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Digital Pedagogy Integration in Geography Teacher Education: A Critical Review of Emerging Literature and Contextual Challenges in Zambian Public Universities

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Abstract: *This article presents a comprehensive critical synthesis of literature published between 2019 and 2025 regarding digital pedagogy integration in geography teacher education with a focus on Sub-Saharan African contexts, specifically Zambia's public higher education institutions. Employing a systematic review approach, scholarly publications, empirical studies, and policy frameworks have been analysed to foreground key barriers such as infrastructural limitations, inadequate continuous professional development, and socio-cultural constraints that hinder effective Digital Pedagogy Integration in geography education. Theoretical frameworks including Technological Pedagogical Content Knowledge (TPACK) and Unified Theory of Acceptance and Use of Technology (UTAUT) are utilized to interpret the complexities surrounding Digital Pedagogy Integration in Geography education. The review identifies a critical empirical gap concerning the lived experiences and contextual challenges faced by Geography Teacher Educators in Zambia, thus underscoring the urgent need for empirical research to inform curricular innovations, policy reforms, and tailored professional development initiatives aimed at enhancing equitable and sustainable digital transformation in teacher education.*

1. INTRODUCTION

Digital pedagogy integration (DPI) represents a transformative opportunity for education systems globally to enhance teaching and learning through technology-enhanced learner engagement, differentiated instruction, and collaborative environments (Kimmons, Graham, & West, 2020; Kandukoori, Kandukoori, & Wajid, 2024). Geography teacher educators (GTEs) particularly stand to benefit from the application of digital tools such as Geographic Information Systems (GIS), mobile applications, and spatial data technologies, which promote enriched spatial thinking and practical, field-based learning experiences required by 21st-century geography trainee teachers for a tech classroom or environment (Kerski, 2021). However, the process of DPI is fraught with complexity, necessitating consideration of infrastructural realities, institutional readiness, pedagogical adjustments, and socio-cultural factors that influence adoption and implementation in the training of 21st Geography Education trainee teachers (Mwila & Mwanza, 2021; Sichula & Genis, 2019).

1.1. Contextual Realities in Sub-Saharan Africa and Zambia

Within Sub-Saharan Africa, there exists marked heterogeneity in digital technology adoption, largely reflective of disparities in infrastructural availability and human capacity development strategies (Ministry of Education [MoE], 2023; Mwanza, 2022). Specifically, in Zambia, considerable infrastructural deficits such as unstable internet connectivity, inadequate hardware, and insufficient Information Communication Technology (ICT) resources confront higher education institutions (Mwanza, 2022; Mwila & Mwanza, 2021). These limitations are compounded by the lack of consistent and sustained Continuous Professional Development (CPD) opportunities tailored to address the specific technological and pedagogical needs of geography teacher educators (Phiri, 2020; Mwila & Mwanza, 2021). Furthermore, the unique requirements of geography educators such as the integration of GIS technology with field-based experiential learning are seldom addressed in existing professional development models, thereby impeding comprehensive DPI (Sichula & Genis, 2019; Kerski, 2021). Policy commitments towards digital transformation, while present, remain largely aspirational without

corresponding resource allocation and strategic capacity-building initiatives (Zhou & Brown, 2020; Ministry of Education [MoE], 2023).

1.2. Theoretical and Practical Gaps in Existing Research

Current theoretical frameworks such as Technological Pedagogical Content Knowledge (TPACK) and Unified Theory of Acceptance and Use of Technology (UTAUT) provide valuable lenses for understanding DPI dynamics among educators. However, their application within the specific domain of Geography Teacher Education (GTE) in Zambia remains underexplored (Baker & Ellis, 2022). Existing literature predominantly takes a generalized approach to teacher influence on adoption and implementation, neglecting the contextual particularities and discipline-specific challenges faced by geography educators (GE) (Mwila & Mwanza, 2021; Sichula & Genis, 2019). Despite this promise, successful DPI among geography education trainee relies heavily on educators' digital proficiency and institutional support systems, both of which remain uneven globally and particularly in developing contexts (Khaldi, 2024). Veteran GTEs often express concerns regarding data accuracy and reliability, coupled with generational divides affecting digital readiness and adoption rates (Kerski, 2021). These challenges complicate the straightforward assimilation of digital methods into traditional pedagogical practices in GTE contexts.

1.3. Lived Experiences and Perceptions of Geography Teacher Educators

Qualitative studies underscore the necessity of exploring geography teacher educators' subjective experiences with digital tools, revealing varied and often ambivalent attitudes. Many educators perceive digital technologies as supplementary aids rather than integral to pedagogy, further limiting authentic DPI implementation (Banda & Mwansa, 2023; Chirwa, 2021). The absence of targeted mentorship programs and scalable professional development mechanisms exacerbates this challenge, hindering progress towards sustainable DPI (Richardson, Mwansa, & Banda, 2021). As a result, evidence-based recommendations that address the intersection of digital literacy, technology adoption behaviours, and discipline-specific pedagogical needs in Zambia's geography teacher education remain scant. This gap inhibits the development of tailored professional development programs and policy reforms responsive to Zambia's educational realities (Banda & Mwansa, 2023; Chirwa, 2021).

