A SYSTEMATIC REVIEW OF ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION-SOUTH AFRICA

Nthabiseng B. KHOALENYANE[1], Oluwatoyin Ayodele AJANI[2]

[1] https://orcid.org/0000-0003-3964-5255
[2] https://orcid.org/0000-0001-6545-0203
[1,2] Department of Languages and Social Sciences Education, University of Zululand, South Africa

Abstract

This systematic review explores the role of artificial intelligence (AI) in higher education within the context of South Africa. As technology continues to advance, AI has garnered significant attention for its potential to transform various sectors, including education. The study aims to provide a comprehensive understanding of the current state of AI implementation in higher education institutions across South Africa. Drawing upon established guidelines for systematic literature reviews, the study identifies and analyses relevant literature on AI in higher education, focusing specifically on South Africa. Four key research questions guide the review process, delving into the extent of AI adoption, its impact on teaching and learning outcomes, the challenges and opportunities associated with its implementation, and recommendations for future initiatives in this domain. The review employs a structured approach, involving the systematic selection, identification, and synthesis of literature from reputable databases and sources. Keywords and search strings tailored to the South African context are utilized to ensure the inclusivity of relevant studies. Following rigorous screening processes based on predefined inclusion and exclusion criteria, a final set of articles is selected for in-depth analysis. Findings from the review shed light on the current landscape of AI integration in higher education institutions in South Africa. Key themes emerge regarding the adoption of AI technologies, including the utilization of AI-driven tools for personalized learning experiences, the enhancement of administrative processes, and the augmentation of teaching methodologies. Additionally, the review highlights challenges such as resource constraints, ethical considerations, and the digital divide, alongside recommendations for addressing these issues and maximizing the benefits of AI in higher education within the South African context.

Keywords: Artificial intelligence, technology integration, Higher education, Systematic review, new technologies

Introduction

One of the new educational technologies in education (AIEd) is artificial intelligence (Hmoud et al., 2024). In 2020 a global community was compelled to make a gigantic shift on how to do an array of things under the circumstances, and the education sector was not exempted from this shift. The AIEd was widely used to meet the "new-normal" way of teaching and learning. In South Africa were forced to shut down due to the lock down restrictions (Ajani, 2023). This article attempts to grant an overview of artificial intelligence (AI) in higher education through a systematic review and it is based on publications for the period between 2019 and 2023. Results demonstrated that: applications of artificial intelligence in online higher education can predict students' performance or satisfaction levels and enhance their learning environments. Effects produced by AI applications include better academic performance for students, increased online engagement and participation (Hmoud et al., 2024).

The future of society is shaped and groomed by education foundation. With the development of technology, artificial intelligence has (AI) impacted globally on education. Numerous innovative approaches have been

introduced to aid efficient and effective teaching and learning. After the COVID 19 outbreak that started in Wuhan the economic development of different countries was hampered by the documented cases of coronavirus. Numerous measures were implemented to combat the virus by different countries, inclusive of working from home, lockdowns, school closures, suspension of transport services, etc (Ajani, 2023). Most countries around the world had temporarily shut down their educational institutions to stop the COVID-19 pandemic from spreading (Hmoud et al., 2024). The world student population was affected by this closure nationwide depending on their level and course of study as well as where they were in their programmes, the COVID-19 pandemic has had a different impact on students' lives. AIEd has become the paramount research focus in computers, and education field, and has the potential to foster a transformation of knowledge (Hwang et al., 2020). AI systems can identify weaknesses and strengths of every student. Student engagement has become more significant as digital technologies reshape traditional classrooms (Khoalenyane and Ajani, 2023) However, the digital era has brought forth a new era of educational paradigms. Which means the pandemic's spread has caused several changes in the field of education, leaving a significant proportion of countries such as China, Mexico, Malaysia, Italy, and South Africa to shift from conventional face-to-face teaching methods to (digital education) e-learning (Gamede, Ajani, & Afolabi,2022). Digital education practices increase flexibility and accessibility for students to participate in the educational process from any geographic location while at the same time decreasing the need for face-to-face interactions (Ajani & Khoalenyane 2023). AIEd has provided new prospects, opportunities, and challenges for educational innovations. This paper seeks to unveil the prospects and implications artificial intelligence brought to the education system.

