

Investigating Effective Ways to Use Artificial Intelligence in Teacher Education

Nyarai Tunjera and Agnes Chigona

Cape Peninsula University of Technology. South Africa

tunjera@cput.ac.za

chigonaa@cput.ac.za

Abstract: The current advancements in natural language processing (NLP) have paved the way for the development of highly effective AI-powered language models. These models can produce human-like writing, making them valuable in various domains, including education. Given the importance of preparing pre-service teachers who can effectively facilitate student learning in the ever-evolving digital landscape, it becomes crucial to explore innovative approaches. This study focuses on investigating the potential integration of ChatGPT, an NLP model, in teacher training programs. The qualitative research involved 2nd and 3rd-year pre-service teachers enrolled in ICTs in the Education curriculum. Data collection was done through a questionnaire and class discussions to gain insights into the pre-service teachers' experiences with using ChatGPT. The findings shed light on the potential strategies for leveraging ChatGPT to enhance lesson planning and classroom activities, as it generates text that closely resembles human communication and exhibits independent learning capabilities. Implementing ChatGPT in teacher training programs holds promise for empowering pre-service instructors in creating engaging educational materials.

Key Words: Artificial Intelligent, ChatGPT, Teacher preparation education, Personalised Learning, Marginalised Communities, AI applications, mobile learning, teacher beliefs

1. Introduction

South Africa's education system has a history of unequal distribution of educational resources, with particular communities being disadvantaged owing to their colour, ethnicity, and socioeconomic condition. Inequality and marginalization have long-term consequences, resulting in limited access to quality education and prospects for social mobility. The education system in the country is still battling with these issues, which have contributed to poor academic achievements and high dropout rates, particularly in marginalised communities. However, researchers believe that incorporating emerging technologies such as AI into teacher preparation education has the potential to improve equal access to quality education (Crompton & Burke, 2022; Jaiswal & Arun, 2021), regardless of background, socioeconomic status, race, gender, or any other characteristics within South African marginalised communities (Chen et al., 2020).

While the use of AI in education has enormous potential, it is not without problems. One of the major issues is bridging the digital divide in South Africa's marginalised areas. There are fears that the use of AI-based education methods may exacerbate the divide between those who have access to technology and those who do not. Furthermore, teachers and students may lack the necessary expertise and resources to effectively employ AI-based technology, which may impede their adoption. Additionally, cultural context, local requirements, and ethical considerations must be considered. As a result, engagement with community people, local educator participation, and addressing potential biases or discrimination in AI systems are crucial to ensuring that AI technologies serve and empower students in marginalised communities while fostering fairness and inclusivity in education.

To emancipate the above dilemma the study's main research problem is the effective implementation of AI in teacher preparation institutions in South African marginalised communities. The study seeks to answer the following research question:

What strategies be employed to effectively implement AI in teacher preparation education in South African marginalised communities?

2. Literature Review

The use of NLP and AI in pre-service teacher education, particularly in marginalized environments, has received relatively little investigation. We may now explore the significance of looking at potential NLP and AI applications for assisting pre-service teachers in marginalized contexts after acknowledging this gap in the research. By filling this study gap, we can learn important lessons about how these technologies might be used to improve support for educators and training in inadequately funded educational contexts.

2.1 Artificial Intelligence (AI)

AI is a branch of computer science concerned with developing intelligent computers capable of perceiving and comprehending their surroundings, learning from experiences, reasoning, making decisions, and interacting with humans in a manner resembling human intelligence (Hwang & Chang, 2021). It includes machine learning, natural language processing, computer vision, and robotics, to develop systems capable of doing difficult tasks that traditionally require human cognitive abilities (Hwang & Chang, 2021). While tremendous progress has been made, the pursuit of artificial general intelligence, in which robots may demonstrate human-level ability across multiple domains, remains an ongoing effort in the field of AI.

The application of AI in education is outlined in this paper as a technique to improve and revolutionise the teaching and learning process (Jean-Claude, 2022). To evaluate data, personalise learning experiences, provide meaningful feedback, and support educational decision-making, AI tools, and algorithms are used. AI, according to Crompton and Burke (2022), AI helps overcome difficulties faced by learners and educators. It generates personalised and flexible learning environments, resulting in improved learning results. Furthermore, by offering online platforms and digital materials, AI bridges the educational gap in rural or disadvantaged places, increasing access to excellent education in areas with few teachers and resources.

