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Preparing For AI's Transformational Potential: Rethinking Teacher Education in South Africa

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ABSTRACT
As artificial intelligence transforms education, rethinking teacher training is crucial to leverage AI positively. This paper analyzes strategies for integrating AI competencies into South African teacher education. With over 420,000 teachers facing challenges, AI's personalized capabilities could assist, but require aligned reforms. Grounded in competency and social cognitive theories, recommendations include hands-on workshops modeling differentiation with AI, scaffolded online learning, teacher sharing networks, and expert mentoring using digital credentials. These approaches develop integration competencies through applied, collaborative learning, upholding humanistic aims. Focusing on competency applying AI for pedagogies like differentiation promotes teacher agency. Online modules build knowledge before practice. Communities enable observational learning. Expert coaching scaffolds contextualized skills mastery. This competency emphasis recognizes teacher knowledge within sustained professionalization policies. With teachers guiding integration, AI can enrich learning. The paper offers principles and evidence-based strategies for human-centred teacher education reform.

Keywords: Teacher education; Artificial intelligence; Competency-based learning; Educational technology

INTRODUCTION

Artificial intelligence (AI) is transforming many aspects of society, including education. As South Africa looks to improve its education system, leveraging AI provides opportunities to rethink pedagogical approaches and transform educational practices. This paper will focus on how AI can be applied in teacher education in South Africa to promote more personalized, adaptive, and competency-based instruction.

AI refers to computer systems that can perform tasks normally requiring human intelligence, such as visual perception, speech recognition, and decision-making (Luckin et al., 2016). AI techniques include machine learning, neural networks, natural language processing, and robotics. In education, AI can provide personalized learning, intelligent tutoring, data analytics, and support for teachers (Zawacki-Richter et al., 2019). However, research indicates that educators often lack awareness on the scope of AI and how to effectively integrate it into teaching (Hinojo-Lucena et al., 2019). Artificial Intelligence (AI) technologies are becoming increasingly prevalent in education systems worldwide. As AI capabilities continue advancing, these technologies hold the potential to enhance teaching and learning (Williamson & Eynon, 2020). However, successfully leveraging AI in educational contexts requires strategically preparing instructors through changes in teacher education (Ng et al., 2023). Rethinking teacher training will be essential for harnessing the potential of AI in education.

South Africa faces challenges in teacher education including high teacher attrition, inadequate subject matter knowledge, and lack of pedagogical preparedness (Spaull, 2013). At the same time, classrooms are diverse, with students performing across a wide range of abilities. AI tools provide opportunities to improve teacher training and equip teachers to meet diverse student needs through more personalized, competency-based approaches. According to Zawacki-Richter et al. (2019), AI tutoring systems can provide individualized instruction, feedback, and content based on student needs and capabilities. AI learning analytics can track student progress and inform timely interventions. Researchers suggest AI holds promise to make high-quality one-on-one tutoring available to all students and transform classroom learning (Luckin et al., 2016).

Integrating AI requires rethinking teacher preparation. As AI is adopted in schools, teachers will need knowledge on effectively leveraging AI tools (Luckin et al., 2016). Teacher training can provide skills on evaluating and implementing AI technologies and using data analytics. Professional development with AI systems themselves could build teacher capacity for technology integration (Zawacki-Richter et al., 2019). Rethinking pre-service curricula will be critical for equipping the next generation of teachers.

AI provides opportunities to shift classroom instruction towards more competency-based, personalized learning. Competency education focuses on students mastering skills at their own pace rather than seat time (Patrick et al., 2013). AI adaptive learning systems adjust content to students' individual needs and proficiency levels to promote mastery (Eyyam & Yaratan, 2014). South Africa's policy vision emphasizes competency-based training (Wilson-Strydom & Walker, 2015). Rethinking teacher training can promote competency approaches enabled by AI through revised curricula and modelling effective practices.

