Issues in Information Systems
Volume 26, Issue 1, pp. 9-19, 2025

DOI: https://doi.org/10.48009/1_iis_102

Adoption of AI chatbots by South African university students

Vusumzi Funda, *University of Fort Hare, vfunda@ufh.ac.za*
Liezel Cilliers, *University of Fort Hare, lcilliers@ufh.ac.za*

Abstract

AI Chatbots hold considerable promise for transforming teaching and learning in higher education, particularly in supporting academic writing. However, their adoption by students is shaped by various perceptual and contextual factors. This study investigates the adoption of AI Chatbots by South African university students, guided by the Innovation Diffusion Theory (IDT). It specifically examines four constructs: Perceived Compatibility, Perceived Relative Advantage, Technology Self-Efficacy, and Perceived Complexity. Using a quantitative research design, data were collected via a structured questionnaire from 224 students across all academic levels at the University of Fort Hare. The sample was purposively selected to reflect a range of experiences with AI technologies. The instrument was grounded in IDT and included validated Likert-scale items measuring each construct. The findings reveal that Perceived Compatibility, Relative Advantage, and Technology Self-Efficacy significantly and positively influence chatbot adoption. Students who viewed chatbots as compatible with academic writing tasks and beneficial in improving writing quality were more likely to use them. Higher levels of technology self-efficacy further strengthened adoption. Conversely, Perceived Complexity was negatively associated with adoption, though this effect was moderate. These results offer practical implications. To support AI integration in higher education, chatbot systems must be user-friendly, contextually relevant, and embedded in digital literacy development. The study contributes empirical evidence from a Global South context, highlighting the intersection of psychological, technological, and contextual factors. It also offers actionable guidance for educators, developers, and policymakers seeking to leverage AI to enhance student engagement and academic performance.

Keywords: students' perceptions, adoption, AI chatbots, ChatGPT, AI tools, South African universities

Introduction

Artificial Intelligence (AI) has significantly transformed the educational landscape worldwide, introducing a myriad of innovations aimed at enhancing both teaching and learning experiences. Globally, AI has facilitated automated grading systems, personalized learning environments, and interactive educational platforms (Shoukat, 2024; Qurbonova & Yusupova, 2024). These advancements have allowed educators to streamline administrative tasks, enabling more time to focus on individual student needs. AI's ability to tailor learning experiences to individual student preferences and performance levels has been shown to increase engagement and improve educational outcomes, as suggested by Rekha et al. (2024). In the context of South Africa, the integration of AI in education is still in its nascent stages but is expanding rapidly. The South African educational system is exploring the potential of AI technologies to address various educational challenges, particularly those stemming from socioeconomic disparities (Patel & Ragolane, 2024; Funda & Mnbangeleli, 2024). One notable initiative is the deployment of AI-driven literacy projects

that incorporate indigenous languages, demonstrating the adaptability of AI technologies to meet local educational needs (Funda & Piderit, 2024). These localized applications of AI not only illustrate the technology's versatility but also highlight its potential to address some of the unique challenges faced by the South African education system.

The ongoing adoption and integration of AI in South African higher education shows a significant shift towards leveraging advanced technologies to enhance learning outcomes and bridge educational gaps. The integration of AI tools in education offers promising prospects for personalized and effective learning experiences, capable of addressing diverse learner needs across various contexts. This study aims to explore the adoption of AI Chatbots by South African university students, focusing on their use and acceptance in writing and other educational tasks. By understanding these experiences, the study seeks to provide valuable insights into the broader implications of AI adoption in South African higher education, ultimately contributing to the development of more effective and inclusive educational practices.

AI Technology

The advancements in Natural Language Processing (NLP) and Machine Learning (ML) over the past decade have significantly enhanced the capabilities of AI-enabled tools. These technologies enable AI-enabled tools to understand, interpret, and respond to human language more effectively (Pappula & Allm, 2023). These models excel at capturing linguistic nuances and user intent, leading to more human-like interactions across various domains (Pappula & Allam, 2023). The GPT architecture, which uses transformer neural networks and pre-training on vast datasets, has undergone several iterations, with GPT-3 being the largest model to date (Adhikari & Dhakal, 2023).

