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Exploring the Impact of the Teacher Education Curriculum on 21st-Century Skill Development Among Pre-service Teachers at a Selected Rural University in South Africa

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Abstract

The study critically examined and interpreted the effect of the Teacher Education Curriculum on the fostering of 21st-century skills, such as collaboration, critical thinking, creativity, and communication—among pre-service teachers in an under-resourced rural South African university. Grounded in Self-Regulated Learning, technological Pedagogical Content Knowledge, and Social Justice Pedagogy, the study adopted a descriptive survey design for an evaluation into how well the Teacher Education Curriculum really developed such skills. A purposive random sampling technique selected participants of 384 pre-service teachers. Descriptive statistics and reliability analyses of quantitative data indicated that in the teaching process of the Teacher Education Curriculum, there was moderate to strong integration of collaborative and communicative skills while critical-thinking and creative-thinking skills were somewhat unequally integrated within different modules. However, the results pointed out certain systemic bottlenecks, such as inadequate digital infrastructure, scarce professional development, and inequality in information and communication the technology resource access, all hindering wide realisation of 21st-century skills. Thus, the study recommends curriculum reform, participatory learning, inquiry-based pedagogies, and digital literacy training. Furthermore, institutional investment must upgrade the faculty through training, and make institutional resources fairly distributed to potentially address socioeconomic imbalance. Linking empirical evidence with theoretical frameworks and research questions, therefore, the study contributes insights in the national and global domain of teacher education reform. The study recommends longitudinal and comparative studies to evaluate the Teacher Education Curriculum's potential as a transformative tool working in contexts of under-resourced education.

Keywords: teacher education curriculum, 21st-century skills, pre-service teachers, higher education, digital transformation

Introduction

The present-day global world is moving at breakneck speed, and the development of 21st-century skills has thus become a major point of focus in educational reforms. This is driven by international frameworks like the UNESCO Education 2030 Agenda (Ahmed, 2025), OECD's Learning Framework 2030, which equips learners with skills to address issues from ethical and sustainable perspectives, fostering a holistic approach to literacy (Martin, 2018; Mima, 2025), and the World Economic Forum's Future of Jobs Report (Gagnidze, 2025; Mima, 2025). The frameworks stress the need for skills that stretch beyond the traditional academic knowledge: critical thinking, creativity, collaboration, communication, and problem-solving—as some of the

skills that youths need to foster to survive in this complicated, the Teacher Education Curriculum h-intensive society. There is universal consensus on these skills; nevertheless, their realisation is context dependent. There is a pressing need in South Africa to integrate 21st-century skills into teacher education in rural institutions that face serious challenges due to resources constraints and the digital divide. This study, focuses on four of the core 21st-century skills: critical thinking, creativity, collaboration, and communication, as provided in the Partnership for 21st Century Learning (P21) framework (Gerona & Yurango, 2025). The study assesses how the Teacher Education Curriculum at a rural university enhances these four skills. It contributes to finetuning how these global educational concerns are localised within the South African rural higher education context.

The selected rural university provides a critical service in pre-service teacher training for the 21st-century needs of education. This university exists in a milieu where digital infrastructure is undeveloped in most cases and access to cutting-edge educational the technologies is barely known. Notwithstanding these impediments, the Faculty of Education at the university must train the future teachers to possess key skills such as collaboration, creativity, communication, and critical thinking. The very rural context makes it apt for the Teacher Education Curriculum to balance between the global and local, so that pre-service teachers are not only digitally literate but able to confront socio-economic and pedagogical challenges peculiar to rural schooling situations.

Studies indicate that limited digital literacy training and excessive academic workloads hinder pre-service teachers' ability to fully engage with 21st-century skills development (Govender, 2018; Chu et al., 2023). Additionally, research has shown that professional development for teacher educators remains a critical factor in ensuring curriculum relevance and efficacy (Ajani, 2020; Govender & Ajani, 2021). Internationally, scholars have advocated for innovative curriculum models prioritising experiential and inquiry-based learning (Alahmad et al., 2021; Darling-Hammond et al., 2019). These models align with global trends in teacher education, reinforcing the need for constructivist approaches that empower pre-service teachers to be active participants in their learning journey (Altan & Lane, 2018). However, curriculum decolonisation and social justice frameworks remain underexplored in South Africa despite their significance in creating equitable learning environments (Blignaut, 2014).

The Fourth Industrial Revolution has transformed different sectors of the economy. According to Alarfaj and Alrashidi (2025), the Fourth Industrial Revolution acts as a primary transformer for swift alteration of all facets of modern-day life created by the removal of geographical and temporal barriers. The educational sector is no exception. Various teaching and learning the technologies have been integrated into classroom practices. Thus, this revolution has further exacerbated the need for a restructured Teacher Education Curriculum, with digital transformation playing a pivotal role in preparing pre-service teachers for future teaching demands (Dlamini et al., 2021; Goh & Abdul-Wahab, 2020). Artificial intelligence (AI), big data analytics, and innovative learning environments have been highlighted as key areas requiring urgent attention (Osiesi & Blignaut, 2025). The selected university must align its curriculum with emerging global education trends to ensure pre-service teachers receive contextually relevant, skills-based training (Fletcher, 2021; Teo et al., 2021). Institutional support and policy alignment are critical factors in successful twenty-first century skills implementation. The Higher Education Act 101 of 1997 and the White Paper on Higher Education (1999) provide a foundational framework for guiding teacher education in South Africa (Department of Education, 1997; 1999). However, research indicates that policy alone is insufficient without robust implementation strategies and continuous monitoring of teacher development programs (Govender et al., 2023).