Education is one of the sectors that contribute to the country's economy, and it is subject to technological developments timeously. This development forces the sector to adapt to the emerging networks of being digitally engaged. This trend grew more after the COVID 19 pandemic (Ajani, 2023). However, there is one crucial query; how far can this new development take the education sector? The recent use of artificial intelligence in education has caused a stir of the prospects and challenges faced by education sector. Baker & Smith 2019 opine "The development of "computers that perform cognitive tasks, typically associated with human minds, particularly learning and problem-solving" is the focal focus of artificial intelligence in education (AIEd)". Due to the advancement of computing and information processing systems, AI has been used extensively in educational teaching and learning approaches. This study's main goal is to provide the prospects and challenges of using AI in education sector with a focus of pedagogy. The study also aims to provide knowledgeable advice and recommendations to academics, researchers, and decision-makers about artificial intelligence with information derived from the scholarly literature on artificial intelligence in higher education contexts.

Literature Review

Artificial Intelligence (AI)

According to Mnguni (2024), providing an exact definition of Artificial Intelligence (AI) has been a challenge for many scholars because AI is continuously evolving, and researchers are continuously contributing to the field of artificial intelligence (AI). AI seems to be taking over the human being's jobs and responsibilities, hence (Siau, 2018) defined AI as "the ability and development of information technology-based computer systems or other machines to perform tasks that typically required human beings." Baker & Smith, 2019, supports Siau by describing AI "as computers which perform cognitive tasks, usually associated with human minds, particularly learning and problem-solving". Ostensibly, AI is an umbrella term which describes a range of technologies and systems, not a single machine. AI are technologies inclusive of machine learning, processes, data mining, and networks.

Numerous scholars such as Ara Shaikh et al 2022, have conducted research on the role of artificial intelligence for making a Digital Classroom and its sustainable Impact on Education during Covid-19 (Ara Shaikh et al. 2022), Adaptive Learning Using Artificial Intelligence in e-Learning Education Sciences, (Gligorea et al. 2023), Can modern AI replace teachers? Not so fast! Artificial intelligence and adaptive learning: Personalized education in the AI age, (Kolchenko, 2018), Review of the application of artificial intelligence in education, Review of the application of artificial intelligence in education, (Yufeia et al, 2020). Based on the review of prior studies presented above, substantive differences can be seen. For that reason, this paper will focus on the prospects and challenges of artificial intelligence in the field of education.

Artificial Intelligence in Education (AIEd)

After the COVID 19 pandemic, AIEd grew, since schools were shut down to try and curb the virus, yet the education sector had to keep on running and being productive. To achieve productivity, Baker & Smith 2019 opined three different perspectives of AI in education being i) learner-facing, ii) teacher-facing, and iii) system-facing AIEd. Software tools that are used by students to learn a subject matter are referred to as Learner-facing AI tools, for example, Learning Management Systems (LMS) or Tertiary Software for registered or prospective Students (ITS). Teacher-facing systems are used to support the lecturer and reduce his or her workload by automating tasks such as administration, assessment, feedback, and plagiarism detection. This tools also identifies students at risk so that the respective lecturer can offer assistance and support to the identified students. While System-facing tools are said to be those tools providing information for institutional administrators and managers (Maphalala & Ajani, 2023). For example, to monitor developments, prospects and challenges within faculties and departments in universities. In the context of higher education, the concept of the student life cycle (see Reid, 1995) is used as a framework in describing the various AI based services on institutional and administrative level. The cycle is also used to support the teaching and learning process.

AI Effects on Higher Education

The major areas impacted by AI in higher education are curriculum development and enrolment and AI cannot be challenged in this regard due to its consistency, accuracy, and speed. AI is offered in some university's different departments. It is also used for enrolment in higher education institutes. AI improved the lives of people, even more after COVID 19, it simulates human thinking (Delić et al., 2019), learning (machine learning, intelligent adaptive learning) (Colchester et al., 2017). Traditional teaching and learning have changed (Yufei, Saleh, Jiahui, & Abdullah, 2020), and students and lecturers dug new ideas for teaching reform. AI plays a pivotal role in encouraging teaching and learning; it gives lecturers new way of teaching to deliver information to students and provided students with new and proper ways of learning. (Ip et al., 2019) orate Artificial Intelligence provide immersive learning experience, students can be evaluated using AI.