2.2 AI in Education

The use of AI in education is gaining popularity worldwide due to its potential to improve the equality and quality of education provided to learners. AI is used to create personalised learning experiences for learners, assess student performance, and support teachers in identifying areas where learners need additional support.

3. Improve Learning Outcome

Improving learning outcomes refers to increasing the overall efficacy and quality of the learning process as well as student outcomes. It entails putting techniques, approaches, and resources in place to improve students' comprehension, retention, and application of knowledge and skills. In this study, AI is employed as a tool to aid in the acquisition and retention of knowledge and skills in marginalised populations.

Chen et al. (2023) revealed the affordances of AI on student increased engagement and learning outcomes specifically for those experiencing resource constraints. Using AI, the system was able to analyse student performance data, determine individual strengths and weaknesses, and make personalised suggestions and interventions. Students were able to acquire specific advice in their weakest academic areas with the help of this adaptive technique, overcoming hurdles to learning and increasing it. This implies the use of an AI system provided students with a personalised learning environment, which most likely contributed to improved learning outcomes.

While the higher engagement suggests that students were more actively interested and motivated in the learning process, the improved learning outcomes imply that students attained greater academic performance. These observations are consistent with the potential advantages of AI in education, which allows for personalised learning experiences and offers each student with specialised support. It shows how AI effectively meet the various demands of students, including those who might need extra help, ultimately resulting in improved learning outcomes.

Intelligent tutoring systems (ITS) is an AI application in education that provides self-paced learning giving instant feedback to students. King et al. (2021) utilised an ITS to help students learn mathematics and reported that the AI technique improved students' learning outcomes as well as their attitudes toward mathematics. Students who used the ITS performed better on tests than those who did not, demonstrating that AI is a useful tool for enhancing students' learning. Therefore, implies an AI-based ITS has a positive impact on student's performance in learning abstract concepts.

Chatbots and virtual assistants are also being investigated as ways to instantly provide students with real-time responses to their questions. Hwang, and Chang (2021) created a chatbot to assist students in a computer science course. The researchers observed chatbot assisted students understand course material as it tailored feedback and support to individual needs. The researchers concluded that chatbots are beneficial in providing students with personalised guidance and resources, hence improving their learning outcomes and sense of satisfaction with the educational process.

4. Personalised Learning

Personalised learning is an educational approach that designs learning experiences to individual student's unique needs, interests, skills, and preferences. AI technologies and personalised learning experiences be extended to students in marginalised communities, ensuring that they receive an education that meets their unique needs and maximises their potential. Hence, AI's personalised approach has the potential to address educational disparities, improve outcomes, and empower students in marginalised communities to achieve academic success. Zhai, Chu, Chai, et al. (2021) examined the potential of AI in education in a review article, emphasising its capacity to offer individualised and adaptable learning experiences as well as its potential to assist teachers in their duties. The authors also discussed the hurdles of integrating AI, such as data privacy concerns and the necessity for teacher training and support. Similarly to this, Kasneci et al. (2023) investigated the difficulties of integrating AI in education in Nigeria and emphasised the demand for laws and procedures that promote the moral and responsible use of AI as well as for teacher assistance and training.

5. Personalisation of Content

Personalisation of content AI uses students' profiles, and performance data to develop or suggest educational materials that are tailored to students' specific needs. These platforms use algorithms to analyse data from patterns on what content students search for, and cultural references (UNESCO, 2019). This helps students to connect with knowledge that is relevant to their backgrounds and experiences, making learning more relevant and meaningful. AI-personalised educational content delivers instruction that is personalised to each student's learning needs using its AI algorithm. The intelligent tutoring system (ITS) entails tailoring the material, difficulty level, or delivery manner to their abilities and learning preferences (King *et al.*, 2021; Laine *et al.*, 2022; Hu, Fu and Yeh, 2023). As a result, students are allowed to progress through the material at their own pace.

