

Review

AI-Enabled Capacity Building for Special Education Pre-Service Teachers: A Systematic Scoping Review of the Global South with Implications for South African Rural Universities

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Abstract

The high rate of the use of artificial intelligence (AI) in education is changing how teachers teach, how they are trained, and how institutions are managed. While many studies explore the use of AI in teaching and learning, there is a lack of research on how it supports capacity building for special education pre-service teachers in rural South African universities. This review examines existing studies on how AI can develop skills and knowledge in pre-service teacher education for inclusive teaching. Using the AI-Capacity-Content Interaction Model and a structured scoping review method, relevant peer-reviewed studies were selected from major academic databases. The findings reveal that AI supports capacity building through improved teaching methods, the use of data for decision-making, hands-on learning, and collaboration. It also helps teachers address diverse learner needs. However, the study also identifies key challenges in rural universities, such as limited infrastructure, lack of resources, weak policy support, digital inequality, and insufficient training for lecturers. These barriers limit the effective use of AI in teacher education. The study highlights the need for better digital infrastructure, ongoing professional development for pre-service teachers, and policies that consider local contexts. These steps are important for ensuring fair access to AI and improving teacher education in rural areas.

Keywords: artificial intelligence (AI); capacity building; higher education; special education pre-service teachers; South African universities; teacher preparation

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1. Introduction

The preparation of pre-service teachers in special and inclusive education remains a central concern in educational contexts, particularly in rural areas seeking to advance equity, diversity, and educational access [1]. Teacher education programmes are expected to cultivate both foundational pedagogical knowledge and specialized competencies that enable future educators to respond effectively to diverse learner needs [2]. In special education, this includes expertise in differentiated instruction, inclusive assessment, behavioural support, and the use of assistive technologies [3]. However, the development of these competencies is often shaped by institutional conditions, resource availability, and broader socio-economic realities. Evidence from the broader Global South indicates that

rural higher education institutions frequently face persistent challenges, including inadequate digital infrastructure, limited internet connectivity, insufficient institutional support, and socio-economic inequalities [4,5].

In South African rural universities, the preparation of pre-service special education teachers is frequently constrained by structural and systemic challenges. The challenges, which include the limited access to resources and training of pre-service teachers in educational technology [6], create significant barriers to their academic success. These institutions often operate with limited infrastructure, insufficient access to specialized personnel, and restricted exposure to inclusive teaching resources and technologies [7]. Although the South African inclusive education policies advocate for equitable, high-quality education [8], their implementation within rural teacher education contexts remains inconsistent. As a result, pre-service teachers may have limited opportunities to engage with true inclusive practices, such as working with learners with disabilities or utilizing assistive and adaptive technologies [9] for supporting their diverse needs. This disconnect between policy and practice raises concerns about pre-service teachers' readiness, particularly in under-resourced school environments.

Recent studies indicate that pre-service teacher education in many global south countries, including South Africa, continues to prioritize theoretical foundations over sustained experiential and practice-based learning opportunities [10,11]. While inclusive education is strongly embedded in policy and coursework, evidence suggests that its translation into meaningful practice remains uneven. For instance, research by [6] highlights that although pre-service teachers are introduced to inclusive education frameworks, their opportunities for structured engagement with a real inclusive learning environment remain limited. This gap is particularly pronounced in rural and historically disadvantaged contexts, where resource constraints, limited mentoring support, and limited access to assistive or innovative teaching tools further restrict opportunities for applied learning [12].

In the backdrop of these challenges, the growing integration of digital technologies in education offers new possibilities for enhancing pre-service teachers' preparation. Artificial intelligence (AI), in particular, has attracted significant attention for its potential to transform teaching and learning [13]. Within pre-service teachers' education, generative AI tools are increasingly used for lesson planning, resource development, and the creation of adaptive learning environments [14,15]. Literature also confirms that these technological tools support pre-service teachers' reflective practice by offering data-driven insights into pedagogical approaches. The relevance of AI in educational research is especially pronounced in special and inclusive education. Literature suggests that AI-enabled tools can facilitate personalized learning pathways, enhance communication for learners with speech and language challenges, and support targeted cognitive and behavioural interventions [16]. Assistive technologies powered by AI, such as speech recognition systems, intelligent tutoring platforms, and emotion-recognition tools, can also help reduce barriers to participation in mainstream classrooms [17]. These capabilities align with the core principles of inclusive education, which emphasize flexibility, responsiveness, and learner-centred pedagogy, which are essential for adapting to diverse learning needs.

Despite this potential, the adoption of AI in teacher education is far from being fully realized, particularly in rural contexts. Rural universities face persistent challenges, including unreliable internet connectivity, limited access to digital devices, and inadequate institutional support [12,18], while both pre-service teachers and teacher educators often demonstrate limited digital literacy and minimal exposure to AI-related pedagogical training. These constraints hinder the effective integration of AI and reinforce existing inequalities in teacher preparation [19]. In South Africa, disparities between urban and rural institutions further complicate AI integration, as some universities have begun incorporating advanced digital tools, whereas many rural institutions continue to face

significant technological and capacity-related barriers [18]. This discrepancy directly affects the preparedness of pre-service teachers in special education.

Given these challenges, there is a growing need to examine how AI can support capacity building among pre-service teachers in special and inclusive education within rural contexts. Although existing literature highlights the potential of AI in education [13,15], there is limited synthesis focusing specifically on its role in preparing pre-service special education teachers in under-resourced settings. This scoping review therefore provides a valuable approach to mapping current knowledge, identifying emerging trends, and highlighting gaps in the literature. This review examines how AI is utilized to support capacity building in the training of pre-service special education teachers in rural South African universities. Using the AI-Capacity-Content Interaction Model, it aims to deepen understanding of how technological innovations can be aligned with context-specific needs, thereby informing future research, policy, and the development of more inclusive and responsive teacher education programmes. This scoping review synthesizes evidence on AI-enabled capacity building for special education pre-service teachers across the Global South to identify practices, opportunities, and challenges that can inform policy, curriculum development, and teacher preparation in South African rural universities.

2. The AI-Capacity-Content Interaction Model

This review uses the AI-Capacity-Content Interactive Model as a guide for analysis. The model brings together AI tools and the environment in which they are used to improve decision-making and the use of resources [20]. It is especially helpful in areas like arts and culture, where AI can support human creativity [21]. The study adopted this model to provide a comprehensive lens for examining how artificial intelligence adoption is shaped by the interaction between technological capabilities, individual and organizational capacities, and the broader contextual environment. This also based on the reason that it is used to assess whether people understand how to use AI properly and responsibly in specific tasks and industries.