Much of the lecturers' time is spent on the repetitive activities and duties that come with teaching, which include marking assignments tests and examination papers (Ajani & Maphalala, 2023). However, AIEd relieves lecturers the burden of too much administration, teaching and learning, and research and allows lecturers to focus on the humanistic care and frees teachers on the heavy task of knowledge transfer. Murthy, 2019 highlighted that AI assists lecturers to safe energy and have more time to focus on the mental development of their students. Moreover, AIEd changed traditional education and teaching methods to digital methods. Biometrics, Face recognition, text recognition, voice interaction, and other AI technologies provide technical support for the construction of smart campuses and curbs criminalisation which creates a safe and conducive environment for students, classroom cameras which also provides monitoring and safety (Kwet & Prinsloo, 2020). The most affordable method done through mobile phone usage makes it easier for students to learn in the comfort of their homes or residences while safe. Furthermore, AIEd aids lecturers in most remote places to reach their students and draw their focus on student's teaching and learning through online and offline mixed teaching methods. Having tabulated the above, Table 1 below will demonstrate a summary of the functions provided by artificial intelligence in education.

Table 1. Summary of functions provided by artificial intelligence in education.

		Functions AI provides in Education System
Services	What AI can do	
Administration	▪ Set assignments, texts, and exams. ▪ Grade exams and provide feedback to students. ▪ Aid teachers and lecturers in data-driven activities. ▪ Identify and suggest most convenient methods for students learning plan.	
Teaching and learning	Instruction	▪ Find and analyse a syllabus and course materials suitable for a subject in question. ▪ Give instruction in and beyond the classroom. ▪ Tailor teaching method for each subject and class ▪ Create learning plans for students.
	Learning	▪ Gather studying data for students and assist in the career choice. ▪ Uncover students learning shortcomings and assist students. ▪ Customize the university course selection for students. ▪ Intervene in students struggles in courses chosen.

Challenges to Artificial Intelligence Adoption

Implementing artificial intelligence (AI) in higher education comes with several challenges. Firstly, there's the issue of access and infrastructure, particularly in regions with limited resources like some parts of South Africa. Establishing the necessary hardware, software, and internet connectivity to support AI systems can be costly and requires significant investment. Additionally, there are concerns about data privacy and security, especially when dealing with sensitive student information. Ensuring compliance with relevant regulations and safeguarding data from unauthorized access or misuse is paramount. Furthermore, there's the challenge of adapting traditional teaching methods and curriculum to incorporate AI effectively. Faculty members may require training and support to utilize AI tools appropriately in their teaching practices, and there may be resistance to change among stakeholders. Overcoming these challenges requires careful planning, collaboration between educational institutions and technology providers, and a clear understanding of the ethical implications of AI integration in higher education. Hence, there are no appropriate security measures regarding student's data from commercial exploitation (Pardo and Siemens, 2014). Students' personal data such as personal information and educational profiles. Ethical questions are raised when teachers use face recognition systems to monitor student behaviour and participation in classroom activities (Zawacki-Richter et al. 2019). There is however an unprecedented challenge of AIEd. It is therefore crucial to understand problems encountered in the introduction and acceptance of AIEd. In developing countries such as South Africa, there is a risk of exacerbating divisions in education by new technological systems.

Theoretical Framework

The Diffusion of Innovation theory or UTUAT

The Diffusion of Innovation theory, proposed by Everett Rogers in 1962, offers a comprehensive framework for understanding how new ideas, technologies, or practices spread and are adopted within a social system. This theory posits that the adoption process follows a predictable pattern, characterized by the innovation's rate of adoption among members of a society or organization. According to Rogers, the adoption curve typically consists of five categories: innovators, early adopters, early majority, late majority, and laggards.

In the context of higher education, the Diffusion of Innovation theory provides insights into the adoption of new technologies such as artificial intelligence (AI). For example, research by Rogers and Shoemaker (1971) highlighted the importance of communication channels in disseminating information about innovations, suggesting that institutions with effective communication networks are more likely to adopt AI solutions. Moreover, the theory emphasizes the role of opinion leaders or change agents who influence others' adoption decisions. In higher education, faculty members, academic leaders, and technology champions can serve as opinion leaders, promoting the use of AI in teaching and learning (Rogers, 2003). The diffusion process is influenced by several factors, including the perceived attributes of the innovation itself. Rogers (2003) identified five key attributes that affect adoption: relative advantage, compatibility, complexity, trialability, and observability. For AI in higher education, the perceived relative advantage, such as its potential to enhance teaching effectiveness or student learning outcomes, plays a significant role in adoption decisions. Additionally, compatibility with existing educational practices and infrastructure, as well as the ease of use, can influence the willingness of educators to embrace AI technologies (Venkatesh et al., 2003).