In the realm of education, AI tools offer scalable and personalized learning opportunities, which are particularly valuable in enhancing the educational experience. These chatbots can mimic one-on-one teaching, provide instant feedback on assignments, and assist with language acquisition. Recent research explores the integration of AI Chatbots in education, highlighting their potential to enhance learning experiences and support educators. AI Chatbots can reduce administrative burdens, offer personalized learning, and provide real-time feedback (Mishra & Varshely, 2024). They can adapt to individual student needs, improving absorption and retention (Alam, 2021).

Despite their potential, the effectiveness of AI tools in educational settings remains a topic of debate. While some studies highlight the numerous benefits of AI tools, such as enhanced personalized learning and administrative efficiency, others point out significant limitations. Barman et al. (2024) discuss issues such as the lack of emotional intelligence in AI tools such as ChatGPT and the potential for disseminating misleading information. However, with proper monitoring and ongoing improvements, these challenges can be mitigated. AI tools are not a perfect solution, but they represent a valuable tool for enhancing personalized learning and administrative efficiency in educational institutions.

AI Chatbots use in higher education

AI Chatbots represent a significant innovation in educational technology, particularly within academic settings. These AI tools can provide real-time, personalized feedback and tutoring to students, enhancing their learning experience and academic performance (Bekkar & Chtouki, 2024). The ability of AI Chatbots to offer tailored support makes them an invaluable resource for students, allowing for more interactive and responsive educational environments. This potential to improve student learning outcomes highlights the importance of studying AI Chatbots in academia. Research by Funda & Piderit (2024) demonstrates that AI Chatbots can assist students with information retrieval and academic writing, thereby enhancing their research skills. The use of AI-enabled tools can streamline the academic process, providing students with efficient tools for gathering information, organizing their thoughts, and improving their writing quality. This can lead to a more effective and engaging learning experience, fostering better academic results.

Understanding the efficacy and acceptability of AI Chatbots in education is crucial for their ethical and successful integration. As AI technologies become more prevalent in academic settings, it is essential to

address concerns related to privacy, data security, and the potential reinforcement of biases. Williams (2024) and Mishara (2024) suggest that, while AI Chatbots have the potential to significantly aid education, these tools must be carefully managed to ensure they do not compromise student privacy or perpetuate existing biases. By exploring the benefits and challenges associated with AI Chatbots, this research will contribute to a deeper understanding of their role in higher education. The findings will provide valuable insights for educators, administrators, and policymakers, facilitating the ethical and effective integration of AI technologies in academic settings. Ultimately, this study seeks to enhance the educational experience for students by leveraging the capabilities of AI Chatbots, ensuring they are used to their fullest potential while mitigating any associated risks.

Challenges in academic writing

University students often encounter numerous challenges when it comes to academic writing, including structural, stylistic, research, and argumentative obstacles. Hardianti and Salija (2023) note that many students struggle with critical thinking and analytical skills, which are essential for producing high-quality academic work. These difficulties are often exacerbated by students' diverse language backgrounds, particularly in a multicultural academic environment like South Africa, where language barriers can add an extra layer of complexity (Molotja, 2023). The intricacies of academic practices and citation standards can also be daunting for newcomers to higher education. Mulenga and Shilongo (2024), highlight that students frequently find it challenging to grasp the concepts of academic integrity and plagiarism, particularly in an era where vast amounts of information are readily accessible online. These foundational challenges underscore the need for robust support systems to aid students in developing their academic writing skills.
Technological advancements have significantly expanded the resources available to support students in their academic writing endeavours. AI tools such as grammar checkers, plagiarism detection software, and academic writing platforms that provide feedback and guidance have been the subject of recent research. Llausas et al. (2024) found that grammar checking software can significantly enhance student writing by offering immediate corrections and suggestions, thereby improving both the quality of writing and the learning process. AI assistance, particularly using chatbots, is becoming increasingly important in this domain. AI Chatbots can provide real-time feedback, suggesting improvements, and assisting with research and citation management. Ekellem (2023) found that AI Chatbots can reduce the time students spend on routine inquiries, allowing them to focus more on the content and organization of their writing. While these AI Chatbots have the potential to improve academic writing, their efficacy remains a topic of debate. Some studies advocate for their use, citing benefits such as increased efficiency and support, while others, like Ha (2024) and Santiago et al. (2023) caution that overreliance on these tools may impede the development of intrinsic writing skills. The major challenge for South African higher education institutions is that many students are not yet prepared for AI-assisted learning. This requires redesigning the curriculum to include technology education and enhancing multilingual and academic abilities (Funda & Piderit, 2024). By examining both the advantages and limitations of this technology, the research seeks to provide a comprehensive understanding of the impact of AI Chatbots on student writing practices and outcomes.