While several educational technology frameworks, such as the Technological Pedagogical Content Knowledge (TPACK) framework, the Substitution, Augmentation, Modification, and Redefinition (SAMR) model, and the Technology Acceptance Model (TAM), provide valuable perspectives on technology integration, they do not fully capture the dynamic interaction between artificial intelligence capabilities, disciplinary content, and pedagogical decision-making in higher education. The AI-Capacity-Content Interaction (ACCI) Model extends these perspectives by explicitly recognizing artificial intelligence as an active educational capability rather than merely a technological tool [22]. This model conceptualizes teaching and learning as the interaction between AI capacities, the nature of disciplinary content, and educators' pedagogical choices. This interaction-oriented perspective provides a more suitable lens for investigating how AI supports curriculum delivery, assessment, student engagement, and learning outcomes within current higher education contexts.

In this study, the AI-Capacity-Content Interaction Model, as illustrated in Figure 1, conceptualizes capacity building as emerging from the intersection of three interdependent spheres: teacher capacity, AI technology, and content. As highlighted by [23], the model helps organize the findings and keeps the analysis consistent. Rather than treating these components as separate or linear inputs, the model emphasizes their overlapping and mutually constitutive relationships. For instance, AI technologies such as generative systems occupy one sphere, representing the expanding range of tools that can support differentiated instruction, adaptive assessment, and personalized learning in special education [3,16]. Teacher capacity forms the second sphere, encompassing the evolving knowledge, skills, and dispositions required to meaningfully integrate AI into inclusive

pedagogical practices [24]. The third sphere reflects the situated conditions under which teaching and learning occur, including institutional resources, curriculum demands, and socio-economic realities [20]. Capacity building is therefore located not within any single domain, but in the overlapping spaces where these spheres interact and co-evolve.

The central intersection of all three spheres represents the optimal zone of AI-enabled inclusive practice [22], wherein pre-service teachers demonstrate the technological capability to critically select, integrate, and apply AI tools to support inclusive pedagogy. The model also draws attention to partial intersections, which are equally analytically significant. For instance, the overlap between AI technology and content highlights how infra-structural limitations such as those found in rural or under-resourced universities mediate access to and functionality of AI tools [18]. Similarly, the intersection between teacher capacity and content highlights how professional learning opportunities and institutional culture shape teachers' ability to adopt AI effectively [7]. In addition, the overlap between teacher capacity and AI technology reflects the practical representation of skills such as prompt design, critical evaluation of outputs, and ethical AI use [25]. By foregrounding these layered interactions, the model conceptualizes capacity building as a dynamic, context-sensitive process that is continuously negotiated, rather than a fixed outcome. This framing allows for in-depth analysis of how AI integration in special education teacher education is enabled, constrained, and transformed across diverse settings.

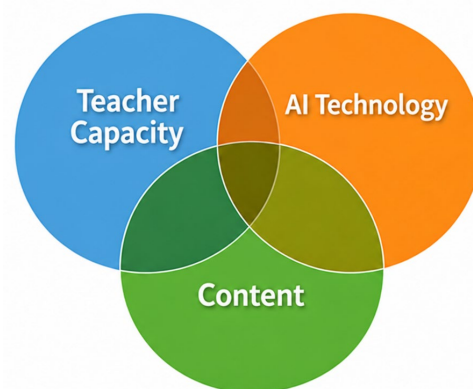


Figure 1. AI-Capacity-Content Interaction Model.

3. Materials and Methods

3.1. Research Design

This study employed a scoping review methodology to identify, map, and synthesize existing literature on the role of artificial intelligence (AI) in capacity building for special education pre-service teachers in rural South African universities. A scoping review is particularly appropriate for examining emerging fields, as it allows for a comprehensive exploration of the breadth, nature, and scope of available evidence while identifying key concepts, gaps, and trends within the literature [26]. Unlike systematic reviews, which focus on narrowly defined questions and often emphasize evidence comparison, scoping reviews adopt broader inclusion criteria to enable a more expansive and exploratory analysis of diverse sources [27]. Guided by established methodological frameworks, this review followed a structured and transparent approach to ensure rigour and replicability in the identification, selection, and synthesis of relevant studies [28,29]. This review followed a four-stage process: (i) problem identification, involving the clear articulation of the research purpose and questions; (ii) literature search, using a systematic and comprehensive search strategy; (iii) study selection and evaluation, guided by predefined inclusion and exclusion criteria; and (iv) data analysis, involving the synthesis of findings through thematic and inductive approaches [30].

3.2. Data Sources and Search Strategy

Peer-reviewed studies were retrieved from several major academic databases to ensure comprehensive coverage of literature. The search was conducted across Scopus, Web of Science, ERIC, EBSCOhost, Google Scholar, and Research Gate, to ensure comprehensive coverage of the available literature. The use of multiple databases enabled a broad and inclusive identification of relevant studies, thereby enhancing the depth and scope of the review [29]. The searches were conducted using database-specific search syntax while maintaining a consistent combination of keywords and Boolean operators across all databases. The complete search strategies, including the exact search strings, database-specific syntax, search dates, screens applied, and the number of records retrieved from each database, are presented in Table 1 to facilitate transparency and reproducibility.

The search strategy was developed around four key concepts underpinning the review: artificial intelligence, special or inclusive education, pre-service teacher education, and capacity building. The primary search string comprised the following terms: (“artificial intelligence” OR AI) AND (“special education” OR “inclusive education”) AND (“pre-service teacher” OR “teacher trainee”) AND (“capacity building” OR “professional development” OR training). Synonymous terms were combined using the Boolean operator OR, while the major concepts were linked using “AND” to maximize the retrieval of relevant studies while maintaining specificity. Where available, searches were limited to peer-reviewed journal articles published in English within the predefined publication period. This approach ensured consistency in study selection and strengthened the credibility of the review [28]. The study selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR, 2020) guidelines to ensure a transparent and reproducible review process. A completed PRISMA-ScR checklist is provided as Appendix A, and the study identification, screening, eligibility assessment, and inclusion process is illustrated in the PRISMA-ScR flow diagram Figure 2. As this review did not involve primary data collection or intervention studies, protocol registration was not undertaken.

Table 1. Complete search strategies used across electronic databases.

