

## Examining the Impact of Pedagogical Knowledge and Skills on Intermediate Phase Mathematics Teacher's Engagement in Chris Hani East Education District

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<b>Corresponding author:</b> Nomaroma Kumanda <a href="mailto:nkumanda@wsu.ac.za">nkumanda@wsu.ac.za</a>	<b>Abstract</b> This study examines the impact of pedagogical knowledge and skills on the engagement of intermediate-phase mathematics teachers in the Chris Hani East Education District, framed within the context of Self-Determination Theory. Given the critical role that effective teaching plays in student learning outcomes, understanding how teachers' pedagogical competencies influence their engagement is essential. Utilizing a qualitative research approach, data were collected through semi-structured interviews and focus group discussions with mathematics teachers. The findings reveal that teachers with strong pedagogical knowledge and skills are likelier to create positive learning environments that foster student engagement, aligning with the principles of autonomy and competence. Teachers lacking adequate instructional strategies reported challenges in maintaining student interest and participation. The study also identifies barriers such as insufficient resources, pressure to adhere to strict curricula, and a lack of confidence in teaching complex mathematical concepts. These insights underscore the need for targeted professional development programs that enhance teachers' pedagogical competencies, ultimately aiming to improve both teacher engagement and student learning outcomes in mathematics education. This research highlights the importance of equipping South African teachers with the necessary skills and knowledge to engage and inspire learners, thereby improving the overall learning experience.
<b>Keywords:</b> Pedagogical Knowledge; Teacher Engagement; Self-Determination Theory; Professional	

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### INTRODUCTION

The quality of mathematics education is a significant determinant of student success, particularly during the intermediate phase of schooling when foundational skills are established. Teacher engagement is crucial in this process, influencing instructional practices, student motivation, and achievement (Kunter, 2019). Effective mathematics teachers are those who possess a blend of strong pedagogical knowledge and skills, enabling them to create engaging and supportive learning environments (Darling-Hammond, Hyler and Gardner, 2017). As educational

systems strive to improve mathematics education, understanding the factors contributing to teacher engagement has become increasingly important.

In the South African context, the challenges of mathematics education are pronounced, with studies indicating persistent issues such as high dropout rates in the subject and unequal access to quality teaching (Taylor, 2021). The Department of Basic Education (2015) has recognized the need for enhanced teacher training programs focusing on pedagogical competencies, particularly mathematics. However, despite these initiatives, many teachers still struggle to engage learners effectively, highlighting the need for targeted research that examines the relationship between pedagogical knowledge, skills, and teacher engagement.

Recent research has shed light on the complexities of pedagogical knowledge, with Leijein et al. (2022) delving into the multifaceted nature of general pedagogical knowledge and its assessment methodologies. Concurrently, Kacmaz and Dube (2022) investigated the pedagogical underpinnings and mathematical knowledge embedded in educational games, revealing innovative approaches to teaching and learning. Furthermore, a comprehensive systematic review by Paidican and Arredondo (2022) critically evaluated the technological pedagogical knowledge of in-service primary education teachers, providing valuable insights for educational practice. This study explores the impact of pedagogical knowledge and skills on intermediate-phase mathematics teachers' engagement. By investigating this relationship, the research seeks to provide insights that can inform teacher training and professional development programs, ultimately enhancing the quality of mathematics education in South Africa. Understanding how factors interact will contribute to the existing body of literature and support efforts to foster more engaging and effective student learning environments.

Teacher engagement is increasingly recognized as a pivotal element in educational success worldwide. Research suggests that engaged teachers enhance their instructional practices and positively influence student outcomes (Kunter et al, 2019). In mathematics education, the interplay between pedagogical knowledge and teacher engagement becomes particularly critical, as effective teaching strategies are essential for fostering student interest and achievement in a subject often perceived as challenging (Boaler, 2016). Studies indicate that teachers with strong pedagogical skills are more adept at creating engaging learning environments, which can lead to improved student performance and attitudes toward mathematics (Darling-Hammond, Hyler and Gardner, 2017).

In Africa, the challenges surrounding mathematics education are compounded by various socio-economic factors, including resource limitations and varying educational standards (Lemmer, 2018). Many African nations face issues such as high teacher turnover rates and inadequate professional development opportunities, which can hinder the development of pedagogical knowledge and skills among mathematics teachers (Main, 2021). Consequently, teachers' engagement in these contexts is crucial for their professional growth and their learners' academic success.

South Africa's educational landscape reflects these broader trends, with significant disparities in teacher training and student performance in mathematics. The country has made strides in recent years to improve teacher education programs, emphasizing the importance of pedagogical knowledge (Department of

Basic Education, 2015). However, challenges such as high dropout rates in mathematics and insufficient support for teachers continue to undermine the effectiveness of these initiatives (Scholler, 2015). Research indicates that teachers with robust pedagogical knowledge are better equipped to engage learners, particularly in mathematics, where learners often struggle (Main, 2021).