2. Discussion

2.1. Interrogating Context, Theory, and Discipline-Specific Capacity

This synthesis has critically examined existing literature and theoretical frameworks concerning the perceptions and practices of DPI among GTEs, with particular attention to the barriers hindering effective digital transformation in Zambian geography education. While the potential of digital tools to enhance teaching, facilitate experiential learning, and promote spatial thinking is acknowledged globally (Kerski, 2021; Panjaitan, Ningrum, & Waluya, 2023), significant obstacles rooted in perceptions, infrastructural deficiencies, and limited professional development persist, undermining widespread adoption.

2.2. The Primacy of Infrastructural Deficits and Policy Gaps

A recurring theme across the reviewed studies is the ambivalent and often sceptical attitude of educators towards digital pedagogy (Banda & Mwansa, 2023; Chirwa, 2021). Banda and Mwansa (2023) note that many educators see digital tools as supplementary rather than essential components of pedagogy. This perception is critically linked to the systemic infrastructural challenges prevalent in Sub-Saharan Africa (SSA), including underdeveloped digital infrastructure, insufficient ICT hardware, unstable internet connectivity (Mwanza, 2022; Mwila & Mwanza, 2021; World Bank, 2024), and limited access to electricity (Nkomo & Nkomo, 2021; Rhind, 2021). Such foundational deficits transform the challenge from a pedagogical adjustment to a logistical crisis, fostering beliefs that digital integration is impractical or unsustainable (Siame et al., 2023; Banda & Mwansa, 2023). Chronic system unreliability fosters lecturer anxieties regarding the inadequacy of digital infrastructures and the resulting threat to lecturer autonomy (Mkhize, Chigona, & Mhlanga, 2024). Furthermore, the high cost of connectivity in SSA, such as the average cost of 1 GB of mobile internet being 10.5% of monthly per-capita Gross National Income in 2019, far exceeds the 2% target, exacerbating the digital divide and restricting equitable access outside campus boundaries (World Bank, 2024). Chirwa and Mubita

(2021) add that generational divides further compound these attitudes, as older educators often lack confidence or familiarity with digital technologies, fostering resistance (Chirwa & Mubita, 2021).

2.3. Critique of Theoretical Frameworks in Context

The importance of theoretical frameworks like the TPACK model (Mishra & Koehler, 2006) and the UTAUT (Venkatesh et al., 2003) is evident in understanding these dynamics (Siame et al., 2023; Batiibwe & Bakkabulindi, 2016). These models suggest that effective technology adoption requires not just access but also the development of integrated knowledge bases and positive behavioural intentions (Venkatesh et al., 2003). However, their application within the Zambian context reveals critical limitations.

The TPACK framework, by emphasizing the synthesis of Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK), is fundamentally impeded when TK is unstable (Woldegiorgis, 2025). In resource-constrained environments like Zambia, infrastructural deficits significantly lower both perceived ease of use (Effort Expectancy, EE) and perceived usefulness (Performance Expectancy, PE) key factors in UTAUT acceptance (Siame et al., 2023). Consequently, Facilitating Conditions (FC) often become the dominant and negative predictor of technology use, overriding positive intentions derived from other constructs (Imamov & Semenikhina, 2021). A crucial finding is that this resistance may be rooted not merely in confidence, but in a conflict where imported technological practices clash with situated professional knowledge, necessitating a decolonized perspective in technology integration (Mitchell et al., 2024; Ndlovu-Gatsheni, 2013).

2.4. Discipline-Specific Barriers: GIS and Experiential Learning

Practically, there is a significant disconnect between the recognition of digital tools' benefits and their application in GTE (Banda & Mwansa, 2023). Mwila and Mwanza (2021) highlight that professional development programs are often insufficiently tailored to discipline-specific needs, particularly the integration of complex geospatial technologies like GIS (Magara 2023; Masumbuko, 2021). Integrating GIS, which promotes enhanced spatial thinking and inquiry skills (Magara 2023.,2025; Kerski, 2021), requires significant Technological Content Knowledge (TCK) (Magara& Dornet, 2023). The successful implementation of GIS is challenged by insufficient formal teacher training (Magara& Donert, 2023; Masumbuko, 2021) and the high cost associated with funding and maintenance of specialized hardware and proprietary software (Foote et al., 2012; Magara & Donert, 2023).