Database	Search Date	Database-Specific Search Strategy	Boolean Operators Used	Screens Applied
Scopus	7 February 2026	TITLE-ABS-KEY((“artificial intelligence” OR AI) AND (“special education” OR “inclusive education”) AND (“pre-service teacher” OR “teacher education”) AND (“capacity building” OR “professional development” OR training))	AND, OR	Peer-reviewed journal articles; English language; Publication years: 2010–2025
Web of Science	12 March 2026	TS = ((“artificial intelligence” OR AI) AND (“special education” OR “inclusive education”) AND (“pre-service teacher” OR “teacher education”) AND (“capacity building” OR “professional development” OR training))	AND, OR	Articles; English language; Publication years: 2010–2025
ERIC	20 March 2026	(“artificial intelligence” OR AI) AND (“special education” OR “inclusive education”) AND (“pre-service teacher” OR “teacher education”) AND (“capacity building” OR “professional development” OR training)	AND, OR	Peer-reviewed; English language; Education source; Publication years: 2010–2025
EBSCOhost	27 April 2026	TX (“artificial intelligence” OR AI) AND TX (“special education” OR “inclusive education”) AND TX (“pre-service teacher” OR “teacher	AND, OR	Peer-reviewed journals; English

	education”) AND TX (“capacity building” OR “professional development” OR training)	language; Publication years: 2010–2025
Google Scholar 28 April 2026	“artificial intelligence” AND (“special education” OR “inclusive education”) AND (“pre-service teacher” OR “teacher education”) AND (“capacity building” OR “professional development” OR training”)	English language; Publication years: 2010–2025
Research Gate 29 April 2026	“artificial intelligence” AND “special education” AND (“pre-service teacher” OR “teacher education”) AND (“capacity building” OR training)	Research articles; English language; Publication years: 2010–2025

3.2.1. Inclusion Criteria

The review included studies that focused on the use of artificial intelligence (AI) in capacity building within teacher education, particularly in relation to special education and inclusive teaching practices. To be eligible for inclusion, studies had to explicitly address pre-service teachers, with a specific emphasis on those preparing to teach in special or inclusive education contexts. Given the contextual focus of the study, priority was given to research conducted in rural, under-resourced, or developing contexts, including but not limited to South Africa. Only studies that examined the application, integration, or impact of AI technologies in educational settings were considered. Eligible sources included empirical research articles employing qualitative, quantitative, or mixed methods designs. To ensure academic rigour and relevance, only peer-reviewed journal articles published in English between 2010 and 2025 were included in the review.

3.2.2. Exclusion Criteria

The review excluded studies that did not focus on the use of artificial intelligence (AI) in teacher education or capacity building contexts. Studies that explored general perceptions or attitudes towards AI without demonstrating its application in educational practice or capacity development were not considered. Papers describing AI initiatives without reporting on any educational, pedagogical, or professional development outcomes were also excluded. Additionally, studies focusing on AI use in disciplines outside education, or those targeting in-service professionals without relevance to pre-service teacher preparation, were not included. Research conducted in highly resourced or non-comparable contexts without implications for rural or under-resourced settings was also excluded. Furthermore, studies that focused solely on technological development, tool validation, or system design without a clear educational application were not considered. General exclusion criteria included conference abstracts, opinion papers, book chapters, editorials, commentaries, theses, dissertations, and review articles, as these do not provide primary empirical evidence required for this study.

3.3. Data Extraction

Following the removal of duplicate records, titles and abstracts were screened against the predefined eligibility criteria by the two independent reviewers. Full-text articles meeting the inclusion criteria were subsequently assessed independently by the same reviewers for eligibility. To enhance methodological rigour, the eligibility criteria were established and applied consistently throughout the screening process. Any discrepancies regarding study inclusion were resolved through discussion and agreement, and where agreement could not be reached, a third reviewer was consulted. Data extraction was conducted using a standardized data extraction form that captured study characteristics which included citation details, country or study context [31]. Additional contextual information, including whether studies were conducted in rural or under-resourced settings,

together with reported educational and professional development outcomes associated with AI integration, was also recorded. The data extraction form was also pilot-tested on a small sample of studies to ensure consistency and completeness before full data extraction was undertaken. Any uncertainties encountered during screening or data extraction were discussed with the two research authors to ensure consistency in decision-making. To enhance the reliability of the synthesis, the extracted data were reviewed iteratively for completeness, consistency, and accuracy before being organized into thematic categories aligned with the review objectives.

3.4. Data Synthesis and Analysis

A qualitative synthesis approach was employed to analyze the extracted data. The data gathered from the included studies were analyzed using a thematic analysis approach, which enabled the identification of recurring patterns, concepts, and relationships across the literature [32]. This process was guided by the six-step framework for thematic analysis as outlined by [33]. The analysis began with familiarization with the data, involving repeated reading of the extracted information to gain a comprehensive understanding of the studies. This was followed by the generation of initial coding patterns, where relevant features of the data were systematically identified and labelled. The next step involved identifying recurring themes by grouping similar codes into broader categories. These themes were then interpreted in relation to the research objectives, ensuring alignment with the focus on artificial intelligence (AI) in capacity building for pre-service teachers in special and inclusive education contexts.

The process further involved ongoing analysis and refinement of specific themes to ensure coherence, consistency, and depth of interpretation [17]. Through this iterative approach, themes and sub-themes were developed to reflect key dimensions of AI-supported capacity building. These themes correspond directly to the guiding research questions of the review and provide a structured understanding of how AI-enabled capacity building is conceptualized, operationalized, and constrained within special education teacher preparation, particularly in rural South African contexts. Content analysis was also applied to examine the frequency and prominence of identified themes across the studies, providing insights into dominant trends within the literature [34]. The synthesis process resulted in a coherent narrative account of how AI contributes to capacity building, the competencies developed among pre-service teachers, and the contextual opportunities and challenges identified. Inductive thematic analysis of the included studies generated three overarching themes and associated sub-themes [35]. Any discrepancies that arose during coding and theme development were resolved through discussions between two authors, thereby enhancing the credibility and trustworthiness of the findings.

4. Results

A total of 2040 articles were identified across all selected databases and imported into Zotero. After removing all duplicates 1030, 1010 articles remained for title and abstract screening. Following this stage, 250 articles were retained for full-text review. Finally, 50 studies met the inclusion criteria and were included in this scoping review (Figure 2).

