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Navigating the Challenges and Opportunities: An Exploration of Physical Sciences Student Teachers' Experiences and Identity Formation During a Five-Week Teaching Practice

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Abstract. This study explored the challenges and opportunities encountered by physical sciences student teachers during a five-week teaching practice, focusing on how these experiences shaped their professional identity formation. The research used identity formation and Situated Learning Theory as theoretical frameworks to investigate the complex interactions between classroom challenges, mentor support, and self-reflection in developing student teachers' sense of professional self. The study employed an interpretivist qualitative case study design. The study purposefully sampled 15 student teachers from a cohort of 25 student teachers. Data were collected through reflective journals and semi-structured interviews. Findings highlighted key challenges such as managing large class sizes and difficulty differentiating instruction for students with diverse abilities. Despite these obstacles, student teachers reflected on their professionalism, with many reporting increased confidence and autonomy by the end of the practice period. The study, therefore, recommends strengthening mentorship programmes and providing more resources to support student teachers on their journey of becoming professional science teachers.

Keywords: identity formation; mentorship; physical sciences education; reflective practice; situated learning; student teachers; teaching practice

1. Introduction

Teacher training programmes in South Africa often consist of a blend of academic coursework and actual teaching practice. The Bachelor of Education (B.Ed.) degree and the Postgraduate Certificate in Education (PGCE) are the two pathways to attaining a teaching qualification. The B.Ed. is a four-year

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undergraduate degree, whereas the PGCE is a one-year programme designed for graduates aspiring to enter the teaching profession (Department of Higher Education and Training [DHET], 2011). These programmes encompass subject-specific content, pedagogical theory, and practical training, strongly emphasising equipping teachers to teach in diverse and multilingual classrooms (Hugo, 2010) and assuring their qualifications to facilitate and assist learning in educational institutions. These programmes further enhance teachers' practices in the classroom, which is essential for advancing learning (Fleur & Dlamini, 2022). Marais et al. (2019) and Velthuis et al. (2014) contend that teacher ability influences educational quality. This implies that student teachers must be equipped to address students' learning requirements and determine the most appropriate pedagogical approaches, as affirmed by Osman and Booth (2014). Osman and Booth (2014) further assert that teacher education programmes should cultivate teachers capable of teaching in all schools nationwide rather than solely in elite institutions designated for the privileged minority.

Nonetheless, the practical component, referred to as Work-Integrated Learning (WIL), Teaching Practice (TP), or School-Based Experience (SBE), is essential for teacher preparation and crucial for cultivating the expertise of student teachers as emerging professionals (Mena et al., 2017). According to Wieman (2022), student teachers are assigned to schools during teaching practice to get practical teaching experience, which enables them to apply theoretical knowledge and cultivate classroom management inside a school environment, learn to overcome disciplinary issues, handle unfamiliar situations and interact with the realities of the South African education system, as affirmed by Zondo and Adu (2024). Strategies, such as mentoring student teachers, peer teaching, teacher support activities, and promoting learning communities, influence the student teachers' identity formation (Beauchamp & Thomas, 2009; Chan & Lo, 2016).

The DHET (2015) stipulates that student teachers must attend at least 80% of their school experience courses to guarantee a cohesive teaching year. Through adherence to a professional code of ethics, provision of sufficient school preparation and attention to diverse student needs, teaching practice facilitates student teachers' full engagement in teaching as they ready themselves for their roles (Zondo & Adu, 2024). However, Boateng and Tatira (2023) show that student teachers in physical sciences frequently encounter difficulties throughout their teaching practice as they struggle to balance mastering the subject content with cultivating effective teaching skills. In addition, Yazan's study (2018) reveals that student teachers encountered diverse emotional states during their teaching practicum and developed skills to regulate these emotions, contributing to their teacher identity development.

This dual challenge may generate conflicts that affect their self-efficacy and identification as prospective educators (Flores & Day, 2006). Moreover, conventional teacher preparation experiences frequently do not expose student teachers to the comprehensive dynamics of the educational landscape, as specific interactions and activities are contingent upon conflict and only arise when opposing forces generate imbalances and inequity (Cochran-Smith et al., 2015;

Zeichner, 2010). Nonetheless, the opportunities for professional development that emerge during teaching practice, including mentorship and reflective practice, are essential in creating student teacher identities. The literature indicates that the professional development of student teachers aligns with the enhancement of subject knowledge, the implementation of specific strategies to elucidate phenomena and processes, and the attainment of distinctive professional skills related to pedagogical practices (Kekana & Gaigher, 2018; Stapp et al., 2019). However, the extent to which physical sciences student teachers effectively leverage these opportunities remains underexplored.

While the existing literature has extensively explored the general experiences of student teachers during teaching practice (Karsli & Yağiz, 2022; Mbhiza et al., 2024), there remains a significant gap in understanding how these experiences impact the identity formation of physical sciences student teachers. Understanding the distinct problems and opportunities faced by student teachers during this pivotal phase is crucial for enhancing teacher education programmes and bolstering support structures for prospective science educators. This study aimed to enhance science education and teacher preparation by investigating the experiences of physical sciences student teachers during a five-week teaching practice and analysing how these experiences influence their identity formation, thereby offering insights to inform the design of teacher education programmes and support the development of future educators in this essential discipline. Moreover, by exploring the intersection of practical experiences and identity formation, this study contributes to the broader discourse on teacher development and the cultivation of effective science teachers.