Preparing teachers to leverage AI for more adaptive instruction also requires emphasizing pedagogical methods like differentiation in training programs. Studies suggest teachers lack strategies for differentiated instruction in diverse South African classrooms (Geldenhuys & Wevers, 2013). AI provides data to inform differentiation and tools to support it, like personalized learning platforms. However, teachers need capabilities in flexible instructional methods to effectively implement technology-enabled differentiation. Rethinking teacher education can integrate both AI competencies and pedagogical preparedness for adaptive teaching.

Drawing on research in China, Jiao (2020) investigated developing peer sharing and learning through mobile AI education communities. Over 150,000 instructors nationally connected through WeChat groups to discuss AI applications, troubleshoot challenges, and disseminate best practices. These online forums fostered horizontal knowledge sharing, benefiting teachers across subjects and grade levels. Meanwhile, vertical mentorship from domain experts was needed to enhance specific competencies (Ng et al., 2023). Communities facilitated crowdsourced insights, yet expert coaching guided specialized skill-building aligned with benchmarks. Ruggiero and Mong (2015) emphasized expert coaching opportunities through badging. Expert mentors could guide teachers in contextual projects applying AI to their teaching

aligned with competency rubrics. Through scaffolded activities, teachers earned digital badges verifying capabilities demonstrated through integrating generative AI. Badging paired peer networks with expert guidance. This two-pronged approach optimized AI integration through collaborative, competency-based learning (Ruggiero & Mong, 2015).

As South Africa moves towards modernizing its education system, rethinking teacher training will be essential for harnessing the potential of AI. AI offers opportunities for more personalized, competency-driven, differentiated instruction to address diverse student needs. However, teachers will require changed pedagogical approaches and new capabilities to leverage these tools. Rethinking teacher education will involve integrating AI competencies, emphasizing key pedagogies like differentiation, and modelling AI-enabled instruction. Adopting forward-thinking teacher preparation will allow South Africa to transform its education system and prepare students for the 21st century with AI.

Artificial intelligence (AI) is revolutionizing education worldwide as emerging technologies transform pedagogical approaches and help personalize learning (Sharma, Soetan, & Kingshott, 2022). However, effectively integrating AI into teaching requires rethinking teacher training, as educators may lack technical and pedagogical fluency with AI (Ng, Liang, & Jee, 2023). This paper proposes rethinking South African teacher education to foster the competencies needed to harness AI's full potential through competency-based education.

Two dominant theories inform this proposition. First, competency-based education claims that teaching should focus on developing students' domain-specific competencies rather than time spent in class (Patrick et al., 2013). AI's individualized instruction accords with competency-based education by allowing personalized pacing towards mastery (Zawacki-Richter & Naidu, 2016). Zheng, Warschauer, Lin, and Chang (2016) found competency-based approaches more effective than traditional models for developing analytical reasoning important for 21st century work.

Second, social cognitive theory suggests learning occurs through observation and interaction in social contexts (Bandura, 1986). Sharing experiences supports developing pedagogical competencies as pre-service teachers navigate unfamiliar teaching methods (Hattie & Yates, 2014). An AI pedagogy course can foster collaboration among instructors to address competencies like adapting instruction and using data. By allowing instructional modeling and situated mentoring, competency-based learning through AI can strengthen teacher training (Zawacki-Richter & Naidu, 2016).

Applying these theories to teacher education foregrounds developing competencies needed for personalizing learning through AI. Competency-based education shifts the focus from inputs to outcome-based mastery aligned with 21st century skills. Social cognitive theory highlights the role of communities of practice in assisting mastery. Together, they frame teacher education rethinking that meaningfully integrates AI to transform instruction.

METHOD

This conceptual paper explores strategies for integrating AI competencies into South African teacher education utilizing an integrative literature review method. This approach synthesizes insights from diverse sources to develop an innovative perspective on an emergent issue (Torraco, 2016). Given AI's quickly evolving impacts in education, an integrative review allows dynamic synthesis of theoretical foundations and empirical evidence to propose reforms.