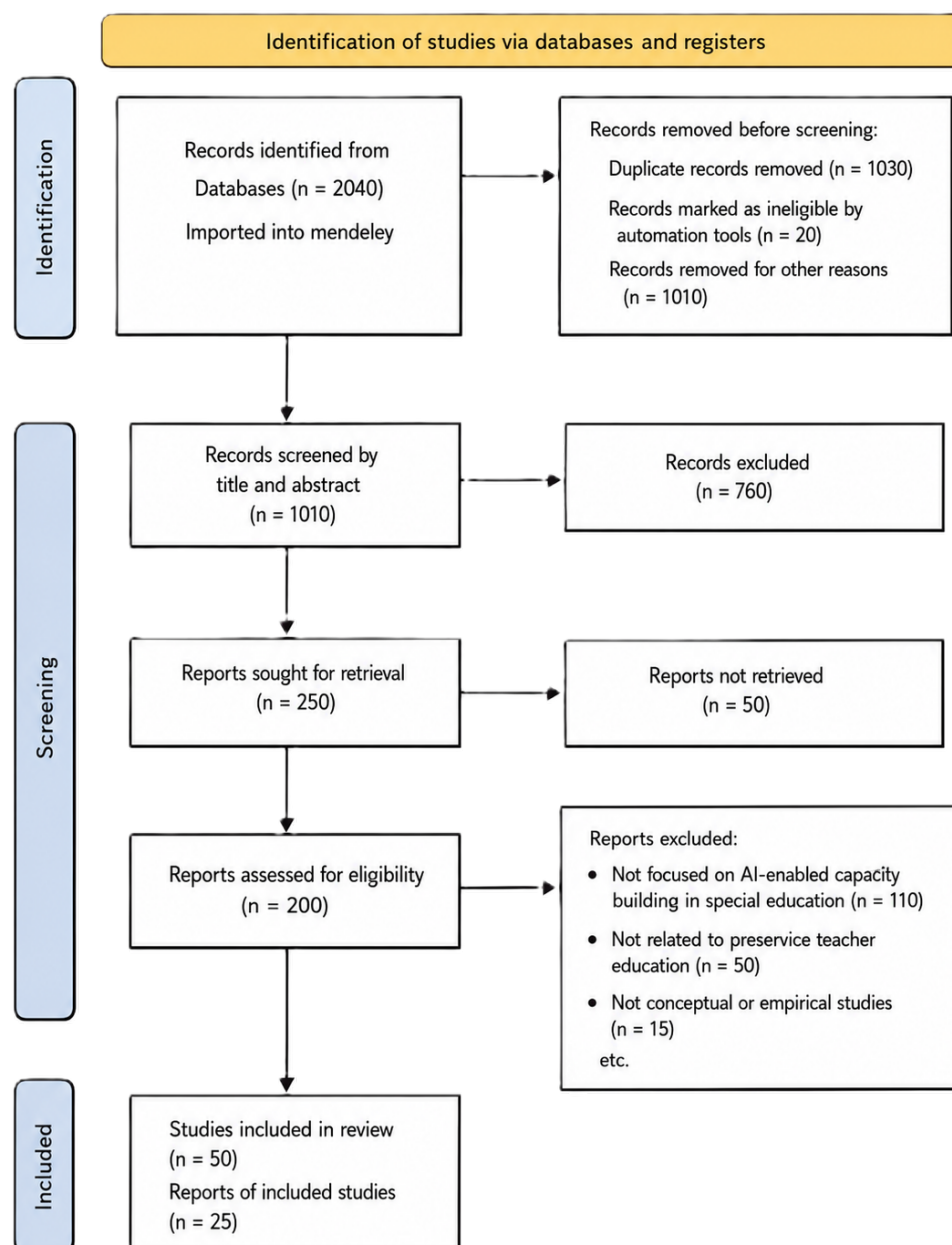


Figure 2. The flow diagram of the study selection protocol adapted from [36] (p. 5).

A summary of the characteristics of the included studies, along with the emerged themes, sub-themes, and supporting literature on AI-enabled capacity building in special education teacher education, is presented in Table 2. The majority of the studies were published within the last decade, reflecting the growing scholarly attention to artificial intelligence (AI) in teacher education. Geographically, most studies were conducted in Global South contexts, with a limited but emerging body of research situated in African contexts, including South Africa. In terms of educational settings, the studies primarily focused on higher education institutions, particularly teacher education programmes, with a subset explicitly addressing rural or resource-constrained university environments. Results across the studies largely comprised pre-service teachers, with some studies including teacher educators and institutional stakeholders. Regarding methodological approaches, the reviewed studies reflected a diversity of designs. A significant proportion employed qualitative methodologies, including interviews, focus group discussions, document analysis, and reflective narratives. Mixed-methods approaches were also evident, combining

surveys with qualitative insights, while a smaller number utilized quantitative designs focusing on perceptions, readiness, or competence development related to AI integration.

Table 2. Emerged themes, sub-themes, and supporting literature on AI-enabled capacity building in special education teacher education.

Themes	Sub-Themes	Descriptions	References
Theme1: Conceptualisations of AI-enabled capacity building.	Holistic professional development	Capacity building is conceptualized as integration of digital competence.	[2,37–39]
	Context responsive & culturally grounded approaches	AI-enabled capacity building is framed as context-sensitivity.	[8,40–43]
	Lifelong learning & adaptive orientation	Continuous professional development as essential tool for adaptive learning.	[14,43–46]
Theme 2: Mechanisms linking AI integration into teacher professional development.	Enhanced pedagogical differentiation & inclusion	AI supports personalized learning & enable pre-service teachers to meet diverse learners needs.	[6,18,38,47,48]
	Development of data literacy & reflective practice	AI enables evidence-based teaching & reflective professional practice.	[49–53]
	Simulation & Experiential Learning opportunities for professional development.	AI supports pre-service teachers in developing evidence-based decision-making skills, strengthening their professional judgement and reflective capacities	
Theme3: Structural constraints shaping AI adoption in rural South African universities.	Infrastructure & resource limitations	Limited technological infrastructure	[5,24,53–55]
	Lack of institutional readiness & policy gap	Lack of AI-specific policies	[7,18,56–58]
	Lecturer preparedness & professional support	Limited AI training for pre-service teacher	[6,48,53,59,60]

5. Presentation of the Results and Discussions

This study's synthesis of the included literature, interpreted through the AI-Capacity-Content Interaction Model [57], highlights the complex and dynamic interplay between technological innovation, professional learning, and contextual realities in shaping AI-enabled capacity building within special education teacher preparation. The findings within the theme "Conceptualizations of AI-enabled Capacity Building" indicate that capacity building is increasingly understood as the integration of digital competence, pedagogical adaptability, and inclusive teaching, where AI supports responsive and differentiated instruction rather than replacing teachers' professional judgement [37]. Capacity development therefore emerges as a multidimensional and contextually situated process rather than a purely technical acquisition of digital skills [39].

Across the reviewed studies, capacity building integrates pedagogical knowledge, technological fluency, and inclusive teaching orientations [61]. This aligns with broader scholarship in pre-service teacher education, which emphasizes that meaningful technology integration requires the alignment of digital tools with pedagogical purpose and learner diversity [38,44]. Beyond confirming previous research, these findings suggest a broader shift in how teacher preparation is conceptualized across the Global South. Rather than treating AI literacy as an additional digital competency, the reviewed studies increasingly position AI as a catalyst for rethinking inclusive pedagogical practice. This shift

reflects growing recognition that the effectiveness of AI depends less on the sophistication of the technology itself than on teachers' ability to critically evaluate, adapt, and contextualize AI-supported instructional strategies. As a result, institutions that emphasize technological proficiency without corresponding pedagogical and ethical preparation may produce graduates who are technically competent but insufficiently prepared to address the complex realities of inclusive classrooms.