This study is relevant as it addresses a critical gap in understanding how pedagogical knowledge and skills directly influence teacher engagement in the intermediate phase of mathematics education. By focusing on this specific context, the research aims to provide insights that can be utilized to foster a more effective and engaging learning environment for learners, ultimately contributing to better educational outcomes in South Africa.

Some teachers' lack of pedagogical skills affects their ability to present content meaningfully. This problem is particularly pronounced in the context of mathematics education, where effective teaching strategies are essential for fostering student engagement and understanding. Research indicates that a well-designed pedagogical approach can significantly enhance student learning outcomes by fostering critical thinking and problem-solving skills (Main, 2021). Without these skills, teachers may resort to traditional, lecture-based methods that do not resonate with learners, leading to disengagement and poor academic performance. Teachers who lack pedagogical skills often struggle to engage their learners effectively, a challenge particularly evident among many intermediate-phase mathematics teachers in South Africa, where enhancing student learning outcomes through effective engagement remains a significant concern. This challenge is compounded by inadequate pedagogical knowledge and skills essential for creating dynamic and supportive learning environments. Research suggests that teachers who lack adequate training in pedagogical strategies tend to be less motivated and less effective in engaging their learners in the learning process (Moats, 2014). This highlights the need for comprehensive content knowledge and pedagogical training in teacher education, as Moats (2014) emphasised in her assertion that 'what teachers don't know' can significantly impact their teaching practices.

Mathematics education faces significant challenges, such as high dropout rates and disparities in educational quality; understanding the relationship between a teacher's pedagogical knowledge and engagement levels is critical. Although initiatives to improve teacher training have been implemented, it remains unclear how effectively these programs address the specific needs of teachers in the intermediate phase, particularly in mathematics instruction. This study seeks to address the gap in knowledge regarding how pedagogical knowledge and skills impact teacher engagement in the mathematics classroom. By investigating this relationship, the research aims to provide insights that can inform the development of more effective professional development programs and ultimately enhance the quality of mathematics education for intermediate-phase learners.

Building on these concerns, it is essential to examine the factors that influence teacher engagement in mathematics instruction, particularly at the intermediate phase. What is the Impact of Pedagogical Knowledge and Skills on Intermediate Phase Mathematics Teacher's Engagement?.

## **RESEARCH METHOD**

This study is qualitative research using the pragmatic paradigm. The qualitative research approach was appropriate for the study as it allowed for an in-depth understanding of teachers' lived experiences, attitudes, and perceptions (Creswell & Poth, 2018) related to Pedagogical Knowledge and Skills in teacher engagement, which allowed the capture of adequate qualitative data. This approach was valuable in eliciting personal and structural insights from teachers. A case study design was used to gain an in-depth understanding of the pedagogical knowledge and skills of intermediate Phase mathematics teachers' engagement within the specific context of the Chris Hani East Education District. Case studies are particularly effective for examining complex issues within real-life contexts (Yin, 2018). This design allowed the researcher to explore the pedagogical knowledge and skills participation in detail, considering the district's unique socio-economic, geographic, and institutional characteristics. Research is often defined as an inquiry conducted by educators within their specific environments to enhance their professional practice and improve learners' learning. This research aims to produce practical solutions that benefit the individuals or organizations with whom the researcher collaborates, emphasizing a collaborative approach (Asenahabi, 2019). Through this process, teachers gain the ability to engage in reflective practices, improving their methods for achieving better results. The goal of action research is to allow educators to observe situations critically, which helps them to enhance the quality of their interventions. This process enables teachers to grasp the practical aspects of a situation, address specific issues, and develop guidelines for enhanced practices. In this study, pragmatism serves as the chosen framework, suggesting that research should be viewed as a human experience shaped by the beliefs and actions of its practitioners, specifically the researcher and the participating teachers. The main aim of pragmatism is to harmonize objectivity with subjectivity, information with values, and rigorous knowledge with varied contextual experiences (Saunders et al., 2019).

Employing a random sampling method, a sample of five schools was drawn for the study, and purposive sampling identified four intermediate-phase mathematics teachers as participants. The sample focused on teachers with experience or interest in professional development workshops who face participation barriers, ensuring relevance to the research and capturing diverse perspectives within the district. Semi-structured interviews were conducted with the selected teachers to elicit their experiences, perceptions, and specific pedagogical knowledge and skills participation. This method allowed the capturing of open-ended responses from teachers who shared personal insights and elaborated on issues about the topic investigated. In addition, relevant documents, such as workshop attendance records, school reports, and government policy documents on teacher development, were reviewed. This analysis provides contextual data on program availability, district policies, and attendance patterns.

