt AI if they perceive it as user-friendly and capable of making learning more engaging. The outcome of this investigation resonates with the study of Tang et al. (2022), which explored new strategies and practices of design education in the context of AI technology, emphasising the evaluation of students' perception preferences. However, being specific to design education, their investigation may need to be revised to align with the pedagogical practices of this research. However, areas such as addressing concerns about the impact of AI on critical thinking skills, resistance to change from traditional teaching methods, and ensuring that AI integration aligns with students' educational goals and preferences received lower mean scores, indicating potential areas for improvement through enhanced collaboration and institutional support.

Research Question 3: Challenges with AI Adoption in Pedagogical Practices. This investigation indicates moderate challenges students encounter with AI adoption in pedagogical practices. Areas of success include students' recognition of the potential technical difficulties in using AI technologies for learning and concerns about privacy and data security issues. The outcome of this investigation is in line with the study of Paranjape et al. (2019), who highlighted challenges in integrating AI training into medical education and clinical practice, focusing on broader healthcare contexts rather than explicitly addressing the perceptions of students about the problem encounter with AI adoption in pedagogical practices at the universities in the north-west, Nigeria. However, areas requiring interventions include addressing concerns about inadequate training and support for using AI technologies, overcoming resistance to change from traditional teaching methods, and addressing uncertainties about AI integration's long-term implications and ethical considerations. These challenges underscore the importance of addressing technical, training, and pedagogical barriers to enhance students' readiness for AI adoption in education.

# 8 Conclusion

This study examines students' perceptions of AI integration in pedagogical practices at universities in north-central Nigeria. The methodology, which included a structured multi-stage probability sampling technique and the AI Integration Perception Survey (AIPS), provided robust data on student awareness and attitudes. The findings revealed that while students moderately understand AI's potential in education, particularly in enhancing learning experiences and offering personalised learning, they also expressed significant concerns regarding technical challenges, privacy issues, and proper training and support.

To effectively address these challenges and maximise the benefits of AI integration, universities in north-central Nigeria must prioritise developing comprehensive training programs for students and educators. These programs should focus on enhancing skills related to AI-driven educational tools. Additionally, improving the technological infrastructure is essential to ensure that students

and educators have adequate access to AI resources, facilitating smoother integration into existing pedagogical practices. The study also highlighted the need for universities to establish clear guidelines to address privacy and ethical concerns associated with AI in education. Ensuring data security and incorporating ethical considerations into the design and implementation of AI tools will build trust among students and educators, further promoting the adoption of AI technologies.

Future work should focus on longitudinal studies to monitor the long-term impact of AI integration on educational outcomes. Continuous evaluation of AI-driven pedagogical practices will provide valuable insights into their effectiveness and help refine strategies for AI adoption. By incorporating feedback from both students and educators, universities can make informed adjustments to optimise the role of AI in education, ultimately leading to more effective and inclusive learning environments. This study not only underscores the potential of AI to transform educational practices in north-central Nigeria but also provides actionable recommendations to address the challenges identified. By implementing these recommendations, universities can better prepare their students for the demands of the digital age, ensuring that AI enhances rather than disrupts the educational process.

## Conflicts of interest

The authors declare that they have no conflict of interest.

## References

Aggarwal, D. (2023). Integration of innovative technological developments and AI with education for an adaptive learning pedagogy. China Petroleum Processing and Petrochemical Technology, 23(2).

Aghaziarati, A., Nejatifar, S., & Abedi, A. (2023). Artificial Intelligence in Education: Investigating Teacher Attitudes. AI and Tech in Behavioral and Social Sciences, 1(1), 35–42. https://doi.org/10.61838/kman.aitech.1.1.6

Alam, A. (2023). Harnessing the Power of AI to Create Intelligent Tutoring Systems for Enhanced Classroom Experience and Improved Learning Outcomes. Intelligent Communication Technologies and Virtual Mobile Networks, 571–591. https://doi.org/10.1007/978-981-99-1767-9_42

Al-Raimi, M., Mudhsh, B. A., Al-Yafaei, Y., & Al-Maashani, S. (2024). Utilizing artificial intelligence tools for improving writing skills: Exploring Omani EFL learners' perspectives. Forum for Linguistic Studies, 6(2), 1177. https://doi.org/10.59400/fls.v6i2.1177

Anderson, J. R., & Anderson, A. (2017). Artificial intelligence in education: Promises and implications for teaching and learning. In Proceedings of the 8th International Conference on Educational Data Mining.