Given these insights, this study seeks to examine the impact of the Teacher Education Curriculum on 21st-century skill development among pre-service teachers at the selected university. By employing a descriptive survey research design, this study evaluates pre-service teachers'

perspectives on the effectiveness of the Teacher Education Curriculum in equipping them with critical skills. Furthermore, it identifies key barriers and opportunities for improving teacher education in rural universities. Through the lens of self-regulated learning, technological pedagogical content knowledge, and social justice pedagogy, this study aims to provide empirical evidence on how a South African university can enhance teacher education curricula to ensure greater alignment with 21st-century learning needs. The study findings contribute to national and international discussions on improving pre-service teacher education and strengthening higher education policies for sustainable educational transformation (Lumadi, 2021; Valtonen et al., 2021). This study is guided by the following research questions:

1. To what extent does the Teacher Education Curriculum at a rural South African university foster the development of collaborative skills among pre-service teachers?
2. How effectively does the Teacher Education Curriculum support the enhancement of critical thinking and analytical reasoning skills in pre-service teachers?
3. What are the perceived challenges and opportunities in developing creative and adaptive thinking skills through the current Teacher Education Curriculum?
4. How does the integration of digital tools and communication strategies within the Teacher Education Curriculum influence the development of 21st-century communication skills among pre-service teachers?

The Importance of 21st-Century Skills in Teacher Education

For this study, the Teacher Education Curriculum's ability to support pre-service teachers in developing and demonstrating collaboration, critical thinking, creativity, and communication skills as they are required in the 21st century, is assumed. 'Effectiveness' was operationalised in the survey instrument using a 4-point Likert rating scale where participants indicated the extent to which they agreed that the Teacher Education Curriculum supported their development in these skills (see Appendix). The scale varied from 'No Extent' (1) to 'Very Large Extent' (4). The quantitative analysis, supported by descriptive statistics and triangulated through theoretical constructs such as Self-Regulated Learning and technological pedagogical content knowledge, allowed a robust analysis of the curriculum's impact on skill acquisition in a rural university environment (Pintrich, 2000; Mishra & Koehler, 2006). Despite the recognised importance of 21st century skills, teacher education programs in rural South African universities struggle to embed them effectively. Issues such as limited digital infrastructure, inadequate professional development for lecturers, and curriculum rigidity hinder the seamless integration of 21st century skills into teacher training (Govender, 2018; Chu et al., 2023). Studies suggest that curriculum reforms should prioritise experiential learning, inquiry-based pedagogies, and interdisciplinary approaches to enhance pre-service teachers' critical thinking and innovation skills (Govender et al., 2023). Moreover, technology-enhanced learning and blended learning models have been proposed as effective methods for bridging existing gaps in twenty-first-century skills development for pre-service teachers (Blignaut, 2021; Teo et al., 2021).

Addressing these challenges requires a multi-faceted approach involving policy reforms, institutional investments, and faculty upskilling initiatives. Aligning teacher education curricula with global best practices and digital transformation trends is imperative for ensuring that pre-service teachers are well-prepared for modern classrooms (Lumadi, 2021; Valtonen et al., 2021). Additionally, fostering collaborative partnerships between universities, educational policymakers, and industry stakeholders can support the sustainable implementation of twenty-first century skills in teacher education (Govender et al., 2023). By embedding innovation-driven pedagogical frameworks, South African teacher education programs can equip pre-service teachers with the necessary skills to effectively navigate and contribute to the evolving educational landscape.

Challenges in Developing 21st-Century Skills in Rural Universities

Rural universities in South Africa face significant challenges in integrating 21st-century skills into teacher education. Many rural institutions struggle with inadequate internet connectivity, access to digital learning resources, and outdated teaching methodologies, which limit pre-service teachers' exposure to modern teacher education curricula in technology-enhanced pedagogies (Blignaut, 2021). Furthermore, the digital divide between urban and rural universities exacerbates disparities in access to information and communication teacher education curricula in information and communication technology (ICT) tools, affecting the quality of teacher training programs (Chuene & Teane, 2024).

Beyond infrastructure limitations, rural universities also experience faculty-related constraints that impact integrating twenty-first century skills. Many educators lack specialised training in digital pedagogies and twenty-first-century skills-focused teaching strategies, making it difficult to implement innovative learning models effectively (Govender et al., 2023). In addition, excessive academic workloads and a lack of continuous professional development opportunities hinder lecturers' ability to stay updated with evolving global trends in teacher education (Ajani, 2020). Policy-driven professional development initiatives and increased investment in teacher training programs could enhance the capacity of educators to effectively foster twenty-first-century skills among pre-service teachers (Govender et al., 2023; Alahmad et al., 2021).

Addressing these challenges requires systemic reforms and strategic investments in rural higher education. Curriculum innovations should incorporate experiential learning, interdisciplinary collaboration, and Teacher Education Curriculum in technology-driven pedagogical approaches to ensure pre-service teachers develop relevant skills for modern classrooms (Darling-Hammond et al., 2019; Valtonen et al., 2021). Moreover, expanding digital literacy training, upgrading ICT infrastructure, and fostering university-industry partnerships could provide sustainable solutions for integrating twenty-first-century skills in rural universities (Teo et al., 2021; Goh & Abdul-Wahab, 2020). Without targeted interventions, rural universities risk perpetuating educational inequalities, limiting the ability of pre-service teachers to engage with contemporary teaching demands effectively.