The following research questions guided the study:

1. What professional growth and skill development opportunities do physical sciences student teachers gain during teaching practice?
2. How do the experiences during teaching practice contribute to the identity formation of physical sciences student teachers, particularly regarding their self-concept as educators and their commitment to the teaching profession?
3. What challenges do physical sciences student teachers encounter during teaching practice?
4. How do the challenges physical science student teachers encounter during teaching practice influence their teaching effectiveness and professional development?

2. Literature Review

2.1 Structure and Components of the South African Teacher Preparation Programmes

Teacher training programmes in South Africa have been changed substantially, especially in reaction to the nation's political and socioeconomic changes. During the apartheid era, teacher education was significantly fragmented and racially separated, leading to substantial differences in the quality of education afforded to various ethnic groups (Sayed & Ahmed, 2011). Post-apartheid reforms sought to rectify these disparities and provide a more cohesive and egalitarian

educational framework. The implementation of the National Qualifications Framework (NQF) and the formulation of new regulations, including the Norms and Standards for Educators (NSE) in 2000 (Department of Education, 2000), were essential in transforming teacher education in South Africa (Council on Higher Education [CHE], 2010; Jansen, 2004). These reforms underscored that teacher education programmes must cultivate reflective, proficient, and socially responsive educators capable of contributing to the nation's democratic evolution.

Effective teacher preparation programmes possess an integrative design, wherein coursework and practical experiences in schools mutually reinforce each other (Darling-Hammond, 2017). Similarly, South African teacher preparation programmes often blend academic training and actual teaching practice. The teaching practice component in teacher preparation programmes in South African universities is recognised as a vital aspect in cultivating successful educators (Nkambule & Mukeredzi, 2017). This component enables student teachers to link academic knowledge with practical application. It enables them to interact with authentic classroom settings, evaluate their pedagogical approaches, and cultivate professional identities (du Plessis, 2015; Marais & Meier, 2004). This experience aims to familiarise student teachers with classroom realities, encompassing the management of learner diversity, the planning of lessons, and the navigation of classroom dynamics within the education system (Aglazor, 2017). Research indicates that teaching practice is a developmental phase in which student teachers' perspectives of the profession are formed and their pedagogical skills are refined (Demir & Nihat Sad, 2021; Pečiuliauskienė & Kaminskienė, 2022; Zondo & Adu, 2024). The guidance offered by experienced educators at this time is crucial for directing student teachers and providing them with constructive comments.

2.2 Opportunities for Professional Growth During Teaching Practice

In South African universities, the teaching practice period also presents opportunities for student teachers to develop their professional identity and teaching skills. One of the primary benefits of teaching practice is the opportunity for student teachers to engage in reflective practices that foster professional growth. Rrustemi and Kurteshi (2023) assert that pedagogical practice is essential for developing professional skills, as it allows student teachers to confront real classroom challenges and apply their theoretical knowledge. This assertion is supported by Abdulai (2021), who notes that student teachers benefit from reflecting on their lessons, individually and collaboratively, enhancing their understanding of effective teaching strategies. Reflection not only aids in assimilating pedagogical theories but also encourages critical thinking and self-assessment, which are vital for professional development (Iqbal et al., 2015).

Zhao and Zhang (2017) emphasise that support from mentors and the broader educational community significantly influences pre-service teachers' professional identity. This mentorship provides guidance and feedback, which is crucial for developing teaching competencies (Tao & Gao, 2017). Similarly, the school environment also plays a critical role in shaping student teachers' experiences during their teaching practice. A favourable school climate, characterised by

supportive colleagues and a collaborative atmosphere, enhances the learning experience for student teachers (Rrustemi & Kurteshi, 2023). Pratama et al. (2022) posit that direct involvement in teaching practice equips student teachers with the necessary skills to respond to contemporary educational challenges. Integrating theoretical knowledge with practical application in a supportive environment cultivates a sense of belonging and professional identity among student teachers.

2.3 Identity Formation of Physical Sciences Student Teachers

The notion of identity is contentious in modern culture and incorporates many different interpretations, including several conflicting meanings that embody distinct conceptions of the individual and society (Gergen, 2018). Essentialist perspectives regard identity as a personal trait developed during one's life, particularly with the onset of maturity (Vázquez et al., 2024). Identity consequently delineates the individual and is perceived as a constant across the diverse expressions of that individual (Vázquez et al., 2024). Conversely, the idea may be regarded as a social construct influenced by the diverse environments in which individuals evolve and exhibit various expressions arising from these situations. According to Vázquez et al. (2024), we may assume roles as parents, teachers, or participants in a sports club, among others. Within each of these identities, we cultivate distinct modes of existence and conduct as we fulfil various functions and hold diverse social and political standings. Within the framework of this debate between essentialism and constructivism, the interpretations of the teacher's identity can vary significantly and exhibit numerous variations (Akkerman & Meijer, 2011).

The teacher's professional identity is a multifaceted and intricate construct comprising various elements recognised in prior research: self-image, motivation, commitment, self-efficacy, beliefs, and job satisfaction (Hanna, 2020). Student teachers carry their personal histories into teacher education, including recollections of their own student experiences, pedagogical ideas, extensive informal learning about teaching, and perceptions of an ideal educator (Anspal et al., 2012; Palmér, 2016). Embracing a professional teacher identity transcends affiliation with a certain group (Ruohotie-Lyhty & Moate, 2016). Student teachers are actively involved in the process, exerting significant work, energy, and dedication to establish their identities as educators. Student teachers encounter tensions in forming their teacher identity, prompting them to assert their agency, which subsequently influences the evolution of their identity (Tao & Gao, 2017).