Methodology

Sampling and Recruitment

This study employed a quantitative research design using a structured survey instrument administered to students at University of Fort Hare in South African. A total of 224 respondents participated in the study, representing various academic levels, including first-year, second-year, and third-year undergraduates, as well as Honours and postgraduate students. The sample was purposively selected to reflect diversity in academic experience and exposure to AI tools, ensuring relevance to the study's objective of understanding AI Chatbot adoption for academic writing. Recruitment was conducted through academic mailing lists and

in-class announcements, encouraging voluntary participation while ensuring anonymity and ethical compliance.

Instrument Design and Constructs

The primary data collection instrument was a self-administered questionnaire, developed based on constructs derived from the Innovation Diffusion Theory (IDT). The questionnaire consisted of closed-ended Likert-scale items (ranging from 1 = Strongly Disagree to 5 = Strongly Agree) designed to measure students' perceptions across four key constructs:

Perceived Compatibility: The extent to which AI Chatbots align with students' academic writing practices.

Perceived Relative Advantage: The perceived benefits and usefulness of AI Chatbots in improving writing efficiency and quality.

Technology Self-Efficacy: Students' confidence in their ability to use AI technologies effectively.

Perceived Complexity: The degree to which AI Chatbots are perceived as difficult to understand or use.

The questionnaire items were adapted from validated instruments in prior literature to ensure content validity and relevance to the higher education context.

Data Analysis Methods

Data were analyzed using descriptive and inferential statistical methods. Reliability of the questionnaire was assessed using Cronbach's Alpha, yielding a coefficient of 0.820, which indicates high internal consistency and reliability of the constructs measured. A summary hypothesis table and visual model were created to illustrate the key findings and enhance interpretability.

This analytical approach provided robust evidence to assess the theoretical assumptions underpinning the study and offered insights into the factors influencing AI Chatbot adoption among South African university students.

Theoretical framework and hypothesis development

The Innovation Diffusion Theory (IDT), developed by Everett Rogers in 1962, provides a comprehensive framework for understanding how innovations are adopted within a social system. This theory has been widely applied in various fields to analyze the adoption of new technologies, including education (Bakkabulindi, 2014; Bennets, 2009). IDT posits that the diffusion of an innovation follows a process through which an innovation is communicated over time among members of a social system. This process involves several stages: knowledge, persuasion, decision, implementation, and confirmation. Each stage represents a different level of awareness and commitment to adopting the innovation (Bakkabulindi, 2014). The IDT framework suggests that several key constructs - Relative Advantage, Compatibility, Complexity, Trialability, and Observability play crucial roles in the adoption process (Bakkabulindi, 2014). However, in the context of this research, the focus is primarily on Perceived Compatibility, Perceived Relative Advantage, Technology Self-Efficacy, and Perceived Complexity. The hypotheses for this study are formulated to test the relationships between these constructs and the adoption of AI Chatbots. Thus, the hypothesis for this study are as follows:

Perceived Compatibility

We hypothesize that there is a significant positive relationship between Perceived Compatibility of AI Chatbots and their adoption for academic writing among university students. Students who perceive AI Chatbots as compatible with their academic tasks are more likely to incorporate them into their writing processes. In the context of the study, compatibility is crucial as it influences students' willingness to integrate AI Chatbots into their academic writing.

H1: *Perceived Compatibility is a predictor for the adoption of AI Chatbots for academic writing among university students.*

Perceived Relative Advantage
We hypothesize that there is a significant positive relationship between Perceived Relative Advantage of AI Chatbots and their adoption for academic writing among university students. Relative advantage refers to the benefits that students believe they gain from using AI Chatbots, such as increased efficiency, improved learning outcomes, and enhanced engagement in their academic tasks.

H2: *The medium strength relationships observed in the study support the assertion that perceived relative advantage is a strong predictor of AI Chatbots adoption for academic writing among university students*.

Technology Self-Efficacy
We hypothesize that there is a significant positive relationship between Technology Self-Efficacy and the adoption of AI Chatbots for academic writing among university students. Technology self-efficacy refers to an individual's belief in their ability to effectively use technology, which can enhance motivation and persistence in engaging with new tools.