Theoretical Framework

This study is underpinned by Self-Regulated Learning, Technological Pedagogical Content Knowledge theories and Social Justice Pedagogy, to comprehensively understand how pre-service teachers develop and acquire 21st-century skills within teacher education. Together, these theoretical lenses help explain how pre-service teachers navigate their learning environments, integrate digital technologies into teaching, and overcome barriers to equitable access to education (Pintrich, 2000; Mishra & Koehler, 2006; Ajani, 2024). Furthermore, Self-Regulated Learning and the Theory of Planned Behaviour provide theoretical insights into how pre-service teachers engage with the Teacher Education Curriculum (Ajzen, 2002; Pintrich, 2000).

Self-Regulated Learning Theory

As Pintrich (2000) proposed, Self-Regulated Learning Theory explores how learners develop independence in acquiring and applying 21st-century skills. It suggests that successful learners actively set goals, monitor progress, reflect on their learning experiences, and deliberately enhance their skills. Within the selected university's teacher education program, Self-Regulated Learning is crucial in helping pre-service teachers take ownership of their pedagogy curriculum regarding technological skill development (Govender et al., 2023). The ability to self-regulate learning is critical in rural university contexts, where limited access to digital resources and professional development opportunities can impede traditional instructional methods (Chuene & Teane, 2024).

Through a Self-Regulated Learning Theory lens, pre-service teachers are encouraged to engage with problem-based and inquiry-driven learning approaches, fostering adaptability and resilience in dynamic teaching environments (Darling-Hammond et al., 2019). However, studies indicate that excessive academic workloads, inadequate mentorship, and lack of digital literacy training may hinder pre-service teachers' ability to engage effectively in self-regulated learning (Ajani, 2020; Blignaut, 2021). Thus, it is imperative to integrate structured support mechanisms, including online learning tools, mentorship initiatives, and self-paced digital literacy programs, to facilitate Self-Regulated Learning adoption in rural universities (Teo et al., 2021).

Technological Pedagogical Content Knowledge

Mishra and Koehler (2006) provide a framework for understanding how teacher education curricula and Technological Pedagogical Content Knowledge intersect in teacher education. It highlights the need for educators to integrate technological tools effectively within their subject-specific teaching methods, to ensure that learning remains engaging, interactive, and relevant (Govender et al, 2023). The term *effectively* denotes the degree to which the Teacher Education Curriculum enables pre-service teachers to acquire and demonstrate core 21st century skills: collaboration, critical thinking, creativity, and communication.

Despite its benefits, the successful application of Technological Pedagogical Content Knowledge in rural universities is often constrained by inadequate access to ICT resources, lack of technical support, and limited professional development for lecturers (Govender, 2018).

Social Justice Pedagogy

Social justice pedagogy focuses on ensuring equal access to ICT and educational opportunities, advocating for fair distribution of resources, curriculum inclusivity, and active resistance to systemic inequalities (Ajani, 2024). In teacher education, this perspective is particularly relevant in addressing the digital divide affecting rural universities (Blignaut, 2021; Lumadi, 2021). Pre-service teachers at the selected university often encounter barriers to ICT integration, including insufficient infrastructure, financial constraints, and socio-economic disparities, which impede their ability to acquire 21st-century skills (Ajani, 2024).

By applying social justice pedagogy, educational institutions can promote equitable access to ICT tools and training, fostering inclusive learning environments that empower pre-service teachers to integrate the Teacher Education Curriculum effectively in diverse classroom settings (Ananiadou & Claro, 2009; Alahmad et al., 2021).

Integrating the Theoretical Frameworks in Teacher Education

By combining insights from Self-Regulated Learning, Technological Pedagogical Content Knowledge, and social justice pedagogy, this study provides a holistic framework for understanding how pre-service teachers develop 21st-century skills within the selected university's Faculty of Education. Self-Regulated Learning equips learners with self-directed learning strategies, Technological Pedagogical Content Knowledge enhances their application of the Teacher Education Curriculum with technological instructional usage, and social justice pedagogy ensures that access to ICT remains an institutional priority (Govender et al., 2023; Ajzen, 2002).

Methodology

Research Design

This study employed a descriptive survey research method. As noted by Rahman (2023), the primary goal of survey research is to collect data from a large diverse group of respondents, in a study. Creswell and Inoue (2025) suggest that survey methodologies allow for a larger sample size, ensuring comprehensive data collection.

Population and Sampling

The study population consisted of pre-service teachers in the Faculty of Education at a South African rural university. A combination of purposive and simple random sampling the techniques was used to determine the sample. The purposive sampling method was employed to select the Faculty of Education, the designated faculty responsible for teacher education. Random sampling was used to select pre-service teachers who were in their second, third, fourth years of Bachelor of Education program at the university, or Postgraduate Certificate in Education who responded to the research questionnaire via Google Forms. The final sample consisted of 384 respondents, ensuring robust data representation.

