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Exploring Grade 4 Mathematics Teachers' Experiences in Pedagogical Competence Development: A Phenomenological Study

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ABSTRACT

This study explored the development of pedagogical competence among Grade 4 mathematics teachers in South Africa, addressing the critical gap between content knowledge and effective teaching strategies. Employing a qualitative phenomenological approach, data was collected through systematic observations of 65 teachers and semi-structured interviews with 8 participants from the Chris Hani East Education District. The analysis identified four key themes: the necessity of contextually relevant professional development, pedagogical transformation, implementation and adaptation and barriers, and the importance of ongoing support mechanisms. The findings reveal that targeted professional development programs incorporating these pedagogical strategies significantly enhance teachers' confidence and effectiveness. This supports existing literature emphasising the need to bridge the gap between content knowledge and pedagogical skills, particularly in mathematics education, which is foundational for STEM disciplines. The study contributes valuable insights into effective professional development practices that can improve teaching outcomes and student engagement in mathematics. By addressing systemic challenges such as resource scarcity and inadequate training, this study aims to inform educational stakeholders and policymakers about the importance of tailored professional development initiatives, ultimately benefiting student learning and fostering a deeper appreciation for mathematics in South Africa.

Keywords: Mathematics Education, Pedagogical Competence, Pedagogical Content Knowledge, Phenomenological Study, Professional Development.

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INTRODUCTION

In today's educational landscape, the significance of pedagogical competence among mathematics teachers has garnered considerable attention worldwide, especially with the growing focus on Science, Technology, Engineering, and Mathematics (STEM) education. This trend is particularly evident in South

Africa, where effective mathematics instruction is essential for enhancing student outcomes and tackling the challenges of a rapidly evolving technological society. Studies have shown that using manipulatives and other innovative teaching strategies can enhance learners' understanding of mathematical concepts and engagement in learning.[1] Despite recognising these pedagogical strategies, a significant gap remains in effectively implementing professional development programs to enhance teachers' pedagogical skills, especially in Africa.

In South Africa, the challenges Grade 4 mathematics teachers face are compounded by systemic issues such as resource scarcity and inadequate training programs.[2] Recent studies indicate that while a growing body of literature addresses teacher education and professional development, many programs focus predominantly on content knowledge rather than pedagogical competencies.[3] This discrepancy highlights a significant gap in teacher training, as a lack of pedagogical competence can significantly impede the effectiveness of instructional practices and ultimately impact student learning outcomes. Furthermore, the insufficient evidence supporting the positive effects of current teacher training programs on these practices underscores the urgent need for a more nuanced approach to professional development that emphasises pedagogical competence.

This study aims to explore the experiences of Grade 4 mathematics teachers in developing their pedagogical competence, specifically focusing on the challenges they face and the strategies they implement to improve their teaching practices. Using a phenomenological approach, this study aims to provide a deeper understanding of these educators' lived experiences, thereby contributing to the existing body of knowledge on teacher professional development in the South African context. This exploration is crucial for informing future training programs and ensuring that teachers are well-equipped to meet the diverse needs of their learners in an increasingly complex educational environment.

LITERATURE REVIEW

Developing pedagogical competence among mathematics teachers is a critical area of research, particularly in enhancing educational outcomes in STEM fields.[4] Mathematics education is a foundational pillar for STEM disciplines, influencing individual academic trajectories and broader societal and economic advancements.[5] The role of mathematics teachers in shaping these outcomes cannot be overstated, as their pedagogical competence directly impacts student engagement, comprehension, and achievement.[6] This literature review explores the complex nature of pedagogical competence, specifically focusing on Grade 4 mathematics teachers in South Africa. This setting poses unique challenges, such as resource disparities, language barriers, and systemic issues, which impede the effective implementation of innovative teaching strategies.[7] To address these challenges, it is essential to understand the interaction between content knowledge, pedagogical skills, and contextual factors.[8]

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[1] J. M. Furner, "The Best Pedagogical Practices for Teaching Mathematics Revisited: Using Mathematics Manipulatives, Children's Literature, and GeoGebra to Produce Mathematics-Confident Young People for a STEM World," *Pedagogical Research* 9, no. 2 (2024): em 0193; Joseph Baidoo and Kakoma Luneta, "Implementing Blended Learning to Enhance the Teaching of 3-Dimensional Trigonometry.," *Journal of Education and E-Learning Research* 11, no. 2 (2024): 332–44.