Within the AI-Capacity-Content Interaction Model, the perspective reflects the capacity dimension, where professional competence is continuously shaped through engagement with AI tools [25,46]. Significantly, the reviewed studies consistently reject deterministic assumptions that AI can replace teachers, instead describing AI as an augmentative resource whose educational value depends on informed human decision-making. This challenges technology-centred narratives that often dominate AI discourse and instead highlights the enduring importance of teacher expertise, particularly in special education where professional judgement, empathy, and contextual responsiveness remain indispensable.

The emphasis on context-responsive and culturally grounded approaches, particularly within African and other Global South settings, further strengthens the content dimension of the model. Studies conducted in resource-constrained environments demonstrate that AI-enabled capacity building cannot be separated from socio-cultural realities, institutional readiness, or infrastructure limitations [41,42]. This finding is particularly significant because much of the existing AI literature is derived from well-resourced educational systems whose assumptions are not always transferable to the Global South. The reviewed literature therefore suggests that effective AI implementation requires adaptation to local epistemologies, available resources, language diversity, and educational priorities rather than the replication of models developed in high-income countries [40,43].

Although the reviewed studies were drawn from diverse Global South contexts, they reveal structural challenges that closely resemble those experienced by many rural South African institutions, including uneven digital infrastructure, limited access to specialized expertise, and resource constraints. Consequently, AI-enabled capacity-building initiatives within South African universities should prioritize contextually responsive implementation strategies rather than adopting externally developed models without adaptation. Such an approach is likely to enhance both sustainability and relevance while supporting the preparation of special education teachers capable of responding effectively to diverse learner needs.

The findings from the second theme, "Mechanisms Linking AI Integration to Professional Competence Development," demonstrate that AI supports the development of professional competence by enabling pre-service teachers to design personalized and inclusive learning experiences. AI-driven adaptive technologies, learner analytics, and virtual simulations strengthen pedagogical differentiation, evidence-based decision-making, and reflective practice, particularly within special education contexts where responsiveness to learner diversity is essential [47,49,50]. Within the AI-Capacity-Content Interaction Model, these findings reinforce the interaction between technology and teacher capacity, illustrating that AI functions as an enabler of professional learning rather than a substitute for teachers' pedagogical expertise [5,24,48,54]. However, the review also indicates that the effectiveness of these mechanisms depends on teachers' ability to critically interpret AI-generated information and adapt it to diverse educational contexts [51,52]. This suggests that AI-enabled competence is shaped by institutional readiness, educator support, and ethical use of AI, rather than technology alone. For Global South institutions, where infrastructure and resource constraints remain common, these findings underscore the importance of integrating AI literacy, reflective practice, and contextualized pedagogical training into teacher education programmes. For South African rural universities, this

implies that AI initiatives should prioritize sustainable capacity building that complements existing pedagogical practices while addressing local contextual realities.

Despite the potential benefits of AI, the findings from the third theme reveal significant structural constraints that limit the adoption and effectiveness of AI-enabled capacity building across the Global South [12]. Limited digital infrastructure, unreliable internet connectivity, inadequate access to technological resources, and institutional policy gaps consistently emerged as barriers to AI integration [7,18,53,62]. Within the AI-Capacity-Content Interaction Model, these findings reinforce the content dimension, demonstrating that AI cannot improve teacher preparation without supportive institutional environments, appropriate policies, and sufficient technological infrastructure. The review further highlights that inadequate lecturer preparedness and limited professional development reduce opportunities for modelling effective AI integration, thereby constraining pre-service teachers' capacity to apply AI meaningfully in inclusive education [6,48]. These findings suggest that successful AI-enabled capacity building depends on strengthening the interaction between technology, professional learning, and contextual readiness rather than investing in technology alone. Across the Global South, institutions require coordinated strategies that combine infrastructure development, institutional support, and continuous professional learning for teacher educators. For South African rural universities, these findings imply that AI implementation should be guided by context-sensitive policies that address existing resource constraints while strengthening educator capacity to support inclusive and sustainable AI integration within teacher education programmes.

6. Limitations of the Study

This review demonstrates several strengths, notably the inclusion of a diverse range of studies across in global south contexts and interventions, which enhances the potential transferability of the findings to varied educational settings. The application of valid inclusion criteria and a systematic approach to analysis further strengthens the credibility and reliability of the synthesized evidence. Although a formal critical appraisal of methodological quality was not undertaken, consistent with the objectives of a scoping review, the characteristics of the included studies provide important insights into the strength of the available evidence. Nevertheless, this review has certain limitations, such as the generalizability of the findings, which is constrained by the scope of the search strategy and inclusion criteria. In addition, the included studies employed diverse methodologies and were conducted across varied contexts, including well-resourced and under-resourced environments, which may limit direct comparability. Variations in methodological quality and, in some cases, insufficient reporting of research procedures also pose challenges to the consistency and depth of interpretation. These limitations suggest the need for cautious interpretation of the findings and highlight the importance of further empirical research in this area.

7. Conclusions and Recommendations

This review indicates that while AI offers significant opportunities to enhance pre-service professional development, its impact remains fragmented due to structural conditions. The findings in this study highlight the importance of context-sensitive and system-level approaches to AI integration, particularly in under-resourced settings. This review aims to offer an integrated, context-sensitive understanding of AI-enabled capacity building in special education teacher preparation through the AI-Capacity-Content Interaction Model. It moves beyond technology-centred perspectives to show that the effectiveness of AI depends on its interaction with professional competencies and contextual realities, positioning AI as part of a broader teaching and learning ecosystem. Empirically, it

consolidates evidence on AI's role in enhancing pedagogical differentiation, data-informed decision-making, reflective practice, and collaboration, while also highlighting structural constraints such as infrastructure and inequality, particularly in rural South African contexts. Methodologically, the inductive thematic synthesis provides a clear framework for organizing diverse literature and guiding future research. Overall, the review underscores that the value of AI in teacher education lies not in the technology itself, but in how it is embedded within supportive, equitable, and contextually responsive systems. Although the reviewed evidence originates from diverse Global South contexts, the findings provide valuable insights for South African rural universities.

The review recommends further efforts to prioritize within rural-based universities regarding context-sensitive implementation of AI in teacher education by:

- Aligning technological tools with pedagogical goals, investing in infrastructure and institutional readiness, and providing sustained professional development for both lecturers and pre-service teachers.
- Emphasis should also be placed on bridging the digital divide to ensure equitable access, while embedding data literacy, reflective practice, and inclusive teaching strategies within AI-enabled training to maximize its impact across diverse and resource-constrained educational contexts.
- The review further recommends that rural-based universities adopt the implementation of the AI-Capacity-Content Interactive Model. This involves actively engaging pre-service teachers and lecturers in the co-design and contextual adaptation of AI-driven teaching and assessment practices. Such an approach ensures that AI integration is not only technically viable but also contextually relevant to the institutional needs.