Ouyang et al. (2023) discovered that student engagement and satisfaction with the instructional materials dramatically rose when recommendations from AI platforms considered the students' preferences, interests, and cultural backgrounds. AI improves students' learning experiences, increase engagement, and fosters a sense of inclusivity by modifying the educational content to the unique requirements and histories of each student context. Students get more emotionally invested in the lessons, which improves their motivation, understanding, and memory of the information. This specialised strategy results in better learning outcomes raised student satisfaction, and promoted a more welcoming learning atmosphere (Hu, Fu and Yeh, 2023). Though AI has enormous promise for creating and proposing personalised educational content, ethical issues need to be considered. Appropriate use of AI and caution must be taken to prevent reinforcing preconceptions, protect student privacy, and maintain transparency in the underlying algorithmic processes.

These AI-assisted personalised learning resources have the potential to address educational disparities, improve outcomes, and empower students in marginalised communities to achieve academic success. By acknowledging and accommodating the specific needs of each student, personalised learning provides a more equitable and inclusive education system that benefits all learners. In light of inclusivity, ITS offer innovative approaches to evaluating students using their current progress. By exploring the capabilities of AI in assessment, we can uncover the potential benefits and alleviate the concerns associated with traditional standardized assessments.

6. Enhanced Assessment

Machine learning techniques and natural language processing are used by AI-based assessment systems to gauge student achievement. In their research, Huang et al. (2023) demonstrate how this has the potential to revolutionise educational evaluation practices by providing more precise and impartial measurements of student performance. Prejudice, consistency problems, and grading errors are less likely to occur when machine learning, and natural language processing techniques are used. It is also crucial to remember that automated grading ensures that every student receives a consistent and fair rating in addition to saving teachers' time. This increases the validity of tests and gives a more precise indication of students' development.

AI systems give students fast, thorough feedback on their academic achievement, highlighting both their strong points and their needs for development (Kuleto et al., 2021). Use of this knowledge, pupils are better able to recognise their errors and correct them. Researchers found that tracking progress, alters students study habits, and eventually enhancing performance, thereby help students stay in school longer (Jaiswal and Arun, 2021; Li and Xing, 2021; Chen *et al.*, 2023). Students adapt their learning tactics in real-time, correct misconceptions, and enhance their performance by using AI to deliver immediate feedback (Chen *et al.*, 2023). Personalized learning

experiences powered by AI encourage students' ongoing progress as it provides immediate feedback loop, leading to more efficient and tailored learning opportunities.

7. Analysis Insights

In instances where manual grading is unfeasible owing to time constraints or a large number of students, AI-powered assessment systems may easily manage enormous amounts of evaluations, making them very scalable and perfect (Jaiswal & Arun, 2021). AI technologies free up teachers to concentrate on other elements of instruction and provide students with more individualized attention by managing enormous numbers of input. Additionally, AI develops clever insights from evaluation data to assist educators in comprehending student performance, learning trends, and places for improvement. Teachers use this data to tailor their instruction to the unique needs of each student, resulting in a more successful and personalized learning process. 4 Additionally, AI-based evaluation systems offer data-driven reports and visualizations that give teachers comprehensive analyses of their students' performance and informing sound educational decisions. The ability of AI to identify data patterns that human evaluators may not see right away allows educators to identify areas where their teaching practices or curriculum may need modification.

While AI-based evaluation techniques offer many benefits, it is essential to balance automation with human engagement. Educators are still crucial when it comes to creating tests, establishing criteria, and analysing outcomes. Collaborating between AI systems and human expertise results in the creation of evaluation methods that are both reliable and efficient. Educational institutions increase the efficacy, objectivity, and reliability of evaluations by utilizing AI to improve assessment methodologies. This will ultimately give students a more accurate assessment of their progress and encourage continual learning.

8. Remedial Support

Remedial support is crucial in education as it provides students with the necessary tools to understand and master complex concepts. Every student has individual strengths and limitations, learning styles, and motivations, which means that one-size-fits-all solutions may not be effective for all students. Therefore, tailored remedial teaching is critical to ensuring that every student realises their full potential. Researchers posit that AI helps design personalise and modify learning experiences to suit individual students' needs, by analysing their performance, identifying areas of weakness, offering tailored solutions, and helping them catch up if they fall behind (Kuleto *et al.*, 2021).