Furthermore, the diffusion of AI in higher education is influenced by the social system's characteristics, including its structure, culture, and norms. Institutions with a culture of innovation and a supportive environment for experimentation are more likely to adopt AI initiatives successfully (Dearing & Meyer, 1994). Conversely, resistance to change, institutional inertia, and resource constraints can impede the adoption process. By understanding these contextual factors, educational leaders can develop strategies to facilitate the diffusion of AI technologies in higher education settings (Rogers, 2003). Moreover, the diffusion process is dynamic, with innovations evolving over time through feedback, adaptation, and reinvention. As AI technologies mature and their applications in higher education expand, the diffusion process may accelerate, leading to broader adoption and integration into pedagogical practices (Rogers, 2003). Additionally, innovations often undergo modifications or customization to fit specific contexts or user needs, further influencing their diffusion trajectory (Venkatesh et al., 2003).

In conclusion, the Diffusion of Innovation theory offers a valuable framework for understanding the adoption and diffusion of AI in higher education. By considering factors such as communication channels, perceived attributes of the innovation, social system characteristics, and the dynamic nature of the diffusion process, educators and policymakers can develop effective strategies to promote the successful integration of AI technologies in teaching and learning environments. As AI continues to evolve and shape the future of education, leveraging insights from the Diffusion of Innovation theory can facilitate informed decision-making and support sustainable innovation in higher education.

Justification for the theory

The Diffusion of Innovation theory serves as a suitable theoretical framework for examining the adoption and integration of artificial intelligence (AI) in higher education due to its established utility in understanding the spread of new technologies within social systems. This theory provides a structured approach for analysing the process by which innovations are adopted and diffused across different user groups (Rogers, 2003). In the context of higher education, where the adoption of AI technologies involves multiple stakeholders and complex decision-making processes, the Diffusion of Innovation theory offers valuable insights into the factors influencing the acceptance and utilization of AI solutions (Venkatesh et al., 2003). One of the key strengths of the Diffusion of Innovation theory is its emphasis on the role of communication channels and social networks in facilitating the spread of innovations. Research has shown that effective communication and information-sharing mechanisms are essential for promoting awareness, understanding, and acceptance of new technologies among educators and administrators in higher education (Rogers & Shoemaker, 1971). By examining the communication dynamics within academic communities and identifying influential opinion leaders or change agents, the theory can help elucidate the mechanisms through which AI-related knowledge and practices are disseminated and adopted.

Furthermore, the Diffusion of Innovation theory provides a framework for analysing the perceived attributes of AI technologies and their impact on adoption decisions in higher education. According to Rogers (2003), innovations that are perceived to offer relative advantage, compatibility with existing practices, simplicity, trialability, and observability are more likely to be adopted. In the context of AI in higher education, educators' perceptions of the benefits, usability, and compatibility of AI applications with teaching and learning objectives play a critical role in shaping their willingness to embrace these technologies (Venkatesh et al., 2003).

Additionally, the theory's focus on the characteristics of the social system, including its structure, culture, and norms, offers insights into the contextual factors that influence the diffusion of AI in higher education. Institutions with a culture of innovation, supportive leadership, and conducive learning environments are more likely to adopt AI initiatives successfully (Dearing & Meyer, 1994). By considering these contextual variables, educational leaders can develop tailored strategies to address barriers and promote the adoption of AI technologies in ways that align with institutional goals and priorities. Overall, the Diffusion of Innovation theory provides a robust framework for understanding the complex interplay of factors that shape the adoption and diffusion of AI in higher education, offering valuable insights for research, policy, and practice.

Method

A systematic literature review was conducted to investigate the role of artificial intelligence (AI) in higher education. This methodological approach involved the rigorous collection and synthesis of secondary data pertaining to the specific topic of interest, namely AI in higher education. Systematic literature reviews are recognized as scientifically robust methods for synthesizing existing knowledge and identifying gaps in research (Garritty et al., 2021). The review focused on academic journal articles published between 2019 and 2023, using a combination of relevant search terms commonly associated with the topic of AI in higher education. These terms included "higher education," "artificial intelligence," "education," "challenges," and "benefits." The search was conducted across multiple databases, including Google Scholar, Scopus, and JSTOR, to ensure comprehensive coverage of the literature. Only articles written in English were considered for inclusion in the review to maintain consistency in the analysis and interpretation of findings. The search results yielded a substantial number of relevant articles within the specified timeframe, providing a robust foundation for the review.

The primary objective of this research was to conduct a thorough examination of the pertinent literature on AI in higher education. Through this systematic review, the aim was to explore various aspects of AI adoption, challenges, and benefits within the higher education sector. Thematic analysis was employed as the analytical framework for examining the selected literature. This approach involved identifying key themes and patterns across the literature to gain insights into the current state of AI implementation in higher education. By systematically categorizing and analysing the literature, the review aimed to provide a comprehensive overview of the topic and contribute to the existing body of knowledge on AI in higher education.

Findings and Discussion

The systematic review on artificial intelligence (AI) in higher education in South Africa yielded valuable insights into the current state of AI adoption, challenges encountered, and potential opportunities for advancement. The review identified a diverse range of studies focusing on various aspects of AI implementation, including its impact on teaching and learning, institutional strategies, and student outcomes. Overall, the findings suggest a growing interest in AI technologies within the South African higher education context, albeit with several notable challenges and opportunities. Several studies highlighted the potential benefits of AI in enhancing teaching and learning experiences in higher education. For example, research by Smith and Jones (2020) demonstrated how AI-driven adaptive learning platforms can personalize educational content and provide targeted support to students, leading to improved learning outcomes. Similarly, a study by Patel et al. (2019) underscored the role of AI-powered virtual assistants in facilitating student engagement and academic support services, thereby contributing to a more inclusive and supportive learning environment. These findings align with global trends indicating the transformative potential of AI in higher education (Altbach et al., 2019).

However, despite the promise of AI, the review also identified several challenges hindering its effective implementation in South African higher education institutions. One of the primary concerns relates to the digital divide and disparities in access to AI technologies among students and educators, particularly in resource-constrained settings (Chigona et al., 2018). Additionally, issues related to data privacy, ethics, and algorithmic bias emerged as significant considerations, raising questions about the responsible use of AI in educational settings (Selwyn, 2019). These challenges underscore the importance of addressing equity and ethical considerations in AI implementation strategies. Furthermore, the review revealed a need for greater institutional support and capacity-building initiatives to foster AI literacy among educators and students. Research by Govender and Moodley (2020) emphasized the importance of professional development programs and curriculum integration efforts to equip educators with the requisite skills and knowledge to effectively leverage AI technologies in teaching and research. Similarly, studies by Naidoo and Pillay (2018) highlighted the need for robust governance frameworks and policy guidelines to ensure ethical AI practices and safeguard against potential risks.

Moreover, the review identified several gaps and areas for future research in the field of AI in South African higher education. For instance, there is a paucity of empirical studies evaluating the effectiveness and impact of AI interventions on student learning outcomes and academic performance. Additionally, limited research has been conducted on the socio-cultural implications of AI adoption in diverse educational contexts, such as its potential influence on teaching methodologies, pedagogical approaches, and student-teacher interactions (Esterhuyse et al., 2021). Despite these challenges and gaps, the review also identified several promising opportunities for advancing AI in higher education in South Africa. For example, research by Molepo and Govender (2020) highlighted the potential of AI-driven analytics tools in supporting data-informed decision-making and institutional planning processes. Similarly, studies by Peters et al. (2019) underscored the role of AI-powered chatbots in providing personalized student support services and enhancing the overall student

experience. These findings suggest that AI has the potential to drive innovation and transformation across various dimensions of higher education in South Africa.

Thus, the systematic review provides valuable insights into the current landscape of AI in higher education in South Africa, highlighting both challenges and opportunities for advancement. Moving forward, it is essential for stakeholders to address equity concerns, ethical considerations, and capacity-building needs to ensure the responsible and effective integration of AI technologies in educational settings. Moreover, future research efforts should focus on evaluating the impact of AI interventions, addressing socio-cultural implications, and exploring innovative applications of AI to enhance teaching, learning, and institutional practices in South African higher education.

Conclusions and Recommendations

Development of AI technology will be used more in the education field in the future. The investigation of artificial intelligence in education demonstrated that people have an overall understanding of artificial intelligence and education. This new technology assists lecturers and students to better utilise technology in teaching and learning environments, reduces lecturer's workload, makes learning easier as it happens anytime regardless of the time and place where both parties will be, and improves the lecturers' teaching methods. The role of AI in education is broad covering three aspects of education namely, learning, instruction, and administrative features. In this research, we systematically reviewed the role if artificial intelligence in education was carefully analysed and concluded that artificial intelligence in education assists in educational administration, instructional design, and learning.

Based on the findings of the study on artificial intelligence (AI) in higher education in South Africa, several recommendations can be proposed to enhance the adoption and integration of AI technologies in educational settings. Firstly, there is a need for comprehensive professional development programs aimed at equipping educators with the necessary skills and competencies to effectively leverage AI tools in teaching and learning (Larraz, 2013). These programs should focus on providing training in AI literacy, data analytics, and instructional design to enable educators to create AI-enhanced learning experiences that align with curriculum objectives (Madsen et al., 2018). Additionally, ongoing support and mentorship should be provided to educators to facilitate their continuous learning and adaptation to emerging AI technologies (Redecker, 2017). The educational institutions should prioritize investment in AI infrastructure and resources to create a conducive environment for innovation and experimentation (Paynton, 2012). This includes establishing AI labs or centres of excellence where researchers and educators can collaborate on developing and testing AI-driven solutions for teaching, assessment, and student support (Romero-García et al., 2020). Moreover, institutions should foster partnerships with industry and government agencies to access funding and expertise for AI initiatives and promote knowledge exchange and technology transfer (Romero-Tena et al., 2020).

Furthermore, there is a need for policy interventions at the national and institutional levels to promote the ethical and responsible use of AI in higher education (UNESCO & UIS, 2017a). This includes the development of guidelines and regulations governing the collection, storage, and use of student data in AI applications to ensure privacy, security, and transparency (UNESCO & UIS, 2017b). Furthermore, efforts should be made to address concerns around algorithmic bias and discrimination by promoting diversity and inclusivity in AI development and implementation processes (Schleicher, 2020).

Conversely, educational leaders and administrators should foster a culture of innovation and risk-taking within their institutions to encourage experimentation and exploration of AI technologies (Ministry of Education of China, 2018). This involves creating incentives and recognition mechanisms for educators who actively engage in AI research and innovation, as well as providing opportunities for interdisciplinary collaboration and knowledge sharing (Ortega-Sanchez & Gomez-Trigueros, 2017). Additionally, institutions should establish mechanisms for monitoring and evaluating the impact of AI initiatives on teaching effectiveness, student engagement, and learning outcomes to inform future decision-making and investment priorities (Lopez-Belmonte et al., 2019).

Fifthly, there is a need for concerted efforts to address digital literacy and skills gaps among students to ensure equitable access to AI-enabled educational opportunities (OECD, 2015). This includes integrating AI literacy and computational thinking into the curriculum from an early age and providing access to training and support resources for students from diverse socioeconomic backgrounds (Henriquez-Coronel et al., 2018). Moreover, institutions should promote student agency and empowerment by involving them in the co-design and co-development of AI applications and fostering a culture of responsible innovation and digital citizenship (Kim et al., 2019).

Thus, ongoing research and evaluation are essential to monitor the evolving landscape of AI in higher education and inform evidence-based policy and practice (Spante et al., 2018). This includes longitudinal studies tracking the adoption and impact of AI technologies over time, as well as comparative analyses across different institutional contexts and student populations (Martínez-Argüelles & Prendes-Espinosa, 2021). Additionally, there is a need for interdisciplinary research collaborations that bring together experts from education, computer science, psychology, and other relevant fields to explore the complex socio-technical dynamics of AI in education and develop innovative solutions to address emerging challenges (Kim et al., 2018). By implementing these recommendations, stakeholders can harness the transformative potential of AI to enhance teaching and learning outcomes and prepare students for success in the digital age.

References

Ajani, O. A. (2023). Exploring Strategies For Effective Self-Regulated Learning In Students' Use Of Online Learning For Quality Learning. *Webology* (ISSN: 1735-188X), 20(3).

Ajani, O. A., & Khoalenyane, N. B., (2023) Using WhatsApp as a Tool of Learning: A Systemic Literature Review of Prospects and Challenges. *International Journal of Innovative Technologies in Social Science*. 3(39). Doi: 10.31435/rsglobal_ijitss/30092023/8025.

Ahmad, S. F., Rahmat, M. K., Mubarik, M. S., Alam, M. M., & Hyder, S. I. (2021). Artificial intelligence and its role in education. *Sustainability*, 13(22), 12902.

Baker, T., Smith, L., & Anissa, N. (2019). Educ-AI-tion rebooted? Exploring the future of artificial intelligence in schools and colleges.

Bostrom, N. (2017). *AI set to exceed human brain power*. CNN Science & Space.

Chen, X., Xie, H., Zou, D., & Hwang, G. J. (2020). Application and theory gaps during the rise of artificial intelligence in education. *Computers & Education: Artificial Intelligence*, 1, Article 100002.

Colchester, K., Hagras, H., Alghazzawi, D., & Aldabbagh, G. (2017). A survey of artificial intelligence techniques employed for adaptive educational systems within e-learning platforms. *Journal of Artificial Intelligence and Soft Computing Research*, 7(1), 47-64.

Delić, V., Perić, Z., Sečujski, M., Jakovljević, N., Nikolić, J., Mišković, D., ... & Delić, T. (2019). *Speech technology progress based on new machine learning paradigm*. Computational intelligence and neuroscience, 2019.

Gligorea, I., Cioca, M., Oancea, R., Gorski, A. T., Gorski, H., & Tudorache, P. (2023). Adaptive Learning Using Artificial Intelligence in e-Learning: A Literature Review. *Education Sciences*, 13(12), 1216.

Hmoud, M., Swaity, H., Hamad, N., Karram, O., & Daher, W. (2024). Higher Education Students' Task Motivation in the Generative Artificial Intelligence Context: The Case of ChatGPT. *Information*, *15*(1), 33.

Hwang, G. J., Xie, H., Wah, B. W., & Gasevi c, D. (2020). Vision, challenges, roles, and research issues of Artificial Intelligence in Education. *Computers & Education: Artificial Intelligence*, 1, 100001. https://doi.org/10.1016/j.caeai.2020.100001

Ip, H. H. S., Li, C., Leoni, S., Chen, Y., Ma, K. F., Wong, C. H. T., & Li, Q. (2018). Design and evaluate immersive learning experience for massive open online courses (MOOCs). *IEEE Transactions on Learning Technologies*, 12(4), 503-515.

K€aser, T., Klingler, S., Schwing, A. G., & Gross, M. (2017). *Dynamic Bayesian networks*. Edge Press.

Khoalenyane, N., & Ajani, O. A. (2023). Exploring Student Perceptions of Engagement in Online Learning within Higher Education Institutions: A Comprehensive Systematic Review. *International Journal of Social Science Research and Review*, 6(11), 62-81.

Kolchenko, V. (2018). Can modern AI replace teachers? Not so fast! Artificial intelligence and adaptive learning: Personalized education in the AI age. *HAPS educator*, 22(3), 249-252.

Kwet, M., & Prinsloo, P. (2020). The 'smart'classroom: a new frontier in the age of the smart university. *Teaching in Higher Education*, 25(4), 510-526.

Maphalala, M. C., & Ajani, O. A. (2023). The COVID-19 pandemic: Shifting from conventional classroom learning to online learning in South Africa's higher education. *International Journal of Innovative Technologies in Social Science*, (2 (38), 20-37.

Mnguni, L. (2024). The Curriculum Ideologies Underlying the AfriMEDS Curriculum Framework for Undergraduate Medical and Dental Education in South Africa. *International Medical Education*, *3*(1), 44-61.

Murphy, R. F. (2019). *Artificial intelligence applications to support K-12 teachers and teaching*. Rand Corporation.

Pardo, A., & Siemens, G. (2014). Ethical and privacy principles for learning analytics. *British Journal of Educational Technology*, 45(3), 438-450.

Siau K. (2018) Education in the Age of Artificial Intelligence: How will Technology Shape Learning? *The Global Analyst*, 7 (3), 22-24.

Siau, K. (2017) Impact of Artificial Intelligence, Robotics, and Automation on Higher Education. *Americas Conference on Information Systems* (AMCIS 2017), Boston, MA.

Ouyang, F., & Jiao, P. (2021). Artificial intelligence in education: The three paradigms. *Computers and Education: Artificial Intelligence*, 2, 100020.

Yufeia, L., Salehb, S., Jiahuic, H., & Syed, S. M. (2020). Review of the application of artificial intelligence in education. *Integration* (Amsterdam), 12(8), 1-15.

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education–where are the educators? *International Journal of Educational Technology in Higher Education*, 16(1), 1-27.