Instruments

A quantitative research instrument, to measure the impact of the Teacher Education Curriculum on the development of 21st-century skills among pre-service teachers was developed based on insights from teacher experiences and existing literature (Fletcher Jr, 2021; Kundu & Bej, 2022). The Google form questionnaire (see Appendix) comprised two sections:

- **Section A:** Captured demographic information (e.g., gender, academic department, year).
- **Section B:** Measured impact of Teacher Education Curriculum on 21st-century skill development among pre-service teachers using a 4-point Likert scale (Highly demonstrated (4) to Not demonstrated (1)). This section had four sub-sections:
  - Collaborative Skills
  - Critical Thinking Skills
  - Creativity
  - Communication

Each of the four sub-sections contained in Section B of the questionnaire was forged ahead with and aligned to the research questions to enhance conceptual coherence and analytical relevance. Questions concerning the Collaborative Skills sub-section were asked to address Research Question 1: To what extent does the Teacher Education Curriculum foster the development of collaborative skills among Pre-Service teachers? Similarly, the Critical Thinking Skills sub-section addressed Research Question 2, which investigates how the Teacher Education Curriculum supports the enhancement of analytical reasoning and reflective thinking. The Creativity sub-section was linked to Research Question 3, focusing on perceived challenges and opportunities in developing creative and adaptive thinking skills. Finally, the Communication sub-section was linked to Research Question 4, about the influence of digital tools and communication strategies within the Teacher Education Curriculum on the development of 21st-century communication skills. In this fashion, alignment was ensured worthy of recalling and meaningfully interpreting the data vis-a-vis the core aims of the study.

To ensure validity, the instrument was reviewed by two statisticians who were experts in questionnaire designs. A pilot study was conducted with 21 respondents from another university, of the same status with the selected university. These respondents and the university have the same features as the selected university for this study. The questionnaire was further validated using the Ordinal Alpha reliability, yielding $\alpha = 0.91$, indicating strong internal consistency.

Data Collection Process

The researchers obtained ethical clearance from the University's Research and Ethics Committee (Ethics Approval Reference: UZ-REC0691-008 Dept2024/11). Respondents were informed about the voluntary nature of participation, and their informed consent was secured before data collection commenced.

With the assistance of a faculty administrator, the questionnaire was disseminated to students. The survey remained open for two months (October–November 2024), which happened to be

the end of the semester, when students were doing examinations. A total of 384 students completed and submitted their responses.

Data Analysis

The collected data were analysed using the Hayes macro process in SPSS version 26.0, given its suitability for handling continuous, ordinal, and categorical data (Hayes, 2012, 2022). Data analysis involved the use of descriptive analysis (Oranga, 2025).

Results

This study utilised a 4-point Likert scale rating from 'Not Demonstrated' (1) to 'Highly Demonstrated' (4) to establish the presence of 21st-century skills in pre-service teachers applying the Teacher Education Curriculum. Effectiveness was operationalised as the extent to which participants perceived the key skills of collaboration, critical thinking, creativity, and communication to be demonstrated through the Teacher Education Curriculum. Findings signify the threshold at which skill development is perceived as moderate or high.

Demographic Characteristics of Respondents

Of the 384 respondents of the Faculty of Education at the selected university, 160 (41.7%) were male, while 224 (58.3%) were female. Regarding the academic departments of the respondents, 13 (3.4%) were enrolled in postgraduate studies, 169 (44.0%) were in primary school education, and 202 (52.6%) were in secondary school education, indicating that most respondents were from the Department of Secondary School Education.

Integration of the Teacher Education Curriculum in the Development of 21st-Century Skills within Pre-Service Teacher Education

Collaborative skills. Collaboration is a fundamental aspect of 21st-century skills, providing pre-service teachers (pre-service teachers) with the skills to engage effectively in team-based problem-solving, foster inclusivity in learning environments, and cultivate cooperative professional relationships (Govender & Ajani, 2021). Table 1 gathers participants' responses on how the Teacher Education Curriculum promotes collaborative skills among pre-service teachers. The results show that the Teacher Education Curriculum is demonstrated in group work, project presentations and group assignments.

Table 1: ***Extent of Pre-service Teachers' Proficiency in Collaborative Skills***

Collaborative Skills in a 21st-Century Learning Context	Not Demonstrated (1)	Minimally Demonstrated (2)	Moderately Demonstrated (3)	Highly Demonstrated (4)
Exhibit professionalism and mutual respect within collaborative groups	8 (2.1%)	4 (1.0%)	190 (49.5%)	182 (47.4%)
Recognise and integrate diverse perspectives in team discussions	11 (2.9%)	4 (1.0%)	168 (43.8%)	201 (52.3%)
Ensure equitable participation and validation of all group members' contributions	8 (2.1%)	7 (1.8%)	137 (35.7%)	232 (60.4%)
Provide constructive support and assistance to peers in collaborative tasks	8 (2.1%)	30 (7.8%)	170 (44.2%)	176 (45.9%)
Enhance personal contributions based on evaluative feedback from peers	8 (2.1%)	9 (2.3%)	166 (43.2%)	201 (52.3%)
Engage in collective task execution, including shared presentations	8 (2.1%)	38 (9.9%)	184 (48.2%)	154 (39.8%)
Adhere to established group norms and collaborative engagement protocols	8 (2.1%)	15 (3.9%)	140 (36.6%)	221 (57.4%)

Critical Thinking Skills. Being fundamental in teacher education, critical thinking equips pre-service teachers in analysing information, building evidence-based arguments, and making reflective pedagogical decisions. Table 2 illustrates how participants see the Teacher Education Curriculum as a means of contributing to critical thinking. The descriptive analysis of all items in the table suggests that the Teacher Education Curriculum encourages analytical reasoning and structured problem solving. Fourth-year students felt more proficient in critical thinking than students at earlier years, hinting at gradual exposure to the curriculum. Analysis by gender showed that female respondents tended to report a high degree of engagement in reflective and evaluative activities, consistent with findings in self-regulated learning research. These findings affirm the Curriculum's intervention in building critical thinking while bringing attention to the significance of differentiated support across different demographic factors.