Furthermore, the integration of digital tools interacts complexly with the core geography tradition of fieldwork and experiential learning (Nkuna, 2023). Active learning strategies like fieldwork already receive low usage scores among teachers due to "financial limitations, time constraints, heavy workloads and inadequate support" (Nkuna, 2023; Nxumalo, Chibani, & Dube, 2024). Large class sizes further complicate the implementation of active learning (Nxumalo et al., 2024; Dube et al., 2018), reinforcing traditional, teacher-centered instructional strategies like lectures and Question &Answer, which receive high usage ratings (Nxumalo et al., 2024). Digital tools, while capable of augmenting field-based activities through situated learning via mobile technologies (Park, 2021; Naismith et al., 2004), risk being perceived as not a cheap substitute if underlying logistical barriers are not resolved (Nkuna, 2023).

The deficiency not only limits pedagogical innovation but also perpetuates a cycle where infrastructural limitations influence attitudes, which in turn hamper actual practice (Banda & Mwansa, 2023). Despite the theoretical insights, there is a critical gap concerning the deeply subjective and socio-cultural aspects influencing educators' behaviours (Chirwa & Mubita, 2021). Existing research confirms that the prevalence of 'one-size-fits-all' CPD models in SSA often undermines, rather than strengthens, the situated professional knowledge and agency of teachers (Mitchell et al., 2024). Banda and Mwansa (2023) further emphasise that the absence of targeted mentorship and context-specific CPD limits educators' confidence and willingness to incorporate digital tools meaningfully. Successful models must shift from focusing on the theoretical rationale ('the why') to practical application ('the how') (Wolfenden et al., 2017), offering sustained support through mentorship frameworks to overcome confidence gaps and knowledge isolation (Richardson, Mwansa, & Banda, 2021). Addressing these issues requires a decolonized perspective, ensuring that technological integration promotes responsible and ethical practices tailored to African contexts (Mitchell et al., 2024; Ndlovu-Gatsheni, 2013).

Without cultivating positive attitudes and behavioural intentions, interventions risk superficial adoption that fails to produce long-term pedagogical transformation (Banda & Mwansa, 2023).

In sum, while existing literature provides valuable insights into macro-level barriers, there remains a pressing need for in-depth, contextually grounded research into the perceptions, pedagogical practices, and socio-cultural influences shaping GTEs' engagement with digital tools or DPI. The application of theoretical frameworks like TPACK and UTAUT must be adapted to capture the unique, high-specialization challenges faced by geography educators in Zambia, considering discipline-specific needs and cultural contexts (Woldegiorgis, 2025; Mitchell et al., 2024). Addressing these gaps will inform targeted, culturally sensitive, and discipline-specific interventions—paving the way for sustainable digital transformation that aligns with Zambia's broader educational and developmental goals (MoE, 2023).

3. Conclusion

The synthesis of existing literature underscores persistent infrastructural, pedagogical, and socio-cultural challenges that inhibit the effective integration of digital pedagogy within GTE in Zambia. While theoretical frameworks such as TPACK and UTAUT provide valuable insights, their application as educator prepare geography trainee teachers remains limited in the context of discipline-specific digital practices, particularly concerning integration of digital tools for experiential learning. Empirical evidence indicates that educators' perceptions often treat digital tools as supplementary rather than integral to pedagogy, compounded by curriculum constraints, a lack of targeted professional development and mentorship programs. These gaps highlight the necessity for further research focused on the lived experiences of GTEs, to inform contextually relevant policy reforms and capacity-building initiatives. Addressing these issues is critical for advancing equitable and sustainable digital pedagogical practices aligned with Zambia's educational transformation goals to ensure achievement of Sustainable Development Goal number 4.

4. Recommendations

- The Ministry of Education (MoE) in collaboration with higher education institutions and professional development providers to develop and implement targeted continuous professional development programs designed and tailored to address the specific technological needs that integrate discipline-specific digital pedagogical for geography teacher educators.
- University administration and department heads within individual higher education institutions should coordinate the creation of mentorship programs, possibly in partnership with professional bodies or teacher associations to establish mentorship frameworks within higher education institutions to facilitate peer support and knowledge sharing related to digital pedagogy integration.
- The Government (MoE-Ministry of Finance), through policy and budget allocation, should ensure the provision of necessary infrastructure at higher education institutions through allocation of adequate infrastructure resources, including reliable internet access and modern ICT equipment, to support sustained DPI in geography teacher education.
- The MoE, in collaboration with policy makers, educator associations, and cultural leaders, should develop and implement policies fostering positive perceptions and addressing socio-cultural challenges by design and enforce policies that address socio-cultural barriers and promote positive attitudes towards digital transformation within teacher education communities in Zambia.
- The MoE, in collaboration with higher education institutions, research agencies, and education policy researchers, should undertake and fund research to conduct multi-method empirical research centred on the lived experiences of geography teacher educators to inform contextually relevant curricular and policy interventions and generate evidence-based insights that will guide effective curricular reforms and policy development aligned with the needs identified in the literature.

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