Purwaningsih et al. (2020) conducted a study examining the identity formation of an Indonesian physics student teacher within the framework of the Indonesian physics teacher preparation programme. The study revealed complex viewpoints on identity development, indicating that the student teacher identity was shaped by rhetorical abilities acquired through participation in university-sponsored student organisations. The study offers significant insights into the intricacies of student teacher identity, emphasising the various aspects that contribute to the development of a professional identity. This suggests that, for student teachers in physical sciences, comprehending the complex nature of identity formation can assist them in overcoming the problems of teaching practice and cultivating a

robust professional identity. This adaptability is essential for effective teaching and is corroborated by studies demonstrating that educators with robust professional identities are more proficient in promoting student engagement and learning outcomes (Nawab & Zada, 2023).

2.4 Challenges Physical Sciences Student Teachers Faced During Teaching Practice

Gravett and Jiyane (2019) assert that students who are preparing to teach in different international settings attest to the importance of school-based practice as they derive greater benefits from the practice than from other elements of their teacher preparation programme (White & Forgasz, 2016). Darling-Hammond (2017) affirms this assertion by indicating that teaching practice enables student teachers to implement their theoretical knowledge in practical environments by facilitating the development of classroom management skills, instructional strategies, and approaches for engaging students. Despite the advantages student teachers gain from teaching practice, Zeichner (2010) emphasises the challenges many student teachers encounter in reconciling theory with practice, particularly in physical sciences, where topic knowledge must be adeptly converted into practical application. The literature indicates that inadequate support from mentor teachers and the school environment constitutes a substantial obstacle (Hudson, 2013). Mbhiza et al. (2024) examined student teachers' mentorship experiences during teaching practice. They discovered that student teachers perceived a lack of support from rural mentors, in contrast to their experiences with urban mentors, since rural mentors occasionally neglected lessons on their behalf. This indicates the necessity for rural school-based mentors to be integrated into university role expectations to enable their effective support of student teachers during teaching practice. Al-Momani's (2016) study examined teaching practices at the Faculty of Education from the viewpoints of supervisors and pre-service teachers. The results indicate that issues regarding instruction, communication skills, and the application of ideas were prevalent challenges. Moreover, Nasir and Zafar (2018) indicate that student teachers encountered challenges in controlling classroom time. Specifically, allocating sufficient time for each task minimises excessive time spent reviewing students' homework, providing directions, and recording attendance. Effective classroom management is essential for creating a conducive learning environment, and studies have shown that teachers who employ proactive management strategies can significantly improve student behaviour and engagement (Krajcik et al., 2022). The challenge of managing classroom behaviour is compounded by overcrowding and poor classroom arrangements, which can hinder effective teaching and learning.

3. Theoretical Framework

Drawing upon the theoretical frameworks of identity formation and situated learning, this study analysed how the experiences encountered by physical sciences student teachers during their teaching practice contribute to the construction of their professional identities.

3.1 Situated Learning Theory

Situated Learning Theory (Lave & Wenger, 1991) asserts that learning transpires through engagement in social and cultural activities, highlighting the significance of context and community in the educational process. Situated Learning Theory posits that knowledge must be imparted within a genuine environment. Students must engage in genuine contexts of daily practice, utilising knowledge and employing objects in constructive yet low-risk ways. This typically necessitates social engagement and cooperation within the community of practice. Nonetheless, learners progressively detach from this community to participate in more dynamic and intricate activities, transitioning into the role of the expert. This process typically transpires inadvertently (Lave & Wenger, 1991). This concept is particularly pertinent to this study since it encompasses student teachers' immersion in the school environment and their interactions with mentors, classmates, and learners. They obtain practical pedagogical skills and cultivate their professional identities through this engagement. The notion of communities of practice within Situated Learning Theory is crucial in comprehending how student teachers assimilate into the teaching community, navigate their roles, and construct their identities as educators through interactions with teachers and colleagues.

3.2 Teacher Identity Theory

Pennington and Richards (2016) conceptualise teacher identity as a collection of competencies, including teachers' language, disciplinary knowledge, teaching context, self-awareness, student learning, the application of knowledge in practice, the transformation of practice into knowledge, and participation in learning communities. Ahmad et al. (2018) established five qualities that define teacher professional identity concerning teacher learning: context, collaboration, classroom practices, teacher self-efficacy, and agency.

The principal objective of Teacher Identity Theory is to delineate how the meanings associated with different identities are negotiated and regulated in interactions. Identity theorists (Ahmad et al, 2018; Pennington & Richards, 2016) specifically examine the interrelations among identities, considering their propensity to emerge in various contexts and their significance to individuals, alongside their connections to role performance, emotional states, physical and mental well-being (including stress, anxiety, and depression), and self-concept (encompassing self-esteem, self-efficacy, and self-authenticity). Teacher identity is increasingly understood as a dynamic process, shaped and reshaped through dialogues in diverse contexts and relationships. Teacher identity is therefore characterised by instability, being continuous and subject to change (Akkerman & Meijer, 2011; Trent, 2010). This suggests that if student teachers reflect on their practicum experiences, assess the influence of the practicum on their identity, and envision their future roles as science educators, they can actively influence their professional paths and ambitions in the field of education.