The results showed that the Teacher Education Curriculum in the rural university appears to be fostering the development of critical thinking and analytical reasoning to some extent or greatly. Over the five items, most of the respondents selected the options either 'Moderately Demonstrated' or 'Highly Demonstrated', and the percentages for these categories were consistent. For example, 54.3% of the respondents considered the Teacher Education Curriculum to be moderately demonstrated in developing innovative strategies for problem resolutions, while 35.8% considered it as highly demonstrated. Likewise, 53.2% of respondents reported that the Teacher Education Curriculum moderately demonstrated the assessment and validation of

logical reasoning, and 40.0% rated it highly demonstrated. These finding trends imply that the Teacher Education Curriculum is supportive in building structured decision-making and reflective inquiry.

Yet some variation in responses exists. The item 'Formulate follow-up inquiries to deepen conceptual exploration' received the most 'Minimally Demonstrated' responses (10.9%), suggesting that, despite the curriculum's broad support for analytical engagement, aspects of critical inquiry might need to be given additional emphasis. However, the distribution implies an overwhelming support for the Teacher Education Curriculum toward the development of cognitive skills, with the 'Not Demonstrated' ratings holding the lowest percentages for all items. The results clearly substantiate the curricular focus on 21st-century learning, with emphasis on evidence-based reasoning and reflective practice.

Table 2: Extent of Pre-service Teachers' Proficiency in Analytical Reasoning and Problem-Solving

Cognitive and Analytical Reasoning Skills	Not Demonstrated (1)	Minimally Demonstrated (2)	Moderately Demonstrated (3)	Highly Demonstrated (4)
Formulate follow-up inquiries to deepen the conceptual exploration	8 (2.1%)	42 (10.9%)	190 (49.2%)	146 (37.8%)
Develop innovative strategies for problem-resolution	8 (2.1%)	30 (7.8%)	210 (54.3%)	138 (35.8%)
Assess and validate logical reasoning supporting arguments	14 (3.6%)	12 (3.1%)	205 (53.2%)	154 (40.0%)
Interpret complex questions to facilitate analytical thinking	8 (2.1%)	13 (3.4%)	191 (49.2%)	172 (44.3%)
Extract and synthesise relevant data from multiple sources	8 (2.1%)	24 (6.2%)	186 (48.2%)	166 (43.0%)

Creative Skills. Creativity is a cornerstone of innovative teaching methodologies, empowering pre-service teachers to design dynamic instructional strategies and adaptive learning environments. Table 3 highlights the extent to which the Teacher Education Curriculum fosters creativity. These results suggest that the university's Teacher Education Curriculum successfully cultivates creative skills among pre-service teachers (Darling-Hammond et al., 2019; Ananiadou & Claro, 2009).

Data presented in Table 3: Creative and Adaptive Thinking Skills, show that the Teacher Education Curriculum at the university is perceived to moderately or largely support the development of creative and adaptive thinking amongst pre-service teachers. For all the five items, most responses are in the categories of 'Moderately Demonstrated' and 'Highly Demonstrated.' Meanwhile, responses vary between 45.5% and 57.3% at the moderate demonstration level, and from 33.8% to 42.6% at the high demonstration level. For example, 57.3% of respondents perceived that modifying communication strategies to suit situational demands was moderately demonstrated, while 42.6% felt that modifying and honing ideas through iterative development was highly demonstrated. The results show that the Teacher Education Curriculum initiates and encourages pre-service teachers for flexible, creative, and context-sensitive thinking.

The ratings of 'Not Demonstrated' stayed consistently low at 2.1% across all the items, indicating that very few respondents felt they absolutely did not encounter these skills in their training. On the other hand, 'Minimally Demonstrated' responses showed much larger variance, the highest being conceptualising and implementing innovative educational solutions at 12.7%. This shows that while the general support for creativity is there, there are inconsistencies regarding how differently such opportunities are realized and delivered in different modules or by way of various cohort experience. In view of the above, it may be said that the Teacher Education Curriculum is perceived favourably in terms of promoting creative and adaptive thinking; however, the outlier categories in minimum demonstration responses provide opportunities towards strengthening curriculum delivery to guarantee that this engagement for innovation-centred pedagogies occurs consistently.

Table 3: ***Extent of Pre-service Teachers' Proficiency in Creative and Innovative Thinking***

Creative and Adaptive Thinking Skills	Not Demonstrated (1)	Minimally Demonstrated (2)	Moderately Demonstrated (3)	Highly Demonstrated (4)
Transfer and adapt acquired knowledge to diverse learning contexts	8 (2.1%)	47 (12.5%)	190 (50.6%)	130 (34.6%)
Modify communication strategies to align with situational demands	8 (2.1%)	26 (6.9%)	215 (57.3%)	127 (33.8%)
Generate novel and innovative concepts for pedagogical advancement	8 (2.1%)	34 (8.9%)	209 (54.6%)	121 (34.4%)
Enhance and refine ideas through iterative development	8 (2.1%)	10 (2.6%)	202 (52.7%)	164 (42.6%)
Conceptualise and implement innovative educational solutions	8 (2.1%)	49 (12.7%)	176 (45.5%)	155 (39.7%)

Communication Skills. Communication skills are a necessary pre-requisite for instructional clarity, classroom management, and professional interactions. Table 4 presents pre-service teachers' views regarding the Teacher Education Curriculum's role in developing their communication skills. Again, the descriptive analysis indicates an effective promotion of speaking and writing skills through the curriculum. Female respondents and respondents in senior years reported their high skills levels in clarifying ideas and conducting professional interactions. Such trends could mean that the Teacher Education Curriculum explicitly teaches communication strategies within its modules and that the strategies are reinforced throughout the whole program. The research findings suggest a need to give attention to communication skills development, particularly in the foundational years of teacher preparation.