Merging AI and remedial support offers a powerful force that transforms education and helps students reach their full potential. With the advancement of technology and the increasing demand for personalised education, AI-assisted remedial support marginalised communities where learning resources are scarce. Proponents of the use of AI in education argue for its potential to significantly assist disenfranchised South African populations (Mbunge *et al.*, 2021; İçen, 2022). According to Jaiswal and Arun (2021) AI-assisted remedial support help to improve access to education for marginalised communities by providing educational resources and support to learners who may not have access to traditional educational resources.

AI-powered remedial support applications and platforms are used to provide educational materials to learners in remote areas or those who are unable to attend traditional schools. This help to increase access to education and reduce educational inequalities. The South African education adapting of AI-assisted intervention helps to address the challenges of low literacy rates in the majority of under-resourced schools and provides a more equitable and effective educational experience for all learners.

8.1 Challenges of using AI in education

While there are numerous potential benefits to using AI in education in South African marginalised communities, there are also several challenges that must be addressed. These challenges include issues related to access to technology, data privacy concerns, and the potential for exacerbating existing educational inequalities.

9. Access to AI infrastructure

The implementation of AI in education presents considerable challenges, especially in marginalised communities. Access to reliable internet connectivity, digital devices, and infrastructure is crucial for the successful functioning of AI technologies (Jaiswal and Arun, 2021). Unfortunately, many students from marginalised communities lack access to such resources, which widens the digital divide and fuels educational

inequalities (Huang *et al.*, 2023; Hwang & Chien, 2022). Consequently, personalised learning experiences, targeted interventions, and the benefits of AI-enabled education may not be accessible to these students. The inadequate infrastructure and resources in marginalised communities further limit the potential benefits of AI.

The use of AI in education may exacerbate existing educational inequalities. In some cases, the implementation of AI-powered educational systems may require significant investment in technology and infrastructure, which may be out of reach for some schools in marginalised communities (Laine *et al.*, 2022). This leads further to a digital divide, where some students have access to cutting-edge educational technology while others do not. It is important to ensure that the implementation of AI in education does not further entrench educational inequalities but rather serves as a tool to reduce them.

Advancing equal access to AI infrastructure, efforts such as supplying devices, internet access, and preservice teacher training are required to ensure that all students be exposed to AI-based educational solutions (UNESCO, 2019). This requires collaborative efforts between governments, non-profit organizations, and private companies undertaking to ensure that all students have equal access to AI-based education solutions, thereby creating an education system that is equitable and beneficial to all students (UNESCO, 2019).

10. Lack of skilled trained Educators

The successful implementation of technology-enhanced learning is hindered by a shortage of technologically skilled teachers. Jaiswal and Arun (2021) posit that to effectively integrate AI technologies into their teaching practices, educators need to have the necessary skills and expertise in integrating emerging technologies. Many teachers lack the technical proficiency and training required to leverage AI tools effectively in the classroom (Zhang and Aslan, 2021). This skills gap limits the potential benefits of AI in enhancing learning outcomes and personalising education experiences for students.

Addressing this challenge requires investing in teacher training programs that focus on building both technological and pedagogical skills among preservice teachers (Scaradozzi *et al.*, 2019). Encouraging collaboration between educators and educational technology experts also helps to ensure the effective and equitable integration of AI in education (Kasneci *et al.*, 2023). Providing teachers with access to necessary hardware and software resources is another critical step towards the successful use of AI in schools.

Importantly, there is a need to encourage collaboration between educators and technology experts also help to address this challenge and ensure effective and equitable integration of AI in education. Furthermore, there is a need to train technology educators who would help realise effective technology-enhanced education. Transforming teacher preparation education in line with the current technology-driven economies is essential for creating a successful AI-based education system, typically in South African marginalised communities.

10.1 Ethical issues

The integration of AI into education raises ethical and privacy concerns that require careful consideration. One major concern is the collection and use of student data. The use of AI in education requires the collection of large amounts of data, including personal information, which may be sensitive and confidential. This raises concerns about how this data will be used, who will have access to it, and how it will be protected from misuse (Gao *et al.*, 2022). Another concern is algorithmic transparency, especially in decision-making processes. Decisions by AI algorithms, such as personalised recommendations or assessments, should be transparent and explainable to ensure accountability and avoid unjust outcomes (Mbunge *et al.*, 2021). This is particularly important since AI algorithms may reflect biases and perpetuate existing inequalities if not monitored.