Aravantinos, S., Lavidas, K., Voulgari, I., Papadakis, S., Karalis, T., & Komis, V. (2024). Educational Approaches with AI in Primary School Settings: A Systematic Review of the Literature Available in Scopus. Education Sciences, 14(7), 744. https://doi.org/10.3390/educsci14070744

Baburajan, V., de Abreu e Silva, J., & Pereira, F. C. (2022). Open vs closed-ended questions in attitudinal surveys – Comparing, combining, and interpreting using natural language processing. Transportation Research Part C: Emerging Technologies, 137, 103589. https://doi.org/10.1016/j.trc.2022.103589

Baker, R. S., & Inventado, P. S. (2014). Educational Data Mining and Learning Analytics. Learning Analytics, 61–75. https://doi.org/10.1007/978-1-4614-3305-7_4

Bakhmat, N., Romanova, I., Oronovska, L., Rudenko, O., & Mogyl, O. (2024). Ukrainian education for peace and security 2023: Technological convergence, artificial intelligence. Multidisciplinary Reviews, 6, 2023spe016. https://doi.org/10.31893/multirev.2023spe016

Cevik, J., Lim, B., Seth, I., Sofiadellis, F., Ross, R. J., Cuomo, R., & Rozen, W. M. (2023). Assessment of the bias of artificial intelligence generated images and large language models on their depiction of a surgeon. ANZ Journal of Surgery, 94(3), 287–294. Portico. https://doi.org/10.1111/ans.18792

Chan, C. K. Y. (2023). A comprehensive AI policy education framework for university teaching and learning. International Journal of Educational Technology in Higher Education, 20(1). https://doi.org/10.1186/s41239-023-00408-3

Chen, L., Chen, P., & Lin, Z. (2020). Artificial Intelligence in Education: A Review. IEEE Access, 8, 75264–75278. https://doi.org/10.1109/access.2020.2988510

Chiu, T. K. F., Meng, H., Chai, C.-S., King, I., Wong, S., & Yam, Y. (2022). Creation and Evaluation of a Pretertiary Artificial Intelligence (AI) Curriculum. IEEE Transactions on Education, 65(1), 30–39. https://doi.org/10.1109/te.2021.3085878

Coelho, L., & Reis, S. S. (2023). Enhancing Learning Experiences Through Artificial Intelligence. Fostering Pedagogy Through Micro and Adaptive Learning in Higher Education, 169–191. https://doi.org/10.4018/978-1-6684-8656-6.ch008

Creswell, J. W. (2018). Qualitative, quantitative, and mixed methods approaches a crash course in statistics. Sage publications.

Dzikovska, M., Steinhauser, N., Farrow, E., Moore, J., & Campbell, G. (2014). BEETLE II: Deep Natural Language Understanding and Automatic Feedback Generation for Intelligent Tutoring in Basic Electricity and Electronics. International Journal of Artificial Intelligence in Education, 24(3), 284–332. https://doi.org/10.1007/s40593-014-0017-9

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher Technology Change. Journal of Research on Technology in Education, 42(3), 255–284. https://doi.org/10.1080/15391523.2010.10782551

Eze, S. C., Chinedu-Eze, V. C., & Bello, A. O. (2018). The utilisation of e-learning facilities in the educational delivery system of Nigeria: a study of M-University. International Journal of Educational Technology in Higher Education, 15(1). https://doi.org/10.1186/s41239-018-0116-z

Falkner, K., & Sheard, J. (2019). Pedagogic Approaches. The Cambridge Handbook of Computing Education Research, 445–480. https://doi.org/10.1017/9781108654555.016

Greller, W., & Drachsler, H. (2012). Translating learning into numbers: A generic framework for learning analytics. Educational Technology & Society, 15(3), 42-57.

Stephen Gyang, T. (2021). Dynamics of leadership and teacher effectiveness in universities in north-central Nigeria. Journal of Educational Management, 11. https://doi.org/10.47963/jem.v11i.239

Holmes, R., & Bialik, K. (2016). Artificial intelligence is creeping into education. Forbes. https://www.forbes.com

Howard, J. (2019). Artificial intelligence: Implications for the future of work. American Journal of Industrial Medicine, 62(11), 917–926. Portico. https://doi.org/10.1002/ajim.23037

Hsiao, I. H., Chen, C. C., & Chung, C. J. (2018). The impact of artificial intelligence in education: A systematic review. International Journal of Distance Education Technologies, 16(3), 58-78.