Further analyses of the data reveal some discrete socioeconomic categories, especially with gender and year of study. In general, more female respondents have rated higher collaborative skills levels on most items (**As shown in Appendix 2**), with a higher proportion of females indicating 'Highly Demonstrated' than males. This means that female pre-service teachers may be more in tune with or practicing collaborative pedagogy as promoted by the Teacher Education Curriculum. Likewise, third- and fourth-year students demonstrated better collaborative skills

than their younger counterparts, which may indicate that curriculum exposure acts incrementally. Thus, these findings urge the need to examine demographic factors in the curriculum impact and show the likelihood that both gender and progression through academic stages mediate the influence of the Teacher Education Curriculum on collaboration.

Based on the data presented in Table 4: Interpersonal and Digital Communication Skills, the findings suggest that the Teacher Education Curriculum is perceived to effectively support the development of communication skills among pre-service teachers.

Across all five items, most responses fall within the 'Moderately Demonstrated' and 'Highly Demonstrated' categories. For example, 51.1% of respondents indicated that they could articulate ideas coherently using structured, logical reasoning at a moderate level, while 41.9% reported high demonstration. Similarly, 46.8% of participants rated their ability to deliver information clearly and effectively in professional settings as moderately demonstrated, and 42.5% as highly demonstrated. These patterns suggest that the Teacher Education Curriculum consistently fosters both verbal and digital communication skills essential for effective teaching.

The 'Not Demonstrated' category remained low across all items (2.1%–3.1%), indicating that very few respondents felt these skills were absent from their training. However, the 'Minimally Demonstrated' responses were more variable, with the highest being 20.8% for 'Facilitate and manage meetings effectively.' This suggests that while communication is generally well integrated into the curriculum, certain professional communication tasks, such as meeting facilitation—may require more explicit instructional support.

The findings indicate a relatively consistent pattern of responses, with slightly more variability in areas like meeting facilitation. These findings affirm the curriculum's alignment with 21st-century communication demands, while also pointing to areas for targeted enhancement.

Table 4: ***Extent of Pre-service Teachers' Proficiency in Effective Communication***

Interpersonal and Digital Communication Skills	Not Demonstrated (1)	Minimally Demonstrated (2)	Moderately Demonstrated (3)	Highly Demonstrated (4)
Facilitate and manage meetings effectively	12 (3.1%)	80 (20.8%)	175 (45.6%)	117 (30.5%)
Organise and structure information in a logical manner	8 (2.1%)	28 (7.3%)	210 (54.8%)	136 (35.4%)
Monitor and track team objectives to ensure goal attainment	8 (2.1%)	49 (12.8%)	180 (46.8%)	147 (38.2%)
Deliver information clearly and effectively in professional settings	8 (2.1%)	33 (8.6%)	180 (46.8%)	163 (42.5%)
Articulate ideas coherently using structured, logical reasoning	8 (2.1%)	19 (4.9%)	198 (51.1%)	162 (41.9%)

Discussion of Findings

The findings in this research offer more nuanced and locally grounded understandings of how the Teacher Education Curriculum at a rural South African university aids development of 21st century skills in its pre-service teachers. The study shows that the Teacher Education Curriculum supports

collaboration, critical thinking, creativity, and communication, skills recognised worldwide in frameworks such as the OECD Learning on Framework, 2030 (Ahmed, 2025), and UNESCO Education 2030 Agenda (Mima, 2025; Martin, 2018; Ananiadou & Claro, 2009). Collaboration was reported as a highly supported skill by pre-service teachers in group work, co-presentation, and peer feedback activities. The findings resonate with Govender and Ajani (2021), who assert that collaborative learning is central to teacher education as a form of professional development. The Self-Regulated Learning framework may reinforce this outcome by suggesting that collaborative settings encourage goal setting, and present opportunities for self-monitoring and reflection (Pintrich, 2000). However, gendered inequalities emerged with female students reporting higher collaborative aptitudes, signalling that the Teacher Education Curriculum might not be equally effective across demographic groups.

Participants felt that critical thinking was moderately to highly supported, especially among senior students. This corresponds to the constructivist position that analytical reasoning develops incrementally within scaffolded learning experiences (Darling-Hammond et al., 2019). The use of digital tools supports evidence-based thinking and reflective inquiry as per Technological Pedagogical Content Knowledge notions (Mishra & Koehler, 2006). Nevertheless, the lower ratings in terms of conceptual exploration indicate a possible weakness in that the Teacher Education Curriculum may still insufficiently stress inquiry-based learning, which makes deep conceptual engagement problematic as argued by Altan and Lane (2018). Creativity showed a wider range of answers, while on average being well supported. Adaptive thinking and maximising iterative developments were moderately rated by pre-service teachers, which corroborates Alahmad et al.'s (2021) plea for innovation-based pedagogy in teacher education. Self-Regulated Learning Theory explains this further in that self-directed learners are likely to engage in creative problem solving. However, inconsistencies within curriculum delivery have been revealed by the prevalence of 'minimally demonstrated' rankings, with which one may argue that the Teacher Education Curriculum's support of creativity is not evenly distributed across modules or instructors. This view aligns with Blignaut's (2021) concern that curriculum transformation in South Africa remains fragmented and contextually constrained.