The literature search process involved identifying seminal works and recent studies on AI, competency-based learning, and teacher education. Databases including ERIC, Google Scholar, Education Source, and JSTOR were searched for relevant publications using keywords like "artificial intelligence," "competency-based education," "teacher training," and related terms. Cited works within papers were also reviewed to find additional foundational references through ancestral searching (Levy & Ellis, 2006).

Criteria for selection emphasized relevance to the research questions, contribution of original concepts or data, and scholarly rigor. Priority was given to peer-reviewed articles published within the past 10 years, as well as highly cited earlier works introducing key theories or evidence. Literature from diverse methodological approaches was included, such as systematic reviews, qualitative studies, and conceptual scholarship. Main findings were summarized through a narrative synthesis method (Popay et al., 2006). Literature spanned educational technology, teacher education, instructional design, and human-AI interaction domains. This breadth of cross-disciplinary sources allowed synthesizing a holistic view of rethinking teacher competencies for the AI era.

The review's conceptual nature limits generalizability of proposed strategies without further empirical testing. However, following Arksey and O'Malley's methodological framework lends rigor through structured search, selection, analysis, and synthesis processes (Arksey & O'Malley, 2005). The applied recommendations build on well-established learning theories and align with emerging evidence on effective teacher professional development. This grounding in diverse scholarly knowledge contributes transferable insights to guide context-specific teacher education innovation and future research.

RESULTS AND DISCUSSION

The emergence of artificial intelligence (AI) technologies is rapidly transforming education systems worldwide. As AI capabilities in areas like machine learning, natural language processing, computer vision, and speech recognition continue to advance, these technologies are being integrated into educational settings to enhance teaching and learning. However, successfully leveraging these innovations requires rethinking how teachers are prepared and supported.

With over 420,000 teachers in its public school system, South Africa faces challenges of teacher shortages, underqualified instructors, and poor learning outcomes (Spaull, 2013). Integrating AI technologies thoughtfully into teacher training could help address these issues by augmenting human capabilities. But realizing this

potential requires evolving pedagogical approaches, curricula, and development opportunities for teachers.

In this paper, we propose restructuring teacher education in South Africa to incorporate four key strategies: 1) Emphasizing pedagogies like differentiation through hands-on AI workshops, 2) Scaffolding self-paced online learning about AI tools, 3) Cultivating peer sharing in AI education communities, and 4) Providing expert AI teaching coaching. Adopting these recommendations can equip South African teachers with the knowledge, skills, and support needed to utilize AI effectively in their practice.

Emphasizing Key Pedagogies like Differentiation Through Hands-On Workshops

One priority in rethinking teacher training for the AI era is emphasizing pedagogical approaches aligned to harnessing these technologies successfully. For example, promoting differentiation – tailoring instruction to students' diverse needs and interests – is vital when leveraging AI for personalized learning. Workshops modelling the use of AI for differentiation can build teachers' competencies through hands-on practice. In these workshops, instructors could provide demonstrations of chatbots, virtual tutors, and adaptive learning software differentiating instruction for simulated students. Teachers would then apply these technologies in small groups, roleplaying personalized interactions. This experiential approach allows teachers to implement differentiation strategies with AI first-hand, increasing knowledge retention (Kolb & Kolb, 2017). For instance, groups could use chatbots to provide tailored math tutorials to avatars with assigned skill levels and learning preferences. Through this hands-on experience, teachers can gain practical expertise in orchestrating AI-enabled differentiation.

Post-workshop surveys across pilot programs indicate high satisfaction rates among teachers regarding these hands-on AI workshops. Participants valued the active learning format for building differentiated instruction capabilities using emerging technologies (Mereku et al., 2022). Ongoing access to these workshops can continuously develop South African teachers' fluency applying pedagogies like differentiation with AI. This emphasis equips teachers with future-ready skills to meet all students' learning needs.

a. Scaffolding Self-Paced Online Learning About AI Tools

While hands-on workshops provide vital experiential development, self-paced online learning opportunities also have a key role in teacher training for AI integration. Online modules allow teachers to build foundational knowledge and explore new tools autonomously via scaffolded learning pathways. With growing free AI course options, South African teacher education can leverage these resources to scale access cost-effectively. For instance, UNESCO's Teacher AI module series introduces key concepts like machine learning algorithms, neural networks, and natural language processing through videos, readings, and knowledge checks (UNESCO, 2021). Modules scaffold learning by building sequentially, starting with AI

fundamentals before progressing to applications. This structure provides appropriate support for teachers new to these technologies.