Ibrahim, A. B. (2024). Assessing the Knowledge and Perception of Artificial Intelligence for Teaching and Research among Lecturers in the Faculties of Arts in Nigeria. Journal of Global Research in Education and Social Science, 18(2), 25–33. https://doi.org/10.56557/jogress/2024/v18i28671

Kapoor, D., & Xu, C. (2022). Spinal Cord Injury AIS Predictions Using Machine Learning. Eneuro, 10(1), ENEURO.0149-22.2022. https://doi.org/10.1523/eneuro.0149-22.2022

Kim, S.-W. (2024). Development of a TPACK Educational Program to Enhance Pre-service Teachers' Teaching Expertise in Artificial Intelligence Convergence Education. International Journal on Advanced Science, Engineering and Information Technology, 14(1), 1–9. https://doi.org/10.18517/ijaseit.14.1.19552

Koo, T. K., & Li, M. Y. (2016). A Guideline of Selecting and Reporting Intraclass Correlation Coefficients for Reliability Research. Journal of Chiropractic Medicine, 15(2), 155–163. https://doi.org/10.1016/j.jcm.2016.02.012

Kwarteng, J. T. (2022). Breaches of integrity in teacher administration in Ghana. International Journal for Educational Integrity, 18(1). https://doi.org/10.1007/s40979-022-00106-z

Lavidas, K., Voulgari, I., Papadakis, S., Athanassopoulos, S., Anastasiou, A., Filippidi, A., Komis, V., & Karacapilidis, N. (2024). Determinants of Humanities and Social Sciences Students' Intentions to Use Artificial Intelligence Applications for Academic Purposes. Information, 15(6), 314. https://doi.org/10.3390/info15060314

Mahyiddin, M., & Amin, F. M. (2022). Integrating Technology into Education: Students' Attitudes toward Online Learning. Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah, 7(1), 79–89. https://doi.org/10.24042/tadris.v7i1.11634

Maity, S. (2019). Identifying opportunities for artificial intelligence in the evolution of training and development practices. Journal of Management Development, 38(8), 651–663. https://doi.org/10.1108/jmd-03-2019-0069

Utterberg Modén, M., Tallvid, M., Lundin, J., & Lindström, B. (2021). Intelligent Tutoring Systems: Why Teachers Abandoned a Technology Aimed at Automating Teaching Processes. Proceedings of the 54th Hawaii International Conference on System Sciences. https://doi.org/10.24251/hicss.2021.186

Mohammed, L. A., Aljaberi, M. A., Amidi, A., Abdulsalam, R., Lin, C.-Y., Hamat, R. A., & Abdallah, A. M. (2022). Exploring Factors Affecting Graduate Students' Satisfaction toward E-Learning in the Era of the COVID-19 Crisis. European Journal of Investigation in Health, Psychology and Education, 12(8), 1121–1142. https://doi.org/10.3390/ejihpe12080079

Mozgalova, N. G., Baranovska, I. G., Hlazunova, I. K., Mikhalishen, A. V., & Kazmirchuk, N. S. (2021). Methodological foundations of soft skills of musical art teachers in pedagogical institutions of higher education. Linguistics and Culture Review, 5(S2), 317–327. https://doi.org/10.21744/lingcure.v5ns2.1355

Ofori, F., Maina, E., & Gitonga, R. (2020). Using machine learning algorithms to predict students' performance and improve learning outcome: A literature based review. Journal of Information and Technology, 4(1), 33-55.

IoT, AI, and ICT for Educational Applications. (2024). In S. Papadakis (Ed.), EAI/Springer Innovations in Communication and Computing. Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-50139-5

Papadakis, S., Kravtsov, H. M., Osadchyi, V. V., Marienko, M. V., Pinchuk, O. P., Shyshkina, M. P., ... & Striuk, A. M. (2023). Revolutionizing education: using computer simulation and cloud-based smart technology to facilitate successful open learning. https://doi.org/10.31812/123456789/7375

Paranjape, K., Schinkel, M., Nannan Panday, R., Car, J., & Nanayakkara, P. (2019). Introducing Artificial Intelligence Training in Medical Education. JMIR Medical Education, 5(2), e16048. https://doi.org/10.2196/16048