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Abbreviation

The following abbreviation is used in this manuscript:

AI Artificial Intelligence

Appendix A. A Completed PRISMA-ScR Checklist

Section and Topic	Item #	Checklist Item	Location Where Item is Reported
TITLE: AI-Enabled Capacity Building for Special Education Pre-service Teachers: A systemic Scoping Review of South African Rural Universities			
Title	1	Identify the report as a systematic review.	Page 1
ABSTRACT			
Abstract	2	See the PRISMA 2020 [36] for Abstracts checklist.	Page 1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Page 3
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 3
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 5
Information sources	6	Specify all databases, registers, websites, organizations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Page 5
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Page 5
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Page 6
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Page 6–7
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g., for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Page 7
	10b	List and define all other variables for which data were sought (e.g., participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Page 7
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Page 7
Effect measures	12	Specify for each outcome the effect measure(s) (e.g., risk ratio, mean difference) used in the synthesis or presentation of results.	The first paragraph under “Data Synthesis and Analysis” page 7
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g., tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Thematic analysis processes were used to decide which studies were eligible in Section 3.4 page 7
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Last paragraph of Section 3.3 page 7.
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Page 8 Table 2, showing how the findings were presented using summary tables that tabulated study characteristics and key outcomes aligned with the review questions.
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Page 7, explains thematic synthesis approach that was used to analyze and integrate findings from the included studies.
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g., subgroup analysis, meta-regression).	No-meta-analysis used

	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	No sensitivity analyses were conducted, as the objective of this scoping review was to map and synthesize existing evidence rather than estimate pooled effects. (The strength of the synthesis was supported through thematic comparison across studies, ensuring that identified patterns related to the research topic in page 7.
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	No statistical methods were used to assess risk of bias due to missing results, as meta-analysis was not performed. However, studies were examined for indications of selective outcome reporting by comparing stated aims page 7.
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Page 7
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	PRISMA 2020 flow diagram is used in Figure 2 showing the search and selection process in page 8.
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Page 9.
Study characteristics	17	Cite each included study and present its characteristics.	Page 9.
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Page 14
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g., confidence/credible interval), ideally using structured tables or plots.	Page 14
Results of syntheses	20a	For each synthesis, briefly summarize the characteristics and risk of bias among contributing studies.	Page 14
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g., confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	No meta-analysis used
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Page 14
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Page 15
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Page 15
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Page 16
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Page 16
	23b	Discuss any limitations of the evidence included in the review.	Page 16
	23c	Discuss any limitations of the review processes used.	Page 16
	23d	Discuss implications of the results for practice, policy, and future research.	Page 17
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	No registration information for the review. Page 7
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Page 7
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	No amendments to report regarding protocol or registration information. Page 7
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Page 17
Competing interests	26	Declare any competing interests of review authors.	Page 17
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Page 17

References

- Debasu, H.; Yitayew, A. Examining Elements of Designing and Managing of Creating Inclusive Learning Environment: Systematic Literature Review. *Int. J. Spec. Educ.* **2024**, *39*, 33–43. <https://doi.org/10.52291/ijse.2024.39.4>.
- Ndebele, C.; Marongwe, N.; Ncanywa, T.; Matope, S.; Ginyigazi, Z.; Chisango, G.; Msindwana, P.N.; Garidzirai, R. Reconceptualizing initial teacher education in South Africa: A quest for transformative and sustainable alternatives. *Interdiscip. J. Educ. Res.* **2024**, *6*, 1–19. <https://doi.org/10.38140/ijer-2024.vol6.07>.
- Hameed, M.; Dilshad, M.; Rasool, T. Use of Differentiated Instruction at Special Education Schools: Teachers' Perspective. *Pak. J. Humanit. Soc. Sci.* **2024**, *12*, 2206–2217. <https://doi.org/10.52131/pjhss.2024.v12i2.2401>.
- Ajani, O.; Ntombela, S.S. Inclusive education for pre-service teachers in South African rural universities. *Int. J. Bus. Ecosyst. Strategy* **2024**, *6*, 225–233. <https://doi.org/10.36096/ijbes.v6i3.531>.
- Omodan, B.I. Challenges of Pre-service Teachers in Rural Places of Teaching Practice: A Decolonial Perspectives. *Int. J. Learn. Teach. Educ. Res.* **2022**, *21*, 127–142. <https://doi.org/10.26803/ijlter.21.3.8>.
- Graham, L. (Ed.) *Inclusive Education for the 21st Century*; Routledge: London, UK, 2020.
- Charles, T.; Alshamsi, A. Navigating Challenges in Technology Integration for Inclusive Classrooms: Insights for Pre-service Teachers. In *Empowering Pre-Service Teachers to Enhance Inclusive Education Through Technology*; IGI Global Scientific Publishing: Hershey, PA, USA, 2025; pp. 87–126.
- Barnett, E.P.; Nthimbane, K.A. Information and Communication Technology Capabilities for Pre-service Teachers in South Africa: An Education Policy Analysis. *Int. J. Learn. Teach. Educ. Res.* **2025**, *24*, 630–649. <https://doi.org/10.26803/ijlter.24.8.27>.
- Singh-Pillay, A. 'Pre-service Technology Teachers' Experiences of Project Based Learning as Pedagogy for Education for Sustainable Development. *Univers. J. Educ. Res.* **2020**, *8*, 1935–1943. <https://doi.org/10.13189/ujer.2020.080530>.
- Showell, L.M. The Accessibility of Tutoring for Underprivileged, Underserved and Under-Resourced Families. Ph.D. Dissertation, Gwynedd Mercy University, Gwynedd Valley, PA, USA, May 2025.
- Liu, Y.; Saleh, S.; Huang, J. Artificial Intelligence in Promoting Teaching and Learning Transformation in Schools. *Int. J. Innov. Creat. Change* **2021**, *15*, 891–902. <https://doi.org/10.53333/ijicc2013/15369>.
- Oye, E.; Frank, E.; Owen, J. Importance of Using Generative AI in Education: Dawn of a New Era. *J. Sci. Technol.* **2024**, *4*, 35–44.
- Cai, H.; Lu, L.; Han, B.; Wong, L.H.; Gu, X. Exploring pre-service teachers' reflection mediated by an AI-powered teacher dashboard in video-based professional learning: A pilot study. *Educ. Technol. Res. Dev.* **2025**, *73*, 1129–1154. <https://doi.org/10.1007/s11423-024-10442-1>.
- Ayeni, O.O.; Al Hamad, N.M.; Chisom, O.N.; Osawaru, B.; Adewusi, O.E. AI in education: A review of personalized learning and educational technology. *GSC Adv. Res. Rev.* **2024**, *18*, 261–271. <https://doi.org/10.30574/gscarr.2024.18.2.0062>.
- Ahmed, S.; Rahman, M.S.; Kaiser, M.S.; Hosen, A.S.M.S. Advancing Personalized and Inclusive Education for Students with Disability Through Artificial Intelligence: Perspectives, Challenges, and Opportunities. *Digital* **2025**, *5*, 11. <https://doi.org/10.3390/digital5020011>.
- Ahiaku, P.K.A.; Uleanya, C.; Muyambi, G.C. Rural schools and tech use for sustainability: The challenge of disconnection. *Educ. Inf. Technol.* **2025**, *30*, 12557–12571. <https://doi.org/10.1007/s10639-024-13311-9>.
- Farahani, M.S.; Ghasemi, G. Artificial Intelligence and Inequality: Challenges and Opportunities. *Qeios* **2024**, preprint. <https://doi.org/10.32388/7HWUZ2>.
- Ajani, O.A. *Empowering Pre-Service Teachers to Enhance Inclusive Education Through Technology*; IGI Global Scientific Publishing: Hershey, PA, USA, 2025.
- Islam, M.T.; Hossain, M.J. Artificial Intelligence for Hosting Capacity Analysis: A Systematic Literature Review. *Energies* **2023**, *16*, 1864. <https://doi.org/10.3390/en16041864>.
- Xiao, Y.; Watson, M. Guidance on conducting a systematic literature review. *J. Plan. Educ. Res.* **2019**, *39*, 93–112.
- Ahmad Riva, F.; Ummul Quro Al-Islami Bogor, I.; Jawa Barat, P.; Rahmawati, N. Workshops and Mentoring as a Strategy to Empower Teachers in Developing 21st-Century Learning-Based Teaching Materials. *J. Pendidik. Dan Pemikir. Islam* **2025**, *5*, 247–262.
- Hwang, B.-N.; Puntha, P.; Jianguo, S. Human-centric AI: Transforming service ecosystems for inclusivity and excellence in resource-constrained contexts. *J. Serv. Theory Pract.* **2026**, *36*, 357–411. <https://doi.org/10.1108/jstp-01-2025-0017>.
- Zhou, X.; Liu, G.; Chiu, T.K.F. A Five-Step AI-Information problem solving (AI-IPS) model for critical, ethical, and responsible usage. *Interact. Learn. Environ.* **2026**, *34*, 1–20. <https://doi.org/10.1080/10494820.2026.2614080>.
- Peters, M.D.J.; Godfrey, C.; McInerney, P.; Munn, Z.; Tricco, A.C.; Khalil, H. Chapter 11: Scoping reviews; 2020 Version. In *JB I Manual for Evidence Synthesis*; JBI: North Adelaide, Australia, 2020; pp. 406–511.