## **RESULTS AND DISCUSSION**

The findings presented in this section were derived from Intermediate Phase Mathematics teachers in the Chris Hani East Education District and focus on the impact of Pedagogical Knowledge and Skills on their engagement. Using Thematic

Data Analysis, the data collected through interviews and document analysis revealed the key themes aligned with the study's question and objectives. The findings were organised thematically, each theme supported by direct extracts to ensure authenticity and credibility. Discussion of the findings is linked to the existing literature and the theoretical framework underpinning the study. The section highlights the challenges intermediate-phase mathematics teachers face; however, it examines the implications of this pedagogical knowledge and skills for developing policies and practices to enhance intermediate-phase mathematics teacher engagement within the South African education system. The main themes include pedagogical knowledge and skills, teacher engagement, and challenges in mathematics education. Semi-structured interviews yielded the following three primary schools:

***What is the Impact of Pedagogical Knowledge and Skills on Intermediate Phase Mathematics Teacher's Engagement?***

**Table 1: Summary of the themes and responses**

Schools	Theme 1 Pedagogical Knowledge and Skills		Theme 2 Teacher Engagement		Theme 3 Challenges in Mathematics Education	
	Question	Response	Question	Response	Question	Response
A	How do pedagogical knowledge and skills impact the engagement of intermediate-phase mathematics teachers?	Lack of instructional strategies	How can teacher engagement be enhanced among intermediate-phase mathematics teachers?	Regular workshops and peer-learning sessions where teachers can share strategies,	What challenges do intermediate-phase mathematics teachers face?	Teachers often struggle with insufficient teaching materials
B	How do pedagogical knowledge and skills impact the engagement of intermediate-phase mathematics teachers?	fostering a more engaged and positive classroom environment.	How can teacher engagement be enhanced among intermediate-phase mathematics teachers?	Training and resources for using technology, games,	What challenges do intermediate-phase mathematics teachers face?	Teachers may face pressure to complete the curriculum within a limited time
C	How do pedagogical knowledge and skills impact the engagement of intermediate-phase mathematics teachers?	Observing learners actively engaging in lessons and demonstrating understanding	How can teacher engagement be enhanced among intermediate-phase mathematics teachers?	innovative teaching practices and collaborative	What challenges do intermediate-phase mathematics teachers face?	a lack of confidence in teaching certain mathematical concepts

Each theme's specific findings and data analysis are provided below. The next part will express the theme by presenting each topic and concluding with a

paragraph summarising the evidence. To protect the participant's confidentiality, a unique teacher number is assigned to each participant

As participants were required to share their lived experiences on pedagogical knowledge, skills, and their impact on the engagement of intermediate-phase mathematics, teachers responded as follows:

Participant 1 responded:

*“Sometimes, as teachers, we do not really have the skills because we do not specialize in mathematics; we are just teaching where there is a shortage.”*

In line with the above response, Participant 3 said,

*“Lack of pedagogical knowledge and skills can lead to a lack of instructional strategies, negatively impacting the engagement of intermediate-phase mathematics teachers”.*

The statement highlights how crucial maths teacher expertise is. According to research, teachers who thoroughly understand mathematics can give their learners superior learning opportunities. For example, Herold (2019) addresses the idea of pedagogical content knowledge, contending that proficient instruction involves subject-matter competence and an awareness of how best to communicate such knowledge to learners. Schoenfeld (2022) sheds light on the multifaceted challenges hindering effective mathematics education, pinpointing inadequate curriculum support, unengaging teaching methods, rote memorization-focused assessments, teacher-centric professional development, and pervasive inequities in educational environments as key barriers. Classroom modernization is essential. Many rural regions still use traditional teaching methods, yet they might not adequately engage learners. Interactive learning environments and digital tools are part of contemporary educational practices

Participating teachers were asked their opinions regarding being fulfilled and motivated to teach mathematics, and they responded as follows:

Participant 1:

*“Improving and increasing the understanding of mathematics teachers and modernizing the classrooms can also help”.*

Participant 5:

*“The rural areas we are working on have not changed yet; we are still using old methods, but we need help with math lessons”.*

Participant 2:

*“What I know is that the learners get something from me as their teacher; it is not easy for them to come up with something new “*

Participant 4:

*“Sometimes, learners are involved in the lesson depending on their learning topic, which can lead me to observe learners actively engaging in lessons and demonstrating understanding”.*

The participants stressed the need for updated teaching methods and greater comprehension among maths teachers. In stark contrast, Mohamed et al. (2023) reveal that a mathematically rich environment can be a game-changer, significantly enhancing student learning by fostering deeper understanding, meaningful connections, and robust conceptual grasp. By facilitating thoughtful exploration, practical application, and contextualization, this approach empowers learners to

reformulate and link new concepts to prior knowledge and experiences, paving the way for more effective learning.