Regarding communication skills, they were rated moderately to highly demonstrated, particularly when it involved expressive shaping of ideas and professional interactions. The findings also bear out the claim made by advocates of the Technological Pedagogical Content Knowledge model emphasising digital communication tool integration within pedagogical practice (Goh & Abdul-Wahab, 2020). Organising information in a clear logical sequence and presenting it are mutually important for teachers' instruction and classroom management (Valtonen et al., 2021). Conversely, for facilitating meetings, the Teacher Education Curriculum may offer insufficient preparation for pre-service teachers to step into leadership and administrative positions, a matter brought raised by Fletcher (2021) in his study on career readiness in teacher education. The findings of this study match with international scholars advocating for experiential and inquiry-based learning forms (Darling-Hammond et al., 2019; Alahmad et al., 2021). Still, they illuminate the barriers confronted in rural South-African contexts. Inadequate digital infrastructure, high academic workloads, and lack of professional development for faculty continue to hinder full realisation of 21st-century skills (Govender, 2018; Chuene & Teane, 2024). These structural limitations have grounded the call for the localisation of Teacher Education Curriculum on global best practices-a balance yet to be found in many rural institutions.

Another essential viewpoint explained through the Social Justice Pedagogy concerns the equity implications of the Teacher Education Curriculum. The results show varied ICT access and digital literacy conditions, limiting pre-service teachers from marginalised backgrounds more so than their counterparts from privileged cases (Blignaut, 2021; Lumadi, 2021). The inclusion of pathways for social justice in the Teacher Education Curriculum will guide universities to create inclusive learning environments that empower all students with 21st-century skills. Targeted interventions

such as government-subsidised ICT programs and community-based digital literacy campaigns are recommended by Chuene and Teane (2024).

The research question is answered based on the findings: the Teacher Education Curriculum enhances collaboration through group work, critical thinking through reflection, creativity through adaptive strategies, and communication through structured reasoning and digital tools. This clearly indicates that the curriculum aligns with the P21 framework and addresses current global educational trends. The findings also demonstrate the presence of gaps needing attention, including ensuring consistency of delivery and equal access amongst worldwide cohorts of students.

The research further strengthens the corpus of literature dealing with 21st-century skills through teacher education and provides a glimpse of the Teacher Education Curriculum's strengths and weaknesses in a rural South African setting. By synthesising the theoretical frameworks with empirical research, the study maps out a more nuanced understanding of the acquisition of critical skills by pre-service teachers. The findings may suggest a need for reform in teacher education curriculum design and policymaking, thus ensuring a modern and relevant preparation system that is inclusive to all. Further research should consider tracking longitudinal impacts and making intracurricular comparisons that will lend further support to curriculum transformation programs in under-resourced settings.

Limitations of the Study

This study has the merit of advancing knowledge about the integration of 21st-century skills in a rural South African teacher education setting. However, there are some limitations. One limitation relates to the fact that the single institution was the scope of this research, which affects generalisations of the findings to other universities, especially those located in an urban or the technologically advanced environment. The idiosyncratic socio-economic and infrastructural profile in the chosen rural university situation may not represent larger national or international scenarios of teacher education. Secondly, the study drew exclusively on numerical data from self-reported questionnaires and may have introduced response biases. Participants may have offered socially acceptable responses rather than actual responses to questions pertaining to their own experiences and skills, thus compromising the trustworthiness of the findings. Furthermore, the descriptive surveys capture big trends but do not allow for the in-depth study of the nuanced experiences of pre-service teachers. The lack of qualitative data such as interviews, focus groups, or classroom observations impedes the study's potential to reveal the contextual and pedagogical factors underlying skill development. Areas such as why gender differences exist in terms of collaborating or the factors supporting or frustrating the uneven development and delivery of creative pedagogies are left unexplored. Mixed methods would have hopefully produced richer, triangulated data to describe Teacher Education Curriculum impacts on learning outcomes and pedagogical practices. Lastly, inequalities in access to digital resources among respondents may have demarcated their position on the efficacy of the Teacher Education Curriculum, also bearing on aspects of the technology-enhanced learning. Irrespective of respondents' socio-economic backgrounds, prior digital literacy, access to devices, and/or internet connectivity were unknown factors unconsidered within the study, and these are significant issues when concerning rural education. These limitations argue for the need for future investigations to take on longitudinal study designs, comparative institutional analysis, and qualitative research methodologies for greater realizations of the system-level and individual-level factors impacting the acquisition of 21st-century skills in teacher education.

Conclusion

The study's results acknowledge the need to equip pre-service teachers with contemporary 21st-century skills, such as collaboration, critical thinking, creativity, and communication, especially in rural South African contexts. The study attests to the fact that collaborative and communication skills are effectively fostered in the Teacher Education Curriculum at the selected university (RQ1 and RQ4), with reports from pre-service teachers of being engaged in group-based learning and structured communication tasks. The critical thinking and creative problem-solving skills, conversely, do not appear to be so consistently developed (RQ2 and RQ3), hence the Teacher Education Curriculum is able to provide some level of foundation, although it needs to be enhanced to be able to fully nurture analytical reasoning and innovation. These findings underscore the validity of the theoretical frameworks, namely Self-Regulated Learning, Technological Pedagogical Content Knowledge, and Social Justice Pedagogy, in explaining how pre-service teachers relate to and negotiate the curriculum. The study further highlights systemic barriers to the full realization of 21st-century skills, especially in the realms of digital accessibility and pedagogical consistency. The inconsistent use of digital tools, coupled with inadequate ICT infrastructure, further disadvantages students with an already precarious socioeconomic background. This scenario calls for curriculum change with social justice at its core. Those involved in curriculum design must, therefore, strive to incorporate more areas of experiential learning, interdisciplinary collaboration, and problem-based learning into the Teacher Education Curriculum. At the same time, university administrators and policymakers will do well to invest in the required digital infrastructure and the professional development of faculty on an ongoing basis. In addition, teacher educators need to be created in such a fashion that they can effectively model the technology-integrated pedagogical practices themselves. Pre-service teachers should also be motivated to engage in self-directed learning activities aimed at enhancing their adaptiveness and resilience-a major principle of Self-Regulated Learning. The present findings form a basis to undertake further research that investigates the longitudinal effects of the Teacher Education Curriculum on skill-building, especially within under-resourced institutions. The employment of mixed-methods designs, and comparative research conducted across rural and urban universities might further provide more clarity concerning how contextual factors impact on the development of 21st-century skills. This will indeed lead to further application of this study's results and may contribute towards evidence-based intervention to improve teacher education in South Africa. In essence, it is placing curriculum, pedagogy, and policy on the very edge of the current needs of a society where pre-service teachers should be adequately prepared to face the daunting challenges of today's classrooms.