H3: *Self-efficacy is a strong predictor of AI Chatbots adoption for academic writing among university students.*

Perceived Complexity
We hypothesize that students are more likely to adopt AI Chatbots when they perceive them as easy to use, while high perceived complexity deters adoption.

H4: *There is a significant negative relationship between Perceived Complexity of AI Chatbots and their adoption for academic writing among university students.*

Results

The respondents were drawn from diverse academic levels as per Table 1 below, including first-year undergraduates (23.7%), second-year undergraduates (29.5%), third-year undergraduates (21%), Honours students (15.2%), and postgraduates (8.9%). The majority of respondents were aged 18–22 years (66.5%), with 24.1% aged 23–26, and the remainder distributed across older age groups. Most participants identified as African (92.9%), while other ethnicities included Coloured, Indian, and White students, each representing less than 2% of the sample. Males constituted 59.8% of the sample, while females accounted for 36.6%, with 3.6% not specifying their gender.

Table 1. Demographic Characteristics of the Respondents (n=224)

Profile	Category	Number	Frequency
Gender	Male	134	59.8%
	Female	82	36.6%
	Missing	8	3.6%
Age in years	18-22	149	66.5%
	23-26	54	24.1%
	27-32	10	4.5%
	>32	9	4.0%
	Other	2	0.9%

Profile	Category	Number	Frequency
Ethnicity	African	208	92.9%
	Coloured	3	1.3%
	Indian	3	1.3%
	White	4	1.8%
	Other	3	1.3%
	Missing	3	1.3%
Study level	Undergrad first year	53	23.7%
	Undergrad second year	66	29.5%
	Undergrad third year	47	21.0%
	Honours	34	15.2%
	Postgraduate	20	8.9%
	Missing	4	1.8%

For this study, the questionnaire achieved a Cronbach's Alpha value of 0.820, indicating a high level of reliability as per Table 2 below. A Cronbach's Alpha score above 0.70 is widely regarded as acceptable for exploratory studies, while values above 0.80 suggest good reliability, ensuring that the items within the constructs consistently measure the same underlying concept (Taber, 2017). This reliability provides confidence in the findings, including the significant relationships identified between constructs such as Perceived Compatibility and Technology Self-Efficacy. Values above 0.70 are generally considered acceptable, with higher values indicating better reliability (Yun et al., 2023). By achieving a high Cronbach's Alpha score, this study ensures the credibility of its insights into the adoption dynamics of AI Chatbots, contributing to a more nuanced understanding of how students interact with educational technologies.

Table 2. Reliability Statistics

Cronbach's Alpha	N of Items
.820	**25**

The results of this study provide valuable insights into the factors influencing the adoption of AI Chatbots by university students in South Africa. Guided by the Innovation Diffusion Theory, the research hypothesized that constructs such as Perceived Compatibility, Perceived Relative Advantage, Technology Self-Efficacy, and Perceived Complexity would play pivotal roles in adoption behaviours. As per Table 3 and consistent with expectations, significant relationships were observed for most constructs, affirming the theoretical framework. However, some findings revealed nuanced deviations from the hypothesis, highlighting the complexity of AI adoption in educational contexts. For instance, as hypothesized, Perceived Compatibility exhibited a strong positive relationship with adoption, reinforcing prior studies suggesting that technologies closely aligned with user needs are more likely to be embraced (Doni et al., 2022; Warner et al., 2022; Yuen et al., 2020). Similarly, the study confirmed the hypothesis that Perceived Relative Advantage positively influences adoption, aligning with research by Dubey and Sahu (2021), which emphasized the role of perceived benefits in fostering technology acceptance. Interestingly, while the results for Technology Self-Efficacy strongly supported the hypothesis, with high self-efficacy correlating with greater adoption, the strength of this relationship exceeded expectations, suggesting that confidence in using technology may have an even more pronounced impact in resource-constrained environments like South Africa.

Table 3. Hypothesis Summary

Hypothesis	Statement	Result
H1	Perceived Compatibility is a predictor for the adoption of AI chatbots for academic writing among university students	Supported – significant positive relationship
H2	Perceived Relative Advantage is a predictor of AI chatbot adoption for academic writing among university students	Supported – significant positive relationship
H3	Technology Self-Efficacy is a predictor of AI Chatbot adoption for academic writing among university students	Strongly supported – significant positive relationship
H4	Perceived Complexity negatively influences the adoption of AI Chatbots for academic writing among university students	Supported – significant negative relationship

In contrast, the findings related to Perceived Complexity partially diverged from the hypothesis. While the anticipated negative relationship between complexity and adoption was confirmed, the relatively moderate strength of this correlation suggests that other factors, such as user training or institutional support, may mitigate the impact of perceived difficulty. This nuanced outcome resonates with Abdallah et al. (2023), who argued that targeted interventions could help users overcome initial challenges associated with adopting complex technologies. Therefore, the results align with much of the theoretical expectations while also offering new perspectives on the interplay between these constructs.