Additionally, there are ethical concerns related to student privacy and data security. The collection and analysis of student data raise privacy concerns, particularly when it comes to sensitive student information. It is essential to develop robust ethical frameworks and guidelines for AI in education to safeguard student rights and ensure equitable treatment (Chen *et al.*, 2023). All stakeholders involved in the collection, storage, and analysis of student data must be aware of their responsibilities in protecting student privacy and ensuring data security.

11. Methodology

11.1 Research design

In the study, a qualitative methodology was utilised, which involved utilizing in-depth techniques such as questionnaires and class discussions to gather information from preservice teachers who belong to marginalised communities in South Africa.

11.1.1 Data Collection Methods

To gain a deeper understanding of preservice teachers' experiences with AI in the lesson planning activity, a survey and class discussions were conducted (Maxwell, 2013). The survey link was disseminated to 2nd and 3rd-year intermediate phase preservice teachers enrolled in an ICT in Education course with evaluative and reflective questions after their AI-generated lesson plan. The survey and class discussions were created to gather participants' perceptions, experiences, and attitudes regarding the use of AI in education. During these discussions, participants provided detailed narratives, insights, and thoughts about their encounters with AI technologies, including perceived advantages or disadvantages, and any modifications they noticed in their teaching or learning methods.

The results of the Likert scale survey were complemented by the rich qualitative data that was revealed during open-ended conversations in class. Combining these methods of data collecting made it possible to fully comprehend how preservice instructors have used AI in teaching and learning. Discussion analysis gave a more comprehensive grasp of preservice teachers' perspectives while also giving a wider view of AI in education as a whole. The participants were chosen through a purposeful sampling process from a South African teacher preparation program that educates educators from underserved communities. Based on their participation in the course preparation exercise and their prior AI experiences, participants were chosen.

11.1.2 Data Analysis Techniques

11.1.3 The study used a combination of questionnaires and class discussions to get insight into how pre-service teachers perceive and interact with AI in teacher preparation programs. The acquired data were analyzed using a qualitative content analysis method, which entailed detecting reoccurring themes and patterns in the data (Maxwell, 2013).

Using a systematic coding approach and carefully analysing the data, the researchers hoped to uncover noteworthy findings and contribute knowledge that could shape future policies and processes. The qualitative content analysis technique allowed for a more in-depth assessment of educators' experiences with AI, as well as the identification of significant themes pertinent to the study's aims (Babbie, 2013).

12. Results and Discussion

The sample population for this study consisted of 2nd and 3rd-year intermediate phase pre-service teachers from marginalised communities in South Africa who are enrolled in teacher preparation education. The focus was on educators from communities that historically faced economic and social disadvantages, such as low-income neighbourhoods and rural areas. The sample size was determined by volunteering participants. Triangulation was used to validate the findings of the study by using multiple sources of data to corroborate the results. The survey data was triangulated with classroom discussion data to provide an effusive and more complete understanding of the experiences of preservice teachers. While research specifically focused on the implementation of AI in teacher preparation education in South African marginalised communities is limited, some studies have shed light on the potential benefits and challenges associated with such implementation (Crompton and Burke, 2022).

13. The Affordances of AI in Education

The participating preservice teachers made some inferences on the advantages and disadvantages of AI in education. They realised that educators should embrace and incorporate AI to enhance their teaching and learning. The preservice teachers emphasised the necessity of emphasising personal skills such as critical thinking, creativity, collaboration, and ability to communicate (4Cs) in teacher preparation education as the study revealed that content is accessible using AI. The majority of preservice teachers stressed the significance of accepting change and adjusting to it to make learning relevant to modern-day digital trends.

13.1 Use of a smarter search engine

During class discussions, preservice teachers reveal the potential of AI as a smart search engine that provides more accurate and relevant search results. Thereby improving the efficiency and effectiveness of information discovery for students and educators.