4. Methodology

4.1 Research Design

This study adopted an interpretive qualitative approach that focused on individual experiences that connect directly with the purpose of the study (Patton, 2015). An interpretivist qualitative case study design (Yin, 2018) was suitable for this study, which sought to explore physical sciences student teachers' subjective experiences and perceptions as they navigate the complexities of their teaching practice. This approach allowed for an in-depth exploration of the lived experiences of student teachers, enabling researchers to uncover the underlying meanings, beliefs, and values that inform their professional identities.

4.2 Sampling and Sampling Procedure

The study employed purposeful sampling to select 15 student teachers from one class of the Natural Science Division based on their ability to describe their experiences with the phenomenon (Creswell & Poth, 2018). The choice of 15 participants from a population of 25 third-year student teachers was driven by both practical and methodological considerations. First, the decision ensured the manageability of data collection and in-depth qualitative analysis, particularly given the reflective nature of the assessments, which required a detailed examination of individual responses. This sample size allowed for a meaningful yet focused exploration of the research questions, while still representing a significant portion (approximately 71%) of the total population, which enhanced representativeness within the cohort.

The participants selected for this study were student teachers in their third year of study. Third-year student teachers were chosen specifically because they are at a critical stage in their training. At this point, they have completed foundational coursework and are preparing for extended teaching practice, making them ideal for reflecting on their pedagogical development and learning experiences. This stage provides valuable insights into their evolving understanding and skills, which aligned closely with the study's objectives.

4.3 Research Instruments

Semi-structured interviews and reflective writing were employed as instruments for data generation. The interview questions and the reflective assessments were guided by specific questions concerning their experiences during teaching practice, their teaching practices, their identity formation, the opportunities for professional development, and the challenges they might experience. Questions included: *What kinds of support (mentorship, resources, training) did you receive during your teaching practice, and how did they impact your experience and development?* This reflective task was used to help pre-service teachers identify the support systems for pre-service teachers in the schools and how the support impacted their experience and development. This enabled the researchers to gauge the effectiveness of mentoring and resources in fostering pre-service teachers' professional growth and confidence. This information could inform future programme improvements.

As part of their teaching practice portfolio, student teachers must submit reflective assessments after their practice teaching. To achieve this, 15 reflective assessments were randomly selected. The same group of student teachers, whose reflective assessments were selected, was also interviewed. The data generated were analysed thematically using Clarke and Braun's (2016) approach. Initially, the researchers listened attentively, copied the recorded information verbatim, and reviewed each participant's reflection activity separately to ensure thorough data comprehension. Upon reviewing the generated written and recorded data, the researchers established the preliminary codes and documented any recurring patterns pertinent to the research topics. Subsequently, pertinent codes were aggregated as they appeared and were classified to establish themes. Themes were rigorously analysed to extract pertinent information addressing the study questions and formulated into the closing theme. The themes were organised to answer the research questions systematically.

4.4 Ethical Considerations

Data were generated after obtaining ethical clearance from the university and informed consent from the intended participants. The three core ethical principles in educational research were followed. The researchers obtained informed consent from all the participants (Creswell & Creswell, 2017). Additionally, the researchers ensured the participants' privacy, confidentiality, and anonymity by using pseudonyms. This included avoiding practices that could lead to stress, embarrassment, or discomfort for student teachers (Mertens, 2023). The researchers explained the purpose of the study in detail and their emphasised participants' right to withdraw should they feel uncomfortable continuing.

5. Findings

Through a detailed analysis of the data, this section highlights the significant experiences of student teachers, the opportunities for growth, the challenges faced, the strategies they employed to overcome these obstacles, and how these experiences influenced their professional identity development. The findings are structured to address the core research questions, clearly explaining how the teaching practice impacted their teaching skills and their sense of self as future teachers. This section serves as a foundation for the subsequent discussion, where these results are further contextualised and analysed.

5.1 Demographic Profile of Physical Sciences Student Teachers

The study participants included 15 student teachers in their third year of study toward a four-year B.Ed. These individuals participated in a five-week teaching practice in rural schools across South Africa after completing a methodology course in the first semester. Of the 15 participants, five (33%) were female, and 10 (67%) were male. This gender distribution contradicts the broader trend in education, where a higher percentage of female students pursue teaching degrees. The age of the pre-service teachers ranged from 20 to 24 years, with an average age of 22. This relatively young age group indicates that the participants were likely in the early stages of their professional development and were still forming their teaching identities. The ethnic composition of the participants was not diverse, with most pre-service teachers representing Xhosa ethnic groups (90%).

All participants had completed their first two years of study, which included foundational education courses, content subject courses, and initial practical experiences. Before their teaching practice, they completed a methodology course that equipped them with pedagogical skills and strategies. This foundational knowledge was crucial for their readiness to engage with learners in rural settings. Given South Africa's linguistic diversity, language proficiency among the participants varied. All participants (100%) were fluent in English, while 90% spoke at least one African language (primarily isiXhosa, isiSesotho or isiZulu). This linguistic ability allowed them to communicate effectively with a broader range of learners in rural schools.

5.2 Presentation of Data

The data obtained from student teachers were categorised into four main themes: *Student teachers' beliefs about physical sciences education*; *student teachers' learning opportunities*; *student teachers' identity formation* and *student teachers' challenges during teaching practice*.