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[3] Bianca Coleman et al., "Academics' Perspectives on a Student Engagement and Retention Program: Dilemmas and Deficit Discourses," *Teaching in Higher Education* 29, no. 2 (February 17, 2024): 518–35, https://doi.org/10.1080/13562517.2021.2000387; Camelia Tjandra, "Effectiveness of Using Manipulatives in Mathematics Teaching in Inclusive Education Programs in an Elementary School," *Dharmas Education Journal (DE_Journal)* 4, no. 1 (2023): 168–78.

[4] H. Lee and Vongkulluksn V. W., " Enhancing Mathematics Teacher Professional through a Contextualised Professional Development Programme," *Teacher Development* 27, no. 7 (2022): 1–24.

[5] Izunna S Nwuba et al., "Innovative Pedagogical Approaches for Classroom Delivery: The Science Teachers' Perspective," *International Research Journal of Science, Technology, Education, and Management* 4, no. 3 (2024): 29–44.

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[7] Stephen L Chew and William J Cerbin, "The Cognitive Challenges of Effective Teaching," *The Journal of Economic Education* 52, no. 1 (2021): 17–40.

[8] Ratnawati Susanto, Yuli Azmi Rozali, and Noni Agustina, "Pedagogic Competence Development Model: Pedagogic Knowledge and Reflective Ability," in *International Conference on Progressive Education (ICOPE 2019)* (Atlantis Press, 2020), 19–23.

The review also highlights the importance of effective pedagogical strategies in mathematics education. Research highlights the transformative potential of learner-centred approaches, manipulatives[9] and differentiated instruction in fostering deeper mathematical understanding.[10] These strategies, however, must be tailored to the specific needs and constraints of the South African educational landscape. This exploration is guided by several theoretical frameworks that inform professional development initiatives. These include constructivist learning theories and adult learning principles, which create a solid foundation for designing training programs to enhance pedagogical competence. By synthesising insights from existing literature, this review seeks to contribute to the ongoing discussion on improving mathematics education through focused efforts in teacher development.

Challenges in Teacher Professional Development

Professional development for mathematics teachers encounters several challenges, especially in aligning content knowledge with effective teaching strategies. A study by Yang and Kaiser in rural schools found that training programs often prioritise subject matter knowledge while neglecting pedagogical skills.[11] The teachers reported that although they gained a deeper understanding of mathematical concepts, they struggled to apply this knowledge effectively in the classroom. One participant remarked, "I understand the mathematical concepts better now, but I still do not know how to make my students understand them." This highlights the critical gap between content mastery and its practical application in teaching.

Another significant challenge is the lack of contextual relevance in professional development programs. Motseki and Sophy examined initiatives in schools in South Africa. They found that many programs failed to address the unique challenges of high-poverty areas, such as large class sizes and limited resources.[12] Teachers expressed frustration that the methods taught during training were impractical for their overcrowded classrooms. One teacher remarked, "The methods we were taught are excellent in theory, but ineffective in my overcrowded classroom with 40 students." This disconnect highlights the need for training programs tailored to the specific environments where teachers work. Implementation of professional development strategies also remains a significant hurdle. Research by Hendriks and Cruywagen in South African schools highlighted the lack of ongoing support for teachers after initial training sessions.[13] Teachers reported feeling isolated and unsupported due to the absence of follow-up workshops or mentoring opportunities. This lack of sustained professional development often led to a reversion to traditional teaching methods, undermining the initial gains made during training. These case studies collectively illustrate the multifaceted challenges in teacher professional development. The misalignment between content and pedagogy, lack of contextual relevance, and inadequate support mechanisms hinder teachers' professional growth and negatively impact student outcomes. According to Coleman et al., addressing these issues requires a comprehensive approach that integrates content knowledge with pedagogical skills, tailors training programs to specific contexts, and provides ongoing support for teachers.[14]