Google gave us a lot of links, but AI retrieves relevant information about the search

This study's finding demonstrates how AI revolutionise education by acting as a smart search engine and giving students access to effective and individualised information retrieval tools.

1. Generate teaching and learning content, lesson plans, assessments

This study's lesson design exercise helped students understand the potential and limitations of AI in teaching and learning. The participants remarked that the ChatGPT lesson plan was a general lesson plan that requires the teacher to contextualise to their specific class settings. However, the content and assessment generated by AI were very relevant and made it easy for Educators to have a starting from and add their style.

*It was an exciting activity of having ChatGPT generate a lesson plan, ... ChatGPT was a general plan and I had to add more specific notes and improvements... at least I had somewhere to start from. ... the objectives for my lesson plan were similar to the ones we have in our CAPS subject guide... I agree with *** the context matters most in our teaching plans...*

The majority of preservice teachers echoed the aforementioned viewpoints, indicating that educators not simply replicate existing practices but must adapt and grow to meet the needs of their students. However, they emphasised the importance of not spending excessive time on content research but rather exploring innovative approaches to create a stimulating and captivating learning environment that accommodates diverse learning styles.

ChatGPT was able to apply known context-specific knowledge, according to one participating preservice teacher, when we used location and grade in constructing lesson plans.

I listed the grade level and location on my lesson plan. ChatGPT was able to provide content examples that were relevant to our situation... I simply need to take my class out particularly to emphasise and relate to the material...

This observation is consistent with earlier research that shows AI develop innovative and engaging content that meets the different demands of learners (Crompton and Burke, 2022).

2. AI and the use of portable technologies

AI and the utilization of portable technologies have emerged as transformative tools in the field of teaching. Crompton and Burke (2022) educators create dynamic and impactful learning environments that cater to the diverse needs of students.

Using my smartphone in this project made me remain active as I use the ChatGPT app and MS Word helped me engage in our project team...

The assertion draws attention to the advantages of using smartphones and particular applications to actively engage in project teamwork. The person was able to stay involved and make a valuable contribution to the project by using the ChatGPT app and MS Word on their smartphone. This highlights how portable technology may facilitate cooperation and production regardless of location because of its simplicity and adaptability. Utilizing mobile apps and productivity tools improve collaboration, document sharing, and project management as a whole, encouraging effective teamwork and involvement.

3. Equal access to infrastructure

In this study, preservice participants emphasised the potential of AI to provide teaching and learning tools to underserved regions. Ninety per cent of the participants emphasised the value of equal access to educational resources, something that AI might help with. However, ten per cent of respondents were sceptical of a viable and comprehensive equity plan in light of the infrastructure inequality in the majority of marginalised communities, particularly the primarily black African population.

Deng et al. (2023), posit that a good infrastructure fosters ongoing professional development, assisting preservice teachers in expanding their expertise, implementing cutting-edge pedagogies, and successfully

integrating AI tools into their lesson plans. This suggests investing in the right technology infrastructure as well as enhancing physical infrastructure and internet connectivity. South Africa can offer equitable infrastructure to establish an egalitarian educational system. Cooperation between governmental organizations, academic institutions, and commercial enterprises is required to close the infrastructure gap.

The application of AI should not make previously existing inequalities worse among marginalised communities, which already experience gaps in educational possibilities. The requirements and circumstances of these communities must be taken into consideration to make sure that AI technologies are available, reasonably priced, and culturally sensitive. The participating preservice Educators highlighted the importance of a 'needs assessment' in line with educational technology,

I am tired of being exposed to technologies that do not work in our communities, however, the approach used in this course helped me to see the opportunities AI have for my academic and future teaching work, however, the one size fits all approach used is wrong, and my thinking...

A participating preservice teacher echoed the aforementioned viewpoint, demonstrating the necessity of a "Needs Assessment" strategy to successfully adopt AI in informal communities. What technologies work best for them and the most effective ways to implement these technologies? Everyone has a cell phone, as demonstrated by the preservice teachers' use of them during study activities.

... we used a mobile phone, I do not have a personal laptop, in this exercise, my mobile phone became my tool to access the AI resources.

This approach recognises and builds upon the strengths and resources already present within the community, empowering learners and promoting educational success. AI resources reduce the dependency on costly resources and expand the availability of quality educational resources.