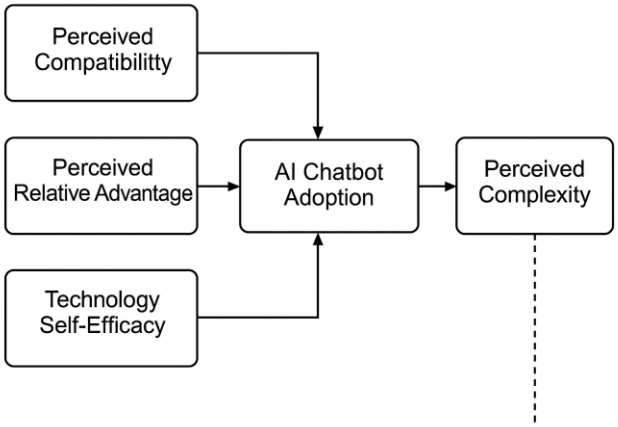

Figure 1. Conceptual Model

Figure 1 illustrates the conceptual model derived from the Innovation Diffusion Theory (IDT), highlighting the factors influencing the adoption of AI Chatbots by South African university students. The model posits that Perceived Compatibility, Perceived Relative Advantage, and Technology Self-Efficacy exert positive influences on AI Chatbot adoption. Students who view chatbots as compatible with their academic tasks, recognize clear benefits, and have confidence in their technological abilities are more likely to adopt these tools. Conversely, Perceived Complexity exhibits a negative relationship with adoption, indicating that user-friendly and intuitive chatbot designs reduce barriers to use. The interplay of these constructs underscores the importance of designing AI Chatbots that are both advantageous and accessible to encourage widespread adoption in academic writing contexts.

These findings underscore the importance of designing user-friendly and contextually relevant AI systems and tailoring support strategies to enhance adoption in diverse educational settings.

Discussion

This study affirms the relevance of the Innovation Diffusion Theory (IDT) in understanding AI Chatbot adoption in educational settings, particularly within a Global South context. The results show that Perceived Compatibility, Perceived Relative Advantage, and Technology Self-Efficacy significantly influence adoption, while Perceived Complexity negatively affects it. For instance, Dubey and Sahu (2021), emphasized the role of perceived usefulness and compatibility in fostering technology acceptance among university students. Similarly, Ayanwale and Ndlovu (2024); Ayanwale and Molefi (2024); Yun et al. (2023), highlighted that self-efficacy enhances user engagement with educational technologies. The negative relationship between complexity and adoption aligns with findings by Abdalla et al. (2023), who stressed the importance of intuitive design for enhancing user experience.

Students in this study expressed a preference for chatbots that required minimal technical skills, reinforcing the need for user-friendly interfaces. The demographic profile suggests that younger students and undergraduates are early adopters of AI Chatbots, which aligns with generational trends in technology use. However, the limited representation of postgraduates highlights the need for targeted interventions to improve adoption rates among advanced learners. Implications for practice include the development of tailored training programmes to enhance students' self-efficacy and technical skills. In the South African higher education context, students often face systemic challenges, including unequal access to digital infrastructure and limited exposure to advanced technologies. This makes self-efficacy not just a supporting factor but a foundational enabler of AI tool adoption. The findings emphasize the need for localized strategies that account for linguistic diversity, academic preparedness, and digital inequality, all of which shape how AI technologies are perceived and adopted.

The study offers several action-oriented recommendations:

- Educators should incorporate digital literacy and AI training into curricula to strengthen students' confidence in using AI tools for academic writing.
- Policymakers must prioritize investment in ICT infrastructure and equitable access to AI technologies across all university campuses.
- AI developers should design user-friendly, multilingual chatbot interfaces tailored to the academic tasks and cultural contexts of South African learners.
- Institutional support such as orientation workshops or embedded chatbot tutorials can further reduce perceived complexity and encourage responsible usage.