[9] Tjandra, "Effectiveness of Using Manipulatives in Mathematics Teaching in Inclusive Education Programs in an Elementary School."
[10] Subuh Anggoro et al., "Differentiated Instruction Based on Multiple Intelligences as Promising Joyful and Meaningful Learning," *Int J Eval & Res Educ ISSN* 2252, no. 8822 (2024): 1195.
[11] Xinrong Yang and Gabriele Kaiser, "The Impact of Mathematics Teachers' Professional Competence on Instructional Quality and Students' Mathematics Learning Outcomes," *Current Opinion in Behavioral Sciences* 48 (2022): 101225.
[12] Puleng Motseki and Kodisang Sophy, "Mathematics Teachers in the Twenty-First Century—What Affordances and Constraints Lie in Preparing Teachers for the Fourth Industrial Revolution (4IR) in South Africa," in *Mathematics Teacher Training and Development in Africa: Trends at Primary and Secondary School Levels* (Springer, 2024), 193–209.
[13] Marna Hendriks and Sonja Cruywagen, "Mathematics in South Africa's Intermediate Phase: Music Integration for Enhanced Learning," *South African Journal of Childhood Education* 14, no. 1 (2024): 1535.
[14] Coleman et al., "Academics' Perspectives on a Student Engagement and Retention Program: Dilemmas and Deficit Discourses."

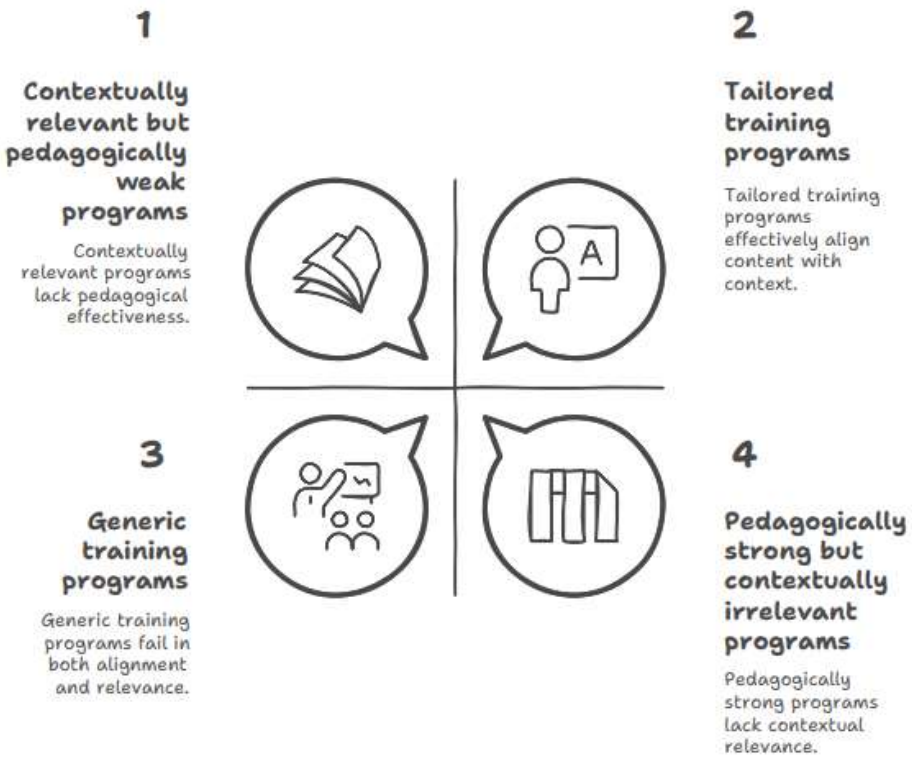

Figure 1: Teacher Professional Development Challenges range from Theoretical to Practical

Figure 1 presents a quadrant framework categorising training programs by their pedagogical strength and contextual relevance: contextually relevant but pedagogically weak, tailored (both strong and relevant), generic (neither strong nor relevant), and pedagogically strong but contextually irrelevant. This visual highlights the importance of aligning both educational effectiveness and contextual appropriateness in training program design.

Importance of Pedagogical Strategies

Grabska et.al. posit that using appropriate pedagogical strategies is crucial for improving mathematics education.[15] Research has consistently demonstrated the effectiveness of manipulatives in enhancing learners' understanding of mathematical concepts. Furner found that students who utilised physical manipulatives, such as base-ten blocks and fraction tiles, significantly improved their understanding of abstract mathematical concepts.[16] These tools help connect theoretical ideas with real-world applications, making mathematics more accessible and engaging for students. Additionally, digital manipulatives, like virtual geometry tools, have emerged as innovative resources that enhance interactive learning experiences.[17]

In addition to manipulatives, the role of Pedagogical Content Knowledge (PCK) in ineffective teaching cannot be overstated. Rahman, Tambi and Anny highlighted that teachers with strong PCK are better equipped to tailor their instructional methods to the diverse needs of their students.[18] For instance, a teacher with robust PCK might use storytelling to explain complex mathematical problems to younger learners or employ real-life scenarios to make algebraic concepts relatable for high school students. This adaptability improves student comprehension and fosters a more inclusive learning environment.