5.2.1 *Theme 1: Student teachers' beliefs about physical sciences education*

Theme 1 explored student teachers' responses regarding their beliefs about the purpose of physical sciences education. The responses reflect a consensus on several key sub-themes that included: *development of scientific knowledge and understanding; nurturing critical thinking and problem-solving skills; and the motivation and preparation for real-world teaching*.

a) *Sub-theme 1: Development of scientific knowledge and understanding*

When physical sciences student teachers were asked what they think the purpose of physical sciences education is, the responses consistently emphasised the importance of giving students a broad understanding of fundamental principles and concepts in physics, chemistry, and related fields. This foundational knowledge is essential for a comprehensive understanding of the natural world. Participants note the aim to equip students with a deep understanding of the natural world, which aligns with the broader educational goal of scientific literacy, as exemplified by participant STB's statement, while participant STA concurred, stating:

> *"To provide students with a broad understanding of physics and chemistry principles and concepts. It aims to develop their critical thinking, problem-solving, analytical skills, and ability to apply scientific knowledge in real-world situations."* (STB, student journal excerpt)

> *"To prepare students for a more complex and rapidly changing world and to allow the students to think critically and solve problems; for example, it allows them to evaluate and analyse scientific data."* (STA, student journal excerpt)

Participants asserted that physical sciences foster knowledge and skills in scientific inquiry and problem-solving, the development and application of scientific and technological knowledge, and an understanding of the nature of science and its connections to technology, society, and the environment. This

implies that the participants believed that the purpose of physical sciences education is to provide students with knowledge, skills, and critical thinking abilities to understand the natural world around them. It also develops scientific literacy, problem-solving skills, and analytical thinking among learners who take physical sciences as a school subject. Although participants believe that physical sciences promote knowledge and scientific understanding, when they were asked about whether they perceived the subject of physical sciences as easy or difficult, they responded that the subject is both challenging and fascinating and involves complex concepts and mathematical calculations, which can make it difficult for some learners. However, with proper guidance and engaging teaching methods, the subject can be made accessible and interesting.

b) *Sub-theme 2: Nurturing critical thinking and problem-solving skills*

Several responses explicitly mentioned the role of physical sciences education in enabling students to "evaluate" and "analyse" data. A recurring theme across the responses is the emphasis on developing critical thinking and problem-solving skills. Thus, the cultivation of these skills is seen as a vital component of effective physical sciences education. The participants highlighted the role of physical sciences education in preparing learners for careers in science, technology, engineering and mathematics (STEM) fields. This preparation is not only about acquiring knowledge but also about cultivating skills that are essential for success in these areas. Two student teachers mentioned:

> *"Teaching physical sciences nurtures students' ability to break down complex concepts and analyse them step by step. This approach helps students improve at evaluating information and making informed decisions in science and everyday life."* (STA, student interview excerpt)

> *"Physical sciences teaches students to ask 'why' and 'how' questions. It is not just about memorising facts but about understanding the underlying principles. Ah ... you see, this inquiry-based approach builds critical thinking as students must justify their conclusions through evidence."* (STE, interview excerpt)

The responses also reflect a desire to inspire curiosity, creativity, and innovation among students. Inquiry-based learning is particularly relevant in physical sciences education, where hands-on experiments and real-world applications can enhance student engagement and understanding.

c) *Sub-Theme 3: The motivation and preparation for real-world teaching*

When asked about their motivations for pursuing a career in physical sciences education, many participants cited a desire to impact learners' lives positively, a passion for their subject areas, and a commitment to community development. This intrinsic motivation is essential for fostering resilience and adaptability in challenging teaching environments. Moreover, motivation and preparation for real-world teaching are essential beliefs student teachers hold. Many service teachers express a desire to make science relevant and applicable to everyday life, which is crucial for engaging students. The student teachers expressed varied

aspirations for their future careers, with interests ranging from teaching in rural schools, with few indicating pursuing further studies in educational leadership or specialisation in specific subjects at the postgraduate level of education. Others aimed to engage in community development projects related to physical sciences education. STD stated:

> *"As a student teacher, my motivation comes from my passion for inspiring curiosity and critical thinking in learners. Science is not just a subject but a way of understanding the world, and I am driven by the opportunity to make it relatable and meaningful to my students. Regarding preparation, I have invested time in deepening my subject knowledge and understanding of the curriculum."*

5.2.2 *Theme 2: Student teachers' learning opportunities*

Theme 2 focuses on the opportunities student teachers experience during teaching practice. The responses to the question reveal multifaceted views of development avenues that student teachers pursue. The participants highlighted several key areas, such as mentoring and reflective practices. Each element is critical in enhancing teaching efficacy and pedagogical skills, which are essential for nurturing student engagement with and understanding of physical sciences. The responses reflect a consensus on several key sub-themes, including participation in professional development sessions, reflective practices, and mentorship.

a) *Sub-theme 1: Participation in professional development sessions*

Professional development sessions also constitute a vital opportunity for growth, as they provide structured environments for student teachers to enhance their pedagogical skills and content knowledge. When participants were asked about the opportunities presented by their host schools during teaching practice, three participants highlighted the following in their journals and concurred during the interviews:

> *"During my teaching practice in physical sciences, I identified opportunities for professional growth through collaboration with the experienced teachers in my host school. I was invited to attend a content gap workshop. I was also invited to sit in my mentor's classroom and discuss his lesson afterwards. For each lesson I teach, my mentor holds a session with me to discuss the lesson for the day as I reflect on my lesson with him."* (STK, student interview excerpt)

> *"There are not many, but I will mention a few collaborations with colleagues, developing leadership styles and participating in Science Week activities."* (STO, student interview excerpt)

> *"During my teaching practice in physical sciences, I identified several opportunities for professional growth, such as participation in staff meetings where I could see teachers sharing insights and gaining feedback. I also learnt how to develop more effective assessment and feedback strategies to improve student understanding and engagement and classroom management and organisation techniques."* (STF, student journal excerpt)

Furthermore, improving classroom management and organisation techniques was identified as a significant opportunity for professional growth. Effective classroom management is essential for creating a conducive learning environment, and many educators expressed a need to refine their skills in this area.

b) *Sub-theme 2: Reflective practices*

The participants highlighted the importance of reflective practices as an opportunity for growth. The participants indicated that they reflect on the importance of classroom management in shaping teachers' self-efficacy beliefs during their practicum experiences. This suggests that professional development, focused on classroom management, can profoundly impact student teachers' confidence and effectiveness. The responses also highlighted the importance of enhancing content knowledge and pedagogical skills. A deep understanding of the subject matter is crucial for effective teaching, and many student teachers expressed a desire to strengthen their knowledge of physical sciences in their journals. This underlines the need for ongoing professional development that deepens teachers' understanding of their teaching content.

c) *5.2.3 Sub-theme 3: Mentorship*

When student teachers were asked about their mentorship experiences, their responses indicated a multifaceted approach to leveraging mentorship, which encompasses seeking feedback, observing seasoned teachers, engaging in collaborative planning, and participating in professional development workshops. The student teachers also reflected on their mentorship experiences in their journals. Two student teachers shared their views:

> "*I was mentored by experienced physical sciences teachers in my host school. I seek their advice, observing their teaching practices and discussing classroom challenges. They provided valuable feedback and guidance that helped me improve my teaching skills.*" (STD, student teacher interview excerpt)

> "*My mentor taught me to embrace challenges, learn from failures and persist in facing obstacles. He provided enough feedback on my lesson plans. He sits behind my classroom and observes me teach the subject. After that, he coached me on what to do next and how I should have done it. He will share his classroom didactics. He assisted me with classroom management issues, discipline, and how to teach confidently.*" (STC, student teacher journal excerpt)

These responses indicated that student teachers were mentored by experienced teachers who provided regular feedback and constructive criticism on their lesson plans and teaching strategies after lesson observations. In these mentoring sessions, student teachers and their mentors engaged in reflective discussions and debriefing to share experiences and best practices.

5.2.3 *Theme 3: Student teachers' identity formation*

Theme 3 explored how the experiences of teaching physical sciences during teaching practice contribute to shaping student teachers' professional identities, influencing their confidence, teaching philosophy and a sense of belonging within the educational community. Their responses reflected a consensus on several key sub-themes, including professional identity development, the transition to becoming a teacher, and long-term aspirations and confidence.

a) *Sub-theme 1: Professional identity development*

When student teachers were asked in what ways they felt their professional identity as a physical sciences student teacher began to take shape during the teaching practice, they responded that teaching physical sciences had played a significant role in shaping their professional identities. Two student teachers explained:

> *"Learning and teaching physical sciences has played a huge role in shaping my professional identity. At first, I struggled with seeing myself as a science teacher because teaching such a challenging subject felt intimidating. However, through practice, I have learned to break down complex topics for my learners, which has given me confidence in my teaching skills and my identity as a teacher. I now feel more competent and purposeful in my role, knowing I can help learners understand concepts they thought were too difficult."* (STA, student teacher interview excerpts)

> *"Teaching physical sciences has been critical to developing my professional identity because it is more than just delivering content. It is about developing a mindset of inquiry and problem-solving. I now see myself as a teacher and a guide who helps learners approach science curiously."* (STK, student teacher interview excerpts)

These responses reflect how student teachers' experiences in physical sciences contribute to forming their professional identities, helping them to develop confidence, a sense of purpose, and a commitment to continuous learning and inquiry. As student teachers engage in practical experiences, they cultivate confidence and authority, which is crucial for effective teaching. This confidence is often linked to their perceived competence in subject matter knowledge and their ability to create engaging learning environments. This shift is not merely a change in role but represents a fundamental reorientation in how individuals engage with the educational process. Student teachers also indicated in their journals that engaging with experienced teachers and peers allowed them to share experiences, reflect on their practices, and gain insights into effective teaching strategies.

b) *Sub-theme 2: The transition to becoming a teacher*

When reading the student teachers' responses from the journals, the participants highlighted various dimensions of this progression, emphasising the shift from passive learning to active facilitation, the development of pedagogical skills, and the cultivation of a supportive classroom environment. Most student teachers articulated a clear transformation from passive recipients of knowledge to active

facilitators of learning and adapting to their learners' diverse needs and learning styles. As the respondents noted, they began to take ownership of their students' learning experiences, reflecting a deeper understanding of the pedagogical responsibilities of teaching. This implies that the student teachers experienced a newfound responsibility to guide and support their students, highlighting the importance of self-reflection and metacognitive skills in their development as teachers.