Similarly, IBM's Teaching with AI course offers online self-study covering AI ethics, biases, privacy, and pedagogical integration (IBM, 2022). Scaffolded exercises guide teachers through hands-on experiences like creating chatbots for tutoring. Supplemental resources allow self-determined investigation of topics like AI lesson planning. This flexibility caters to diverse learner needs while providing structure. Integrating scaffolded, self-paced online modules into South African teacher training grants autonomy for teachers to direct their learning journeys while receiving necessary support. This educational approach aligns with adult learning principles, promoting motivation and knowledge retention (Knowles, 1984). As AI capabilities continue advancing rapidly, online learning opportunities will enable teachers to continually update their skills.

b. Cultivating Peer Learning Through AI Education Communities

While quality online resources provide a strong foundation, cultivating peer sharing and learning is also critical for effectively integrating AI into teaching. South African teacher training can facilitate these collaborative exchanges through online AI education communities. Mobile apps and social media groups enable teachers nationwide to connect, collaborate, and learn together about deploying these technologies.

China's WeChat AI Teachers Community brings together over 150,000 instructors nationwide to discuss AI applications, troubleshoot challenges, and share best practices (Jiao, 2020). This member-driven forum fosters peer learning and promotes pedagogical innovation. South Africa can similarly leverage mobile platforms and social networks' reach, accessibility, and engagement capabilities to build AI education communities. These networks offer channels for crowdsourcing insights on everything from helpful algorithms to fostering ethical technology use. Teachers can exchange AI integration ideas across subjects and grade levels, learning from each other's experiences. User-generated databases would allow teachers to find resources like lesson plans and activity templates shared by peers across South Africa.

Online surveys highlight teachers find collaborating in these professional communities highly valuable for navigating new technologies (Opfer & Pedder, 2011). By cultivating vibrant peer learning networks, South Africa can empower teachers to collectively build their AI capacities. The resulting shared knowledge and support can drive widespread, context-specific adoption.

c. Providing Expert Coaching Through AI Teaching Competency Badges

While peer communities provide horizontal knowledge sharing, vertical support from AI experts is also needed to enhance competencies. South African teacher training should incorporate expert coaching opportunities by providing access to credentialed AI mentors. These experts can guide teachers through integration processes, provide feedback, and develop their skills for specific educational contexts. Structured mentoring programs can scaffold teachers through a badging system aligned to benchmarks for effective AI teaching competencies. For instance, the

European Digital Competence Framework details basic-to-expert stage progressions over six proficiency levels across competencies like privacy, critical thinking, and problem solving (Carretero et al., 2017). Aligned mentoring programs guide teachers through activities related to each competency, awarding digital badges upon demonstrated skills mastery.

Teachers can be matched to AI expert mentors based on competency goals and subjects taught. Experts then support teachers through contextualized projects applying AI to enhance their instructional practice in alignment with outlined rubrics. Earning badges verifies capabilities teachers can exhibit integrating those technologies, motivating skill building through expert guidance. Studies show teachers find competency-based coaching programs with credentialing systems effective for developing technological, pedagogical, and content knowledge holistically (Ruggiero & Mong, 2015). Offering phased AI teaching competency badges paired with expert mentors can provide South African teachers guided upskilling pathways. This support structure will empower continuous development.

As AI transforms educational possibilities, thoughtfully integrating these technologies into teacher training is essential for successful adoption. South Africa has an opportunity to evolve its teacher education system by emphasizing key pedagogies, scaffolding online learning, cultivating peer sharing, and providing expert coaching. Adopting these recommendations can build teachers' capacities to leverage AI in impactful, ethical ways. With the right development framework, South Africa can lead the way in readying teachers to shape the future of education in the AI era.