[15] Meri Grabska, Srbuhi Gevorgyan, and Stepan Grabski, "Pedagogical Practice as an Essential Step for Development of Pedagogical Competencies," *People* 3, no. 2.67 (2020): 2–80.
[16] Furner, "The Best Pedagogical Practices for Teaching Mathematics Revisited: Using Mathematics Manipulatives, Children's Literature, and GeoGebra to Produce Mathematics-Confident Young People for a STEM World."
[17] Baidoo and Luneta, "Implementing Blended Learning to Enhance the Teaching of 3-Dimensional Trigonometry."
[18] Sajedur Rahman, Fatimah Tambi, and Nusrat Zerin Anny, "The Importance of Enhancing Pedagogical Skills through Continuing Professional Development," *International Journal of Research in Business and Social Science* 9, no. 4 (2020): 121–29.

Rachmadtullah et al. emphasised integrating pedagogical strategies into teacher training programs.[19] Their study found that teachers who received targeted training on using manipulatives and pedagogical content knowledge (PCK) reported greater confidence and effectiveness in their teaching practices. For instance, one participant stated, "The training helped me understand not just what to teach, but how to teach it in a way that resonates with my students." This highlights the need for professional development initiatives that focus on content knowledge and pedagogical skills. The effective use of strategies such as manipulatives and PCK is crucial for enhancing mathematics education.[20] By equipping teachers with the necessary tools and knowledge to implement these strategies, educational systems can significantly improve student learning outcomes and foster a deeper appreciation for mathematics.

THEORETICAL FRAMEWORKS

This study is informed by two key theories in adult education and teacher development: Speck's Adult Learning Theory and Guskey's Theory of Teacher Change. Speck's theory highlights the unique characteristics of adult learners, indicating that professional development activities should be tailored to address their specific needs and experiences. This approach is particularly relevant for mathematics teacher training, as understanding the diverse backgrounds and teaching experiences of educators can significantly improve the effectiveness of training programs.[21] Guskey's Model of Teacher Change suggests that meaningful shifts in teachers' beliefs and practices primarily occur when they witness concrete improvements in student learning outcomes.[22] This model emphasises the importance of providing teachers with evidence demonstrating the effectiveness of new pedagogical strategies, which can motivate them to adopt and maintain these practices in their classrooms. Incorporating these theoretical frameworks into the design of professional development programs can create a more comprehensive approach to enhancing the pedagogical competence of mathematics teachers.[23]

The literature indicates that while there is a growing recognition of the importance of pedagogical competence among mathematics teachers, significant challenges remain in the effective implementation of professional development programs. Focusing on content knowledge rather than pedagogical skills and the demand for innovative teaching strategies underscores the need for a more targeted approach to teacher training. This study, grounded in established theoretical frameworks, aims to contribute to the ongoing discussion on improving pedagogical competence among Grade 4 mathematics teachers in South Africa.

METHODOLOGY

This study employed a qualitative research approach, grounded in a phenomenological design, to explore and understand teachers' lived experiences in enhancing their pedagogical competence.[24] The phenomenological approach was particularly suitable, as it allowed for an in-depth exploration of participants' constructed meanings and experiences within their educational context, aligning with Tomaszewski, Zarestky, and Gonzalez's assertion that qualitative research should focus on understanding and portraying the meaning constructed by participants in social settings.[25]

The research utilised purposive sampling to select participants from the Chris Hani East Education District (CHEED), explicitly targeting mathematics teachers across four circuits. The purposive sampling strategy ensured the selection of participants who could provide rich, relevant information about the