25. Mak, S.; Thomas, A. An Introduction to Scoping Reviews. *J. Grad. Med. Educ.* **2022**, *14*, 561–564. <https://doi.org/10.4300/JGME-D-22-00620.1>.
26. Arksey, H.; O'Malley, L. Scoping studies: Towards a methodological framework. *Int. J. Soc. Res. Methodol. Theory Pract.* **2005**, *8*, 19–32. <https://doi.org/10.1080/1364557032000119616>.
27. Snyder, H. Literature review as a research methodology: An overview and guidelines. *J. Bus. Res.* **2019**, *104*, 333–339. <https://doi.org/10.1016/j.jbusres.2019.07.039>.
28. Peters, M.D.J.; Marnie, C.; Tricco, A.C.; Pollock, D.; Munn, Z.; Alexander, L.; McInerney, P.; Godfrey, C.M.; Khalil, H. Updated methodological guidance for the conduct of scoping reviews. *JBI Evid. Synth.* **2020**, *18*, 2119–2126. <https://doi.org/10.1112/JBIES-20-00167>.
29. Büchter, R.B.; Weise, A.; Pieper, D. Development, testing and use of data extraction forms in systematic reviews: A review of methodological guidance. *BMC Med. Res. Methodol.* **2020**, *20*, 259. <https://doi.org/10.1186/s12874-020-01143-3>.
30. Braun, V.; Clarke, V. Conceptual and design thinking for thematic analysis. *Qual. Psychol.* **2022**, *9*, 3–26.
31. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. <https://doi.org/10.1191/1478088706qp063oa>.
32. Sahar, R.; Munawaroh, M. Artificial intelligence in higher education with bibliometric and content analysis for future research agenda. *Discov. Sustain.* **2025**, *6*, 401. <https://doi.org/10.1007/s43621-025-01086-z>.
33. Clinton, M.; Doumit, M.; Ezzeddine, S.; Rizk, U. Using frame analysis to re-analyse the results of inductive thematic analysis: A methodological discussion of investigating meanings and learning contexts in baccalaureate nurse education. *J. Adv. Nurs.* **2020**, *76*, 3204–3212. <https://doi.org/10.1111/jan.14485>.
34. Tolera, S.T.; Alemu, B.; Mengistu, D.A.; Deressa, A. Occupation-related respiratory diseases among sanitary workers in the workplace: A systematic review and meta-analysis. *Front. Public Health* **2024**, *12*, 1501768. <https://doi.org/10.3389/fpubh.2024.1501768>.
35. Jain, K.; Devi, R.; Singh, A.P.; Agrawal, S.; Yadav, A.K.; Kumari, R.; Jain, A.K.; Jain, A.S. Artificial intelligence reimagining pre-service teacher training: A comprehensive study of blended learning models in developing and developed contexts. *TPM* **2025**, *32*, 1530–1544.
36. Govender, S.; Ramatea, M.A. Artificial Intelligence Integration into Education for Underserved Communities: Inclusive Education Classrooms in the SADC Region. In *Preparing Educators for Complexity and Change*; IGI Global Scientific Publishing: Hershey, PA, USA, 2026; pp. 291–318. <https://doi.org/10.4018/979-8-3373-9494-7.ch009>.
37. Andreasen, J.K.; Tomte, C.E.; Bergan, I.; Kovac, V.B. Professional digital competence in initial teacher education: An examination of differences in two cohorts of pre-service teachers. *Nord. J. Digit. Lit.* **2022**, *17*, 61–74. <https://doi.org/10.18261/njdl.17.1.5>.
38. Choi-Lundberg, D.L.; Butler-Henderson, K.; Harman, K.; Crawford, J. A systematic review of digital innovations in technology-enhanced learning designs in higher education. *AJET* **2023**, *39*, 133–162.
39. Lopez, S. Integrating Artificial Intelligence in Regional Education: A Holistic Framework for Inclusive, Adaptive, and Community-Centric Learning. *Electron. J. Soc. Strateg. Stud.* **2025**, *6*, 26–45. <https://doi.org/10.47362/EJSSS.2025.6102>.
40. Kotsis, K.T. Integrating Artificial Intelligence into Higher Education Curricula: Challenges and Opportunities for Science-Based Programs. *Int. J. Artif. Intell. Eng. Transform.* **2025**, *6*, 4–12. <https://doi.org/10.54660/IJAET.2025.6.1.04-12>.
41. Webber, J.L.; Jamshid, P.; Naveen, S.; Bostani, A.; Temirov, A.; Mehbodniya, A.; Kumar, S.S. Innovative Pedagogical Technologies and Artificial Intelligence in Education: A Research Investigation into AI-Enabled Learning Models for Social Innovation and Community Development. *ACTA Innov.* **2026**, *59*, 9–16.
42. Instefjord, E.; Munthe, E. Preparing pre-service teachers to integrate technology: An analysis of the emphasis on digital competence in teacher education curricula. *Eur. J. Teach. Educ.* **2016**, *39*, 77–93. <https://doi.org/10.1080/02619768.2015.1100602>.
43. Zou, D.; Xie, H.; Kohnke, L. Navigating the Future: Establishing a Framework for Educators' Pedagogic Artificial Intelligence Competence. *Eur. J. Educ.* **2025**, *60*, e70117. <https://doi.org/10.1111/ejed.70117>.
44. Khasanova, N. Empowering educators: How AI tools support continuous professional development. *Ment. Enlight. Sci. Methodol. J.* **2025**, *6*, 285–293. <https://doi.org/10.37547/mesmj-V6-I7-37>.
45. Zhang, J.; Zhang, Z. AI in teacher education: Unlocking new dimensions in teaching support, inclusive learning, and digital literacy. *J. Comput. Assist. Learn.* **2024**, *40*, 1871–1885. <https://doi.org/10.1111/jcal.12988>.
46. Judijanto, L. Beyond Access: Cultural, Ethical, and Infrastructural Challenges of AI in Marginalised Education Contexts. *Eur. J. Contemp. Educ. E-Learn.* **2025**, *3*, 83–98. [https://doi.org/10.59324/ejceel.2025.3\(6\).07](https://doi.org/10.59324/ejceel.2025.3(6).07).
47. Karataş, F.; Yüce, E. AI and the Future of Teaching: Preservice Teachers' Reflections on the Use of Artificial Intelligence in Open and Distributed Learning. *Int. Rev. Res. Open Distrib. Learn.* **2024**, *25*, 304–325. <https://doi.org/10.19173/irrodl.v25i3.7785>.