4. Utilization of available mobile technology

An effective way to address educational issues and improve access to high-quality education in underrepresented groups is to make use of already-existing technologies. Leveraging the resources and technologies already present in these communities might result in significant and long-lasting benefits instead of just concentrating on introducing new technologies.

The majority of preservice teachers who took part in the project, if not all of them, had access to or owned a smartphone. This is in line with Chen et al. (2023) who observed that mobile phone usage is rising among underprivileged groups in places with poor infrastructure. Mobile devices are useful tools for distributing educational content, gaining access to learning resources and enhancing parent-child and teacher-student communication. Mobile technology be used to close the digital divide and guarantee equal access to education.

13.2 Challenges and Concerns about Using AI in Teaching

The potential for improving teaching and learning processes through AI integration in education is enormous. But it is crucial to handle the problems and worries that come with it. One of the primary concerns with AI integration in education is the collection and analysis of large volumes of student data (Kasneci *et al.*, 2023). Educational institutions are obliged to implement stringent data protection measures to safeguard student information and comply with relevant data protection regulations. It is essential to address concerns regarding data privacy, algorithmic transparency, and the potential for unintended consequences to ensure the ethical implementation of AI technologies.

While AI can assist with administrative tasks, personalization, and data analysis, it cannot replace the essential human elements of teaching, such as building relationships, providing emotional support, and promoting critical thinking skills (Kasneci *et al.*, 2023). This calls for educators, policymakers, and all stakeholders to collaborate to create strategies and guidelines that support responsible and efficient integration of AI in education by concentrating on data privacy and security, equitable access, bias and fairness, teacher roles and professional development, ethical considerations, and technological limitations. By doing this, educators maximize the advantages of AI while maintaining fairness, equality, and moral application to enhance student learning results.

14. Conclusion

This study investigated the effective use of AI in teacher preparation education for marginalised communities in the South African context. The findings show the potential benefits of AI in addressing current educational

challenges faced by students from marginalised communities in South Africa. The findings revealed that preservice teachers were able to access educational resources regardless of their physical location. However, challenges such as accessibility to AI infrastructure and connectivity were highlighted as drawbacks to the inclusivity that AI bring. The findings further hinted at the need to develop supportive policies and procedures to facilitate the effective implementation of AI in teacher preparation courses. However, further research is required to explore the efficacy of AI-based teaching approaches, assess the impact of AI on teacher preparation programs, and examine the long-term viability of AI interventions in these communities. Successful integration of AI in teacher education significantly enhances educational standards, making it an area worth exploring for policymakers, educators, and researchers alike.

Acknowledgement

This study was facilitated by funding from the National Research Foundation of South Africa.