[19] Reza Rachmadtullah et al., "Professional Development for Indonesian Elementary School Teachers: Increased Competency and Sustainable Teacher Development Programs," *F1000Research* 13 (2025): 1375.
[20] Melanie Nind, "A New Application for the Concept of Pedagogical Content Knowledge: Teaching Advanced Social Science Research Methods," *Oxford Review of Education* 46, no. 2 (March 3, 2020): 185–201, https://doi.org/10.1080/03054985.2019.1644996.
[21] Bruce W Speck, *Facilitating Students' Collaborative Writing. ASHE-ERIC Higher Education Report. Jossey-Bass Higher and Adult Education Series.* (ERIC, 2002).
[22] Thomas R. Guskey, "Professional Development and Teacher Change," *Teachers and Teaching* 8, no. 3 (August 25, 2002): 381–91, https://doi.org/10.1080/135406002100000512.
[23] Furner, "The Best Pedagogical Practices for Teaching Mathematics Revisited: Using Mathematics Manipulatives, Children's Literature, and GeoGebra to Produce Mathematics-Confident Young People for a STEM World"; Nind, "A New Application for the Concept of Pedagogical Content Knowledge: Teaching Advanced Social Science Research Methods."
[24] Shefaly Shorey and Esperanza Debby Ng, "Examining Characteristics of Descriptive Phenomenological Nursing Studies: A Scoping Review," *Journal of Advanced Nursing* 78, no. 7 (2022): 1968–79.
[25] Lesley Eleanor Tomaszewski, Jill Zarestky, and Elsa Gonzalez, "Planning Qualitative Research: Design and Decision Making for New Researchers," *International Journal of Qualitative Methods* 19 (2020): 1609406920967174.

phenomenon under study.[26] The sample comprised 65 teachers who participated in the professional development program, all of whom were observed during training sessions. From this larger group, eight teachers (two from each circuit) were purposively selected for in-depth semi-structured interviews, ensuring representation across all four circuits while maintaining a manageable sample size for detailed qualitative analysis.

Data collection employed two complementary methods: observation and semi-structured interviews. The observation phase included systematically assessing all 65 teachers during their training sessions. This focused on analysing their engagement patterns, interactions, and responses to professional development activities.[27] Following this, semi-structured interviews were conducted with eight selected participants to deepen the exploration of their experiences and perceptions. The interview format provided flexibility while focusing on the research objectives, enabling participants to share detailed accounts of their experiences and perspectives regarding pedagogical competence enhancement.

The data analysis followed a thematic approach involving systematic coding and theme development from observational notes and interview transcripts. This process began with familiarisation with the data, followed by initial coding, theme development, and refinement. The analysis focused on identifying patterns and relationships within the data, ensuring that the emerging themes accurately represented the participants' experiences and perspectives.[28] This analytical approach aligned with a phenomenological design, enabling a deeper understanding of the essence of teachers' experiences in their professional development journey.[29]

Several measures were implemented to ensure the quality and trustworthiness of the research. These measures included triangulating data sources using observational and interview data, conducting member checks of interview transcripts, and maintaining detailed documentation of the research process. The study also adhered to ethical considerations, such as obtaining informed consent, ensuring confidentiality, and protecting participant anonymity throughout the research. This methodological approach provided a comprehensive framework for understanding teachers' experiences and enhancing pedagogical competence. It allowed for rich data collection and systematic analysis while upholding academic rigour within the phenomenological tradition. The combination of observations, interviews, and thematic analysis facilitated a thorough exploration of the research phenomenon, contributing to a deeper understanding of teachers' professional development experiences in mathematics education.

PRESENTATION OF DATA AND DISCUSSION

The study employed a phenomenological qualitative research design to explore and understand teachers' experiences and perceptions regarding pedagogical competence enhancement strategies. Data collection involved the observation of 65 teachers during professional development sessions and in-depth semi-structured interviews with eight purposively selected participants. The study utilised thematic analysis to interpret both observational and interview data, allowing for a deep understanding of the lived experiences of mathematics teachers in their professional development journey.

Observational Data Presentation

Table 1: Teacher Engagement Patterns During Professional Development Sessions (N = 65)

Observed Behaviour Categories	Frequency of Occurrence	Representative Indicators
Active Participation	High (80%)	Asking questions Contributing to discussions Taking notes
Collaborative Engagement	Moderate to High (75%)	Group work participation Peer discussions Shared problem-solving

[26] Jacob Owusu Sarfo et al., "Qualitative Research Designs, Sample Size and Saturation: Is Enough Always Enough," *Journal of Advocacy, Research and Education* 8, no. 3 (2021): 60–65.
[27] Tomaszewski, Zarestky, and Gonzalez, "Planning Qualitative Research: Design and Decision Making for New Researchers."
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[29] Sarfo et al., "Qualitative Research Designs, Sample Size and Saturation: Is Enough Always Enough."

Implementation Practice	High (85%)	Practice teaching sessions Strategy application Peer feedback
Resource Utilisation	Moderate (65%)	Using