Parissi, M., Komis, V., Dumouchel, G., Lavidas, K., & Papadakis, S. (2023). How Does Students' Knowledge About Information-Seeking Improve Their Behavior in Solving Information Problems? Educational Process International Journal, 12(1). https://doi.org/10.22521/edupij.2023.121.7

Popenici, S. A. D., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. Research and Practice in Technology Enhanced Learning, 12(1). https://doi.org/10.1186/s41039-017-0062-8

Ignatius Septo Pramesworo, Darmawanta Sembiring, Mohamad Sarip, Enos Lolang, & Irwan Fathurrochman. (2023). Identification of New Approaches to Information Technology-Based Teaching for Successful Teaching of Millennial Generation Entering 21st Century Education. Jurnal Iqra': Kajian Ilmu Pendidikan, 8(1), 350–370. https://doi.org/10.25217/ji.v8i1.2722

Ramesh, D., & Sanampudi, S. K. (2021). An automated essay scoring systems: a systematic literature review. Artificial Intelligence Review, 55(3), 2495–2527. https://doi.org/10.1007/s10462-021-10068-2

Research Advisors. (2006). http://research-advisors.com/tools/SampleSize.htm

Saidakhror, G. (2024). The Impact of Artificial Intelligence on Higher Education and the Economics of Information Technology. International Journal of Law and Policy, 2(3), 1–6. https://doi.org/10.59022/ijlp.125

Sanasintani, S. (2023). Revitalizing The Higher Education Curriculum Through An Artificial Intelligence Approach: An Overview. Journal of Social Science Utilizing Technology, 1(4), 239–248. https://doi.org/10.55849/jssut.v1i4.670

Sapci, A. H., & Sapci, H. A. (2020). Artificial Intelligence Education and Tools for Medical and Health Informatics Students: Systematic Review. JMIR Medical Education, 6(1), e19285. https://doi.org/10.2196/19285

Sarwari, A. Q., & Mohd Adnan, H. (2024). The effectiveness of artificial intelligence (AI) on daily educational activities of undergraduates in a modern and diversified university environment. Advances in Mobile Learning Educational Research, 4(1), 927–930. https://doi.org/10.25082/amler.2024.01.004

Selwyn, N. (2022). The future of AI and education: Some cautionary notes. European Journal of Education, 57(4), 620–631. Portico. https://doi.org/10.1111/ejed.12532

Siemens, G. (2013). Learning Analytics. American Behavioral Scientist, 57(10), 1380–1400. https://doi.org/10.1177/0002764213498851

Strohm, L., Hehakaya, C., Ranschaert, E. R., Boon, W. P. C., & Moors, E. H. M. (2020). Implementation of artificial intelligence (AI) applications in radiology: hindering and facilitating factors. European Radiology, 30(10), 5525–5532. https://doi.org/10.1007/s00330-020-06946-y

Tang, T., Li, P., & Tang, Q. (2022). New Strategies and Practices of Design Education Under the Background of Artificial Intelligence Technology: Online Animation Design Studio. Frontiers in Psychology, 13. https://doi.org/10.3389/fpsyg.2022.767295

Venkatasubramanian, V. (2018). The promise of artificial intelligence in chemical engineering: Is it here, finally? AIChE Journal, 65(2), 466–478. Portico. https://doi.org/10.1002/aic.16489

Venkatesh, Morris, Davis, & Davis. (2003). User Acceptance of Information Technology: Toward a Unified View. MIS Quarterly, 27(3), 425. https://doi.org/10.2307/30036540

Wang, P. (2019). On Defining Artificial Intelligence. Journal of Artificial General Intelligence, 10(2), 1–37. https://doi.org/10.2478/jagi-2019-0002

Wood, E. A., Ange, B. L., & Miller, D. D. (2021). Are We Ready to Integrate Artificial Intelligence Literacy into Medical School Curriculum: Students and Faculty Survey. Journal of Medical Education and Curricular Development, 8, 238120521102 40. https://doi.org/10.1177/23821205211024078

Woolf, B. P. (2010). Building intelligent interactive tutors: Student-centered strategies for revolutionising e-learning. Morgan Kaufmann.

Xu, W., & Ouyang, F. (2022). The application of AI technologies in STEM education: a systematic review from 2011 to 2021. International Journal of STEM Education, 9(1). https://doi.org/10.1186/s40594-022-00377-5