References

- Babbie, E. (2013) *Qualitative Research, The Practice of Social Research*. Edited by E. Babbie.
- Chen, Y. *et al.* (2023) 'Artificial Intelligence (AI) Student Assistants in the Classroom: Designing Chatbots to Support Student Success', *Information Systems Frontiers*, 25(1), pp. 161–182. Available at: <https://doi.org/10.1007/s10796-022-10291-4>.
- Crompton, H. and Burke, D. (2022) 'Artificial intelligence in K-12 education', *SN Social Sciences*, 2(7). Available at: <https://doi.org/10.1007/s43545-022-00425-5>.
- Deng, W.H., Eslami, M. and Holstein, K. (2023) 'Towards "Anytime, Anywhere" Community Learning and Engagement around the Design of Public Sector AI', pp. 1–4. Available at: <http://arxiv.org/abs/2304.00167>.
- Gao, C.A. *et al.* (2022) 'Comparing scientific abstracts generated by ChatGPT to original abstracts using an artificial intelligence output detector, plagiarism detector, and blinded human reviewers', *bioRxiv*, p. 2022.12.23.521610. Available at: <https://www.biorxiv.org/content/10.1101/2022.12.23.521610v1%0Ahttps://www.biorxiv.org/content/10.1101/2022.12.23.521610v1.abstract>.
- Hu, Y.H., Fu, J.S. and Yeh, H.C. (2023) 'Developing an early-warning system through robotic process automation: Are intelligent tutoring robots as effective as human teachers?', *Interactive Learning Environments*, pp. 1–14. Available at: <https://doi.org/10.1080/10494820.2022.2160467>.
- Huang, X. *et al.* (2023) 'Trends, Research Issues and Applications of Artificial Intelligence in Language Education', *Educational Technology and Society*, 26(1), pp. 112–131. Available at: [https://doi.org/10.30191/ETS.202301_26\(1\).0009](https://doi.org/10.30191/ETS.202301_26(1).0009).
- Hwang, G. and Chang, C. (2021) 'A review of opportunities and challenges of chatbots in education', *Interactive Learning Environments*, 0(0), pp. 1–14. Available at: <https://doi.org/10.1080/10494820.2021.1952615>.
- Hwang, G.J. and Chien, S.Y. (2022) 'Definition, roles, and potential research issues of the metaverse in education: An artificial intelligence perspective', *Computers and Education: Artificial Intelligence*, 3(April), p. 100082. Available at: <https://doi.org/10.1016/j.caeai.2022.100082>.
- İçen, M. (2022) 'The future of education utilizing artificial intelligence in Turkey', *Humanities and Social Sciences Communications*, 9(1), pp. 1–10. Available at: <https://doi.org/10.1057/s41599-022-01284-4>.
- Jaiswal, A. and Arun, C.J. (2021) 'Potential of Artificial Intelligence for transformation of the education system in India', *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 17(1), pp. 142–158.
- Kasneci, E. *et al.* (2023) 'ChatGPT for good? On opportunities and challenges of large language models for education', *Learning and Individual Differences*, 103(February), p. 102274. Available at: <https://doi.org/10.1016/j.lindif.2023.102274>.
- King, C.L. *et al.* (2021) 'Intelligent Tutoring System: Learning Math for 6th-Grade Primary School Students', *Education Research International*, 2021. Available at: <https://doi.org/10.1155/2021/5590470>.
- Kuleto, V. *et al.* (2021) 'Exploring opportunities and challenges of artificial intelligence and machine learning in higher education institutions', *Sustainability (Switzerland)*, 13(18), pp. 1–16. Available at: <https://doi.org/10.3390/su131810424>.
- Laine, J. *et al.* (2022) 'Systematic Review of Intelligent Tutoring Systems for Hard Skills Training in Virtual Reality Environments To cite this article : Systematic Review of Intelligent Tutoring Systems for Hard Skills Training in Virtual Reality Environments', *International Journal of Technology in Education and Science (IJTES)*, 6(2), pp. 178–203.
- Li, C. and Xing, W. (2021) 'Natural Language Generation Using Deep Learning to Support MOOC Learners', *International Journal of Artificial Intelligence in Education*, 31(2), pp. 186–214. Available at: <https://doi.org/10.1007/s40593-020-00235-x>.
- Maxwell, J.A. (2013) *Qualitative Research Design An Interactive Approach An Interactive Approach* - Joseph A. Edited by V. Knight *et al.* Washington DC: Sage.

- Mbunge, E. *et al.* (2021) 'Ethics for integrating emerging technologies to contain COVID-19 in Zimbabwe', *Human Behavior and Emerging Technologies*, 3(5), pp. 876–890. Available at: <https://doi.org/10.1002/hbe2.277>.
- Ouyang, F. *et al.* (2023) 'Integration of artificial intelligence performance prediction and learning analytics to improve student learning in online engineering course', *International Journal of Educational Technology in Higher Education* [Preprint]. Available at: <https://doi.org/10.1186/s41239-022-00372-4>.
- Scaradozzi, D. *et al.* (2019) 'Implementation and Assessment Methodologies of Teachers' Training Courses for STEM Activities', *Technology, Knowledge and Learning*, 24(2), pp. 247–268. Available at: <https://doi.org/10.1007/s10758-018-9356-1>.
- UNESCO (2019) *Artificial intelligence in education: challenges and opportunities for sustainable development*, Unesco. Available at: <https://en.unesco.org/themes/education-policy->.
- Zhang, K. and Aslan, A.B. (2021) 'AI technologies for education: Recent research & future directions', *Computers and Education: Artificial Intelligence*, 2, p. 100025. Available at: <https://doi.org/10.1016/j.caeai.2021.100025>.