48. Zagami, J. AI Chatbot Influences on Preservice Teachers' Understanding of Student Diversity and Lesson Differentiation in Online Initial Teacher Education. *Int. J. E-Learn.* **2024**, *23*, 443–455.
49. Atenas, J.; Havemann, L.; Nerantzi, C. Critical and creative pedagogies for artificial intelligence and data literacy: An epistemic data justice approach for academic practice. *Res. Learn. Technol.* **2024**, *32*, 3296. <https://doi.org/10.25304/rlt.v32.3296>.
50. Kaufman, D.; Ireland, A. Enhancing Teacher Education with Simulations. *TechTrends* **2016**, *60*, 260–267. <https://doi.org/10.1007/s11528-016-0049-0>.
51. Chaminade, C.; Padilla Pérez, R. The challenge of alignment and barriers for the design and implementation of science, technology and innovation policies for innovation systems in developing countries. In *Research Handbook on Innovation Governance for Emerging Economies*; Edward Elgar Publishing: Cheltenham, UK, 2017.
52. Podosynnikova, H.; Homolia, V. AI-Powered Case-Based Learning: Fostering Engagement and Personalized Instruction for Pre-Service EFL Teachers. *Dialogica* **2025**, *1*, 150–170. <https://doi.org/10.5709/dialogica-01.02.2025-03>.
53. Searson, M.; Langran, E.; Trumble, J. *Exploring New Horizons: Generative Artificial Intelligence and Teacher Education*; Association for the Advancement of Computing in Education (AACE): Waynesville, NC, USA, 2024.
54. Wang, D.; Huang, X. Transforming Education Through Artificial Intelligence and Immersive Technologies: Enhancing Learning Experiences. *Interact. Learn. Environ.* **2025**, *33*, 4546–4565. <https://doi.org/10.1080/10494820.2025.2465451>.
55. Kabashkin, I. Cognitive Atrophy Paradox of AI–Human Interaction: From Cognitive Growth and Atrophy to Balance. *Information* **2025**, *16*, 1009. <https://doi.org/10.3390/info16111009>.
56. Gabriel, J. How Artificial Intelligence (AI) impacts inclusive education. *Educ. Res. Rev.* **2024**, *19*, 95–103. <https://doi.org/10.5897/err2024.4404>.
57. Adams, M.; Yitbarek, K.; Osho, G.S. Artificial intelligence and the transformation of african educational systems: Opportunities, challenges, and pathways forward. *Int. J. Artif. Intell. Educ. Res. Dev.* **2026**, *4*, 8–35. https://doi.org/10.34218/IJAIERD_04_01_002.
58. Mabidi, N. A systematic review of the transformative impact of the digital revolution on higher education in south africa introduction and scope of the study. *S. Afr. J. High. Educ.* **2024**, *38*, 97. <https://doi.org/10.20853/38-3-6366>.
59. Ali Elfa, M.A.; Dawood, M.E.T. Using Artificial Intelligence for enhancing Human Creativity. *J. Art. Des. Music* **2023**, *2*, 106–120. <https://doi.org/10.55554/2785-9649.1017>.
60. Sultana, N.; Afroje, S.; Shohel, M.S.H. Capacity building for teachers in developing countries: A systematic review of sustainable ict training frameworks with a focus on bangladesh. *Am. J. Interdiscip. Stud.* **2023**, *4*, 27–51. <https://doi.org/10.63125/k88zyv83>.
61. Mormina, M.; Istratii, R. “Capacity for what? Capacity for whom?” A decolonial deconstruction of research capacity development practices in the Global South and a proposal for a value-centres approach. *Welcome Open Res.* **2021**, *6*, 129. <https://doi.org/10.12688/wellcomeopenres.16850.1>.
62. Suliman, Z.; Mohale, N.E.; Maphoto, K.B.; Sevnarayan, K. The interconnectedness between Ubuntu principles and generative artificial intelligence in distance higher education institutions. *Discov. Educ.* **2024**, *3*, 188.

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