By tailoring AI adoption strategies to the local educational landscape, universities can better leverage AI Chatbots to support student learning outcomes, especially in under-resourced contexts.

Future research should explore longitudinal data to examine how sustained use of AI Chatbots influences academic outcomes and user perceptions. Additionally, qualitative studies could provide deeper insights into students' experiences and challenges with chatbot adoption.

References

Abdallah, S., Omar, M. & Ahmed, H. (2023) *Overcoming barriers to AI adoption: The role of institutional support in reducing perceived complexity*. AI & Society, 38(3), pp. 487–502. https://doi.org/10.1007/s00146-022-01456-w

Abdallah, W., Harraf, A., Mosusa, O. & Sartawi, A. M. (2023) *Investigating factors impacting customer acceptance of artificial intelligence chatbot: Banking sector of Kuwait*. International Journal of Applied Research in Management and Economics, 5(4), pp. 45–58. https://doi.org/10.33422/ijarme.v5i4.961

Adhikari, S. & Dhakal, B. (2023) *Revolutionizing natural language processing with GPT-based chatbots: A review*. Tech. Journal, 3(1), 61943. https://doi.org/10.3126/tj.v3i1.61943

Alam, A. (2021) *Should robots replace teachers? Mobilisation of AI and learning analytics in education*. In *Proceedings of the International Conference on Advanced Computing, Communication and Control (ICAC3)*, pp. 1–12.

Ayanwale, M. A. & Ndlovu, M. (2024) *Investigating factors of students' behavioral intentions to adopt chatbot technologies in higher education: Perspective from expanded diffusion theory of innovation*. Computers in Human Behavior Reports, 14, 100396. https://doi.org/10.1016/j.chbr.2024.100396

Ayanwale, M. A. & Molefi, R. R. (2024) *Exploring intention of undergraduate students to embrace chatbots: From the vantage point of Lesotho*. International Journal of Educational Technology in Higher Education, 21, 5. https://doi.org/10.1186/s41239-024-00403-7

Barman, D., Guo, Z. & Conlan, O. (2024) *The dark side of language models: Exploring the potential of LLMs in multimedia disinformation generation and dissemination*. Machine Learning Applications, 12, 100169. https://doi.org/10.1016/j.mlwa.2024.100169

Bakkabulindi, F. (2014) *A call for return to Rogers' innovation diffusion theory*. Makerere Journal of Higher Education, 6, pp. 55–85.

Bekkar, H. & Chtouki, Y. (2024) *Chatbots in education: A systematic literature review*. In *Proceedings of the International Conference on Smart Computing and Communication (ICSCC)*, pp. 637–644.

Bennetts, R. E. (2009) *Intermountain Region Diffusion of Innovations: A Theoretical Framework for Understanding How*. PhD thesis.

Doni, S., Alamsyah, P., Setyawati, I. & Rohaeni, H. (2022) *New technology adoption of e-learning: Model of perceived usefulness*. In *Proceedings of the International Conference on Big Data Analytics Practices (IBDAP)*, pp. 79–84.

Dubey, P. & Sahu, K. K. (2021) *Students' perceived benefits, adoption intention and satisfaction to technology-enhanced learning: Examining the relationships*. Journal of Research and Innovation in Teaching & Learning, 14(1), pp. 25–40. https://doi.org/10.1108/JRIT-09-2019-0054

Ekellem, E. A. (2023) *Conversational AI in academia: A practical exploration with ChatGPT*. In *Proceedings of the International Symposium on Multidisciplinary Studies in Innovation and Technology (ISMSIT)*, pp. 1–4.

Funda, V. & Mbangeleli, N. (2024) *Artificial intelligence (AI) as a tool to address academic challenges in South African higher education*. International Journal of Learning, Teaching and Educational Research, 23(11), pp. 1–15. https://doi.org/10.26803/ijlter.23.11.27

Funda, V. & Piderit, R. (2024) *A review of the application of artificial intelligence in South African higher education*. In *Proceedings of the Conference on Information and Communication Technology and Society (ICTAS)*, Durban, South Africa, pp. 44–50. https://doi.org/10.1109/ICTAS59620.2024.10507113

Ha, T. N. (2024) *Suggestions on artificial intelligence-assisted tools for teaching and learning English writing skills*. ACEID Official Conference Proceedings.