c) *Sub-theme 3: Long-term aspirations and confidence*

When student teachers were asked about their long-term aspirations, their responses consistently expressed that teaching practice experiences have reinforced their commitment to becoming effective physical sciences teachers, highlighting a significant correlation between teaching experience and professional aspirations. Moreover, the respondents noted increased confidence levels attributed to the practical strategies they developed while teaching for the second time. The iterative nature of teaching allows the student teachers to have the confidence and the mindset for a long-term aspiration to be teachers. One student teacher shared the following:

> *"As a student teacher, I aspire to become an effective teacher who imparts knowledge and inspires and supports my students in their personal growth. I also aspire to continuously develop my own teaching skills and stay updated on innovative teaching practices. In terms of confidence, I believe I have gained more confidence in my ability to manage classrooms, plan lessons, and respond to students' needs since starting my teaching practice."* (STC, excerpt from journal reflections)

5.2.4 *Theme 4: Student teachers' challenges during teaching practice*

When the student teachers were asked to share their challenges during teaching practice, most mentioned learner disengagement in the class activities, citing a lack of interest in physical sciences. This issue is common in educational settings, particularly in subjects perceived as difficult, such as physical sciences. Furthermore, traditional teaching methods have been shown to contribute to this disengagement, as students often find the "talk to chalk" approach of teaching less stimulating than interactive or project-based learning approaches. The participants noted that, despite attempts to implement more engaging methods during their second teaching experience, not all learners responded positively, suggesting a need for differentiated instructional strategies to cater to different learning preferences. Two student teachers wrote the following in their journals:

> *"I struggled with a lack of resources, especially when conducting experiments. Practical work is crucial in physical sciences, but the school had few working science kits. I had to get creative with simulations and videos from my laptop, which wasted my time. This limited the students' understanding of the topic I was teaching."* (STO, student teacher journal excerpt)

> *"My challenge was explaining complex concepts like Newton's laws or electricity to students with different levels of understanding. Some students grasped the material quickly, but others struggled, and I had to simplify the lessons without diluting the content. It was a balancing act to*

> *keep the advanced students engaged while ensuring the struggling students did not fall behind. I also struggled to reach everyone because of the many learners."* (STG, student teacher journal excerpt)

Classroom management emerged as another significant challenge. The respondents highlighted the difficulty of managing diverse student behaviours and dynamics, particularly when adapting to new groups with varying personalities and learning styles. Pacing of lessons was another challenge that student teachers faced during their teaching practice. The complexity of physical science concepts often requires more time for thorough explanation and understanding. Respondents noted that some topics took longer to teach than anticipated, leading to time constraints covering the entire curriculum. Participants reported difficulties managing student misconceptions and prior knowledge and adapting instruction to the varied learning styles and abilities.

6. Discussions

The findings of this study revealed significant insights into the experiences of physical sciences student teachers during their five-week teaching practice, which were analysed in the context of two key theoretical frameworks, Situated Learning Theory (Lave & Wenger, 1991) and Teacher Identity Theory (Pennington & Richards, 2016), how they align with existing literature, and the potential impact of these experiences on the future development of student teachers' professional identities.

The first finding shows that student teachers collectively perceive physical sciences education as instrumental in developing scientific knowledge, critical thinking, and problem-solving skills, alongside motivating and preparing students for real-world challenges. Situated Learning Theory emphasises learning as a social practice, asserting that knowledge is constructed within specific contexts (Lave & Wenger, 1991). This aligns with the participants' emphasis on teaching scientific inquiry and fostering understanding of the relationship between science, technology, and society.

Participants highlighted the role of physical sciences in promoting analytical and evaluative skills, resonating with Hattie's (2009) assertion that critical thinking is vital for engaging with complex issues. This perspective mirrors the theoretical focus of Situated Learning on participation and problem-solving within authentic contexts. Similarly, the Teacher Identity Theory underscores the importance of aligning personal beliefs with professional roles, which is reflected in the participants' views on fostering curiosity and innovation in their students (Beijaard et al., 2004). The literature further supports these findings, as studies have shown that integrating critical thinking and inquiry-based strategies enhance teaching effectiveness and student engagement (Velthuis et al., 2014), reinforcing the need for teachers to cultivate societal awareness and scientific literacy among learners.

The second finding underscores the significance of mentoring and reflective practices in shaping student teachers' pedagogical skills and efficacy. Situated

Learning Theory's concept of legitimate peripheral participation is evident in the mentorship process, where student teachers gradually assume teaching responsibilities under the guidance of experienced mentors (Lave & Wenger, 1991). Constructive feedback emerged as a cornerstone of professional development, aligning with Stapp et al.'s (2019) research that highlights the transformative impact of structured feedback mechanisms. Reflective practices also play a pivotal role in developing teacher identity. As participants reflected on classroom management and instructional strategies, they articulated their beliefs and adjusted their practices, consistent with the Teacher Identity Theory's focus on evolving self-perceptions through reflection (Beijaard et al., 2004). This aligns with the findings of Njenga (2023), who noted that, while introductions to colleagues are part of mentorship, they constitute only a small part of what effective mentorship entails; rather, continuous feedback is vital for fostering teacher development (Njenga, 2023).

Professional development sessions are vital for enhancing content knowledge and pedagogical skills. This is supported by Michalsky (2012) and Pečiuliauskienė and Kaminskienė (2022) who emphasise the role of targeted development programmes in improving teaching outcomes. Reflective practices, mentorship, and professional learning opportunities collectively align theoretical knowledge with practical application, strengthening teaching confidence and instructional competence (Demir & Nihat Sad, 2021).

The third finding highlights teaching practice as a transformative experience that shapes professional identity. Participants reported enhanced confidence and a shift from passive recipients of knowledge to active facilitators of learning. This transition reflects Situated Learning Theory's emphasis on learning through participation in authentic activities, which fosters a deeper connection between personal beliefs and professional roles (Lave & Wenger, 1991).

As student teachers engaged in teaching practice, they developed a sense of belonging within the educational community. This aligns with the Teacher Identity Theory, which posits that professional identity is constructed through social interactions and reflective experiences (Beijaard et al., 2004). The confidence gained through practical experiences is often linked to perceived competence in subject matter knowledge, as noted in Tao and Gao's (2017) research that underscores the iterative nature of teaching in building pedagogical skills. This aligns with educational research findings suggesting that repeated exposure to teaching enhances pedagogical skills and confidence, ultimately fostering a more substantial commitment to the profession (Yusuf et al., 2018). Teaching solidifies knowledge and cultivates a deeper understanding of the complexities of science education, which is crucial for aspiring teachers (Tao & Gao, 2017). The iterative nature of teaching allows the student teachers to have the confidence and mindset for a long-term aspiration to be teachers.

Participants also emphasised the importance of inclusivity and adaptability in teaching, reflecting a commitment to addressing diverse learner needs. Nawab and Zada (2023) assert that strong professional identities equip teachers to

navigate the complexities of modern classrooms effectively. The iterative experiences of teaching practice contribute to shaping long-term aspirations and a sustained commitment to the teaching profession.

The last finding of the study identified several challenges during teaching practice, including learner disengagement, classroom management, and time constraints. The issue of disengagement is often linked to traditional teaching methods, as interactive and project-based approaches have been shown to be more effective in stimulating interest (Krajcik et al., 2022). These findings echo the Situated Learning Theory, which advocates for active, context-driven participation to enhance learner engagement. Classroom management was another significant challenge, particularly in diverse and overcrowded classrooms. Time constraints and the pacing of lessons emerged as critical challenges, especially in teaching complex physical sciences concepts. These issues are compounded by the need to address students' misconceptions and adapt to varied learning styles, underscoring the importance of differentiated instruction (Krajcik et al., 2022).

The findings provide a nuanced understanding of the interplay between theoretical frameworks, literature, and the lived experiences of student teachers. The insights gained from these responses highlight the need for ongoing professional development, mentorship, and reflective practices to address challenges and foster the holistic development of teacher identity and pedagogical competence.

7. Conclusions and Recommendations

This study explored the experiences and identity formation of physical sciences student teachers in navigating the challenges and opportunities during a five-week teaching practice, illuminating the complex and transformative nature of teaching practice for student teachers. Grounded in teacher identity formation and situated learning frameworks, this study explored the challenges and opportunities experienced by physical sciences student teachers and their identity formation during a five-week teaching practice. The findings reveal that the participants navigated a complex interplay of personal, professional, and contextual factors, which shaped their evolving teacher identities. Challenges, such as large class sizes, limited resources, and the need to adapt theoretical knowledge to practical settings, were prominent. However, the teaching practice also presented opportunities for growth, including the development of resilience, classroom management skills, and a deeper understanding of the teaching profession. These findings underscore the multifaceted nature of identity formation in pre-service teachers and highlight the importance of teaching practice as a critical component of teacher education programmes.

However, the study was not without limitations. The sample size, although sufficient for in-depth qualitative analysis, was limited to a specific cohort within a particular context. This may affect the generalisability of the findings to other populations or regions. Additionally, the study focused on a relatively short

duration of teaching practice, which may not capture long-term identity formation processes.

The study, therefore, provides the following recommendations. The study recommends that teacher education programmes should enhance mentorship programmes by providing mentor teachers with training that emphasises constructive feedback and emotional support for student teachers. Mentors should actively facilitate identity formation by offering student teachers opportunities to gradually take more ownership of classroom activities while providing guidance and support. In addition, teacher training programmes should embed structured reflective practices within teaching practice, where student teachers can discuss their challenges and growth to make sense of their evolving identities and teaching philosophies. In addition, providing adequate resources is essential for successful teaching, particularly in the physical sciences, where practical experiments are crucial. In collaboration with schools, teacher training institutions should work toward ensuring student teachers have access to functional laboratories and learning materials. Additionally, schools should support student teachers by offering alternative solutions, such as virtual simulations, when resources are limited.

Furthermore, teacher training programmes should foster communities of practice among student teachers, mentors, and university faculty. Regular workshops or group discussions during the teaching practice periods would allow student teachers to share their experiences, exchange ideas, and receive peer support, promoting collective learning and reinforcing their professional identity formation. Student teachers would benefit from more targeted training in differentiated instruction methods to assist them to manage classrooms with students at varying levels of understanding. Providing them with strategies to adapt content without compromising rigour will enhance their teaching effectiveness and confidence. It is recommended to consider extending the duration of teaching practice beyond five weeks to allow for deeper engagement and identity formation. Prolonged exposure to the classroom environment would give student teachers more time to build confidence and refine their teaching skills in real-world settings.

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