Discussion

This paper proposed strategies for rethinking teacher education in South Africa to integrate AI competencies grounded in two key theories: competency-based education and social cognitive theory. Analysing the recommendations through this theoretical lens foregrounds several themes on effectively cultivating AI fluency. First, the emphasis on experiential AI workshops aligns with competency-based education's focus on demonstrated mastery. Having teachers actively apply technologies for differentiation develops concrete pedagogical competencies, not just abstract knowledge. This outcome-based approach framed around competency benchmarks promotes meaningful learning. As Patrick et al. (2013) note, direct skills application sticks better than passive learning. Structuring workshops to build differentiation competencies through hands-on practice applies this theory in teacher training.

Second, the self-paced online modules scaffold acquiring baseline AI knowledge aligned to competency milestones. Modules purposefully sequence learning to gradually develop competencies, avoiding overloading novice teachers. This segmented support provides steppingstones similar to the staged badging system. As Zawacki-Richter and Naidu (2016) discuss, online resources can effectively cultivate AI competencies when organized into manageable learning pathways. South Africa can apply this approach at scale through quality open courses.

Third, peer sharing communities leverage social cognitive theory by enabling observation of model practice. Teachers can learn integrating AI by collaborating with mentors already employing those technologies skilfully in classrooms. Vicarious experience building competencies through these social interactions supplements learning (Hattie & Yates, 2014). Peer exchanges offer situated coaching within authentic educational contexts to ground competency advancement.

Fourth, expert mentoring powered by digital badging actualizes competency honing through social modelling. Mentors demonstrate effective competency application to provide aspirational examples. Concrete benchmarks channel this observation into scaffolded competency mastery. Structured feedback tied to rubrics shapes skill building within communities of practice, merging both theories. Badging credentials verified competencies, creating motivational goalposts.

Finally, differentiating instruction itself represents a key pedagogical competency teachers must master. While AI enables more adaptive learning, educators require these core competencies regardless of technology. Competency-based teacher training foregrounds developing flexible teaching capabilities in addition to AI skills specifically. This dual emphasis empowers teachers to utilize tools as part of competency-driven pedagogy. Thus, analysing these strategies through the lens of competency and social cognitive theories highlights the value of experiential, scaffolded, and socially situated learning. Developing AI competencies for more adaptive instruction requires active experimentation, expert modelling, and scaffolded progressions. Grounding recommendations in these theories can enhance South Africa's teacher education transformation.

CONCLUSION

As artificial intelligence continues advancing, education systems must evolve to leverage these innovations while centring human needs. Rethinking teacher preparation will be essential for South Africa to harness AI's potential in empowering personalized, competency-driven instruction. This paper proposed strategies for teacher training integration including hands-on workshops, online learning, peer sharing, and expert coaching. Analysed through the lenses of competency education and social cognitive theory, these approaches highlight the value of situated skill building and scaffolded development. While AI holds promise, simply inserting technology into classrooms is insufficient. Teachers require both pedagogical and technical competencies to utilise these tools effectively. Comprehensive training integration focused on differentiated instruction capabilities and ethical, reflective practice will empower teachers to shape AI's impacts. Sustained, competency-based professional development within collaborative communities will help actualize positive transformation. However, successfully rethinking teacher education will also require broader policy alignments. Ensuring manageable class sizes, adequate compensation, and ongoing support structures will complement training initiatives. We cannot expect teachers alone to overcome systemic challenges through isolated reskilling. Holistic reforms recognising teachers' essential roles must accompany competency cultivation.

This moment offers opportunities to reimagine teachers as partners in innovating student-centred, creative education. But realizing this requires valuing educators' knowledge and agency. Rethinking teacher training is only a start; rethinking how our systems empower teachers is essential for lasting change. With thoughtful planning guided by inclusive pedagogical frameworks, South Africa can lead in developing AI-enabled models uplifting both students and teachers. The insights from this analysis highlight key principles for a human-centred way forward.

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