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Appendix 1: Survey Questionnaire

Title: *Evaluating the Impact of the Teacher Education Curriculum (TEC) on 21st-Century Skills Development Among Pre-service Teachers*

Section A: Demographic Information

(Please tick or fill in the appropriate response)

1. **Gender:**

- Male
- Female
- Other (please specify): _____

2. **Age Group:**

- Under 20
- 21–25
- 26–30
- Above 30

3. **Year of Study:**

- 2nd Year
- 3rd Year
- 4th Year
- PGCE

4. **Programme/Department:**

- Primary School Education
- Secondary School Education
- Postgraduate (PGCE)

5. **Access to Digital Devices (Laptop, Smartphone, etc.):**

- Yes
- No

6. **Frequency of Internet Access:**

- Daily
- Several times a week
- Rarely
- Never

Section B: Development of 21st-Century Skills

Instructions: Indicate the extent to which you believe the Teacher Education Curriculum (TEC) supports your development in the following areas, using the scale provided.

Scale:
1 = Not Demonstrated | 2 = Minimally Demonstrated | 3 = Moderately Demonstrated | 4 = Highly Demonstrated

B1. Collaborative Skills

To what extent has the Teacher Education Curriculum enabled you to:

Item	1	2	3	4
Exhibit professionalism and mutual respect in group tasks	[ ]	[ ]	[ ]	[ ]
Integrate diverse perspectives in team discussions	[ ]	[ ]	[ ]	[ ]
Ensure all group members contribute equitably	[ ]	[ ]	[ ]	[ ]
Support peers constructively during collaboration	[ ]	[ ]	[ ]	[ ]
Respond to peer feedback to improve group outcomes	[ ]	[ ]	[ ]	[ ]
Participate in shared responsibilities (e.g., group projects)	[ ]	[ ]	[ ]	[ ]
Follow group norms and collaboration protocols	[ ]	[ ]	[ ]	[ ]

B2. Critical Thinking and Analytical Reasoning

To what extent has the Teacher Education Curriculum enabled you to:

Item	1	2	3	4
Formulate follow-up questions to deepen understanding	[ ]	[ ]	[ ]	[ ]
Develop problem-solving strategies creatively	[ ]	[ ]	[ ]	[ ]
Evaluate arguments using logical reasoning	[ ]	[ ]	[ ]	[ ]
Interpret complex issues analytically	[ ]	[ ]	[ ]	[ ]
Extract and synthesise relevant information from sources	[ ]	[ ]	[ ]	[ ]

B3. Creative and Adaptive Thinking

To what extent has the Teacher Education Curriculum enabled you to:

Item	1	2	3	4
Transfer knowledge across varied teaching situations	[ ]	[ ]	[ ]	[ ]
Adapt communication strategies to classroom needs	[ ]	[ ]	[ ]	[ ]
Generate innovative instructional ideas	[ ]	[ ]	[ ]	[ ]
Refine teaching strategies based on feedback	[ ]	[ ]	[ ]	[ ]
Design context-relevant learning solutions	[ ]	[ ]	[ ]	[ ]

B4. Communication Skills (Oral, Written, Digital)

To what extent has the Teacher Education Curriculum enabled you to:

Item	1	2	3	4
Facilitate and manage professional meetings	[ ]	[ ]	[ ]	[ ]
Organise and present information logically	[ ]	[ ]	[ ]	[ ]
Track and manage group objectives	[ ]	[ ]	[ ]	[ ]
Communicate clearly in academic/professional settings	[ ]	[ ]	[ ]	[ ]
Articulate ideas coherently and persuasively	[ ]	[ ]	[ ]	[ ]

Thank you for your valuable input. Your responses will remain confidential and contribute meaningfully to the improvement of teacher education in South Africa.

Appendix 2: Breakdown of Respondents

1. Gender Distribution of Respondents (N = 384)

Gender	Frequency (n)	Percentage (%)
Male	160	41.7%
Female	224	58.3%
Total	**384**	**100.0%**

2. Participant Distribution By Year of Study and Gender with Percentages) N=384

Year of Study	Male	%	Female	%	Total	%
2nd Year	35	9.1%	46	12.0%	81	21.1%
3rd Year	42	10.9%	58	15.1%	100	26.0%
4th Year	51	13.3%	64	16.7%	115	29.9%
PGCE	32	8.3%	56	14.6%	88	22.9%
Total	**160**	**41.7%**	**224**	**58.3%**	**384**	**100%**

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