The existing dependence on antiquated techniques hampers effective teaching. Teachers may feel less motivated and fulfilled in their jobs if they do not feel like they are getting the support they need to grow. According to research, sustaining teacher motivation requires access to innovative teaching techniques and continual professional growth.

The challenges encountered by teachers when teaching mathematics. Teachers demonstrate a high level of interest and willingness in the classroom while teaching mathematics; nevertheless, they listed a number of barriers like insufficient teaching materials, lack of support, teachers may face pressure to complete the curriculum within a limited time

Two participants mentioned training:

*“We need training, and I believe regular training sessions will equip us with the necessary skills to overcome our challenges”.*

Participant 5:

*“There are no mathematics specialists in these surrounding areas, which makes it even more important for us to bridge this gap without mathematics skills.”*

Participant 1:

*“I can mention that lack of resources, such as teaching aids, up-to-date textbooks, and access to technology, are the serious challenges in my school “.*

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In line with the research by Darling-Hammond et al. (2017), it indicates that sustained and high-quality teacher training can enhance instructional practices by up to 21% and positively impact learner performance. Addressing these challenges through focused and consistent training programs can significantly bridge the gaps in mathematics education.

Teachers who participate in ongoing professional development tend to report greater levels of efficacy and personal satisfaction, which are closely correlated with their motivation levels, according to a study by Kunter et al. (2019). The statement regarding the continued use of antiquated techniques in rural areas highlights systemic stagnation. According to studies, rural schools frequently have major obstacles to professional growth, resource access, professional development, and modern pedagogical approaches. Teachers cited time constraints to provide learners with enough mathematic skills for learning. Time constraints hamper teachers in many faces in their workload, as noted by Fokides (2018).

The synthesis of these contexts highlights the critical importance of pedagogical knowledge and skills in enhancing teacher engagement, particularly in mathematics education. Globally, effective teaching practices are linked to improved student outcomes, while in Africa and South Africa, specific challenges necessitate a focus on developing teachers' pedagogical competencies. This study explores how these factors intersect, particularly in the intermediate phase of education, where foundational mathematical skills are developed.

The implications of this study are significant for educational policy and practice. By examining the impact of pedagogical knowledge and skills on teacher

engagement, the study seeks to inform professional development programs and teacher training initiatives in South Africa and similar contexts. Understanding the relationship between these variables can lead to targeted interventions that enhance teacher engagement, thereby improving student learning outcomes in mathematics.

Establish continuous professional development (CPD) initiatives focused on improving pedagogical content knowledge and teaching methodologies for mathematics. These programs should be tailored to the specific needs of teachers in rural areas, emphasizing practical strategies and innovative practices that can foster engagement among learners.

Create opportunities for teachers to collaborate and share best practices through mentorship programs, peer observations, and networking platforms. This will help teachers feel less isolated, promote the sharing of successful strategies, and provide ongoing support.

Invest in modernizing classrooms by incorporating digital technologies and interactive learning tools. Training teachers to effectively use technology in their lessons can enhance student engagement and provide real-world applications of mathematical concepts.

Encourage teachers to develop lesson plans that connect mathematical concepts to real-life situations, making the content more relevant and engaging for learners. Facilitate workshops that help teachers explore creative ways to integrate practical applications into their mathematics instruction.

Promote pedagogical methods encouraging active student participation, such as inquiry-based learning, collaborative group work, and hands-on activities. Providing teachers with training on these approaches will help them create more dynamic classroom environments.

Establish systems for regular feedback from both learners and teachers regarding teaching practices and student engagement. This feedback can inform further professional development and instructional adjustments to meet learners' needs better.

Advocate for better resource allocation to rural schools, including access to teaching materials, technology, and classroom supplies. Ensuring that teachers have the necessary tools will enable them to implement modern teaching practices effectively.

## **CONCLUSION**

The findings underscore the critical role that pedagogical knowledge and skills play in influencing the engagement of intermediate-phase mathematics teachers and their learners. Teachers with a strong understanding of effective teaching strategies are likelier to create positive and interactive learning environments, improving student outcomes. However, the persistent reliance on outdated teaching methods in rural areas presents significant challenges.

It is essential to implement tailored professional development programs, foster collaboration among teachers, integrate technology, and emphasize the relevance of mathematics in everyday life. By taking these proactive steps, educational stakeholders can enhance teachers' engagement and effectiveness while promoting active student learning. Addressing these factors will ultimately

contribute to advancing mathematics education in rural areas and support teachers in achieving greater fulfillment and motivation in their roles

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