Hardianti, H., Jabu, B. & Salija, K. (2023) *Students' critical thinking skills in writing analytical exposition text*. ELT Worldwide: Journal of English Language Teaching, 10(2), pp. 45–56.

Llausas, S. M., Ruiz, E., Ayucan, S. M. & Evardo Jr, O. J. (2024) *A systematic literature review on the use of Grammarly in improving the writing skills of ESL/EFL students*. International Journal of Multidisciplinary Applied Business and Education Research, 5(2), pp. 120–136.

Mishra, R. & Varshney, D. (2024) *Comprehensive analysis of human and AI task allocation in the education sector: Defining futuristic roles and responsibilities*. World Journal of Advanced Research and Reviews, 19(1), pp. 34–50.

Mishara, P. (2024) *The ethical implications of AI in education: Privacy, bias, and accountability*. Journal of Informatics Education Research, 2(1), pp. 67–82.

Molotja, T. (2023) *Enhancing students' engagement and critical thinking skills in English language teaching: A transformative approach*. International Journal of Membrane Science & Technology, 14(3), pp. 112–123.

Mulenga, R. & Shilongo, H. (2024) *Academic integrity in higher education: Understanding and addressing plagiarism*. Acta Pedagogia Asiana, 6(1), pp. 15–29.

Pappula, S. R. & Allam, S. R. (2023) *LLMs for conversational AI: Enhancing chatbots and virtual assistants*. International Journal of Research Publications and Reviews, 4(12), pp. 159–165. https://doi.org/10.55248/gengpi.4.1223.123425

Patel, S., & Ragolane, M. (2024). The implementation of artificial intelligence in South African higher education institutions: Opportunities and challenges. *Technium Education and Humanities, 9*, pp. 51–65. https://doi.org/10.47577/teh.v9i.11452

Qurbonova, B. & Yusupova, A. (2024) *The deep investigation of the part of AI integration in the field of education: A technical review*. In *Proceedings of the 4th International Conference on Advanced Computing and Innovative Technologies in Engineering (ICACITE)*, pp. 503–507.

Rekha, K., Gopal, K., Satheeskumar, D., Anand, U. A., Doss, D. S. & Elayaperumal, S. (2024) *AI-powered personalized learning system design: Student engagement and performance tracking system*. In *Proceedings of the 4th International Conference on Advanced Computing and Innovative Technologies in Engineering (ICACITE)*, pp. 1125–1130.

Santiago, C.S., Embang, S.I., Acanto, R.B., Ambojia, K.W.P., Aperocho, M.D.B., Balilo, B.B., Cahapin, E.L., Conlu, M.T.N., Lausa, S.M., Laput, E.Y. and Malabag, B.A. (2023) *Utilization of writing assistance tools in research in selected higher learning institutions in the Philippines: A text mining analysis*. International Journal of Learning, Teaching and Educational Research, 22(11), pp. 259–284. https://doi.org/10.26803/ijlter.22.4.5

Shoukat, R. (2024) *Harnessing AI for educational transformation: A comparative study of China, India, and Pakistan*. Strategic Studies, 46(2), pp. 101–120.

Taber, K. S. (2017) *The use of Cronbach's alpha when developing and reporting research instruments in science education*. Research in Science Education, 48(6), pp. 1273–1296. https://doi.org/10.1007/s11165-016-9602-2.

Williams, R. T. (2024) *The ethical implications of using generative chatbots in higher education*. Frontiers in Education, 9, article 139. https://doi.org/10.3389/feduc.2024.000139

Yun, V. W., Ulang, N. M. & Husain, S. H. (2023) *Measuring the internal consistency and reliability of the hierarchy of controls in preventing infectious diseases on construction sites: The Kuder-Richardson (KR-20) and Cronbach's alpha*. Journal of Advanced Research in Applied Sciences & Engineering Technology, 19(3), pp. 15–29.

Yuen, K. F., Cai, L., Qi, G. & Wang, X. (2020) *Factors influencing autonomous vehicle adoption: An application of the technology acceptance model and innovation diffusion theory*. Technology Analysis & Strategic Management, 33(4), pp. 505–519. https://doi.org/10.1080/09537325.2020.1793289

Warner, L. A., Rihn, A. L., Fulcher, A., Schexnayder, S. & LeBude, A. V. (2022) *Relating grower perceptions and adoption of automated nursery technologies to address labor needs*. Journal of Agricultural Education, 63(1), pp. 23–38. https://doi.org/10.5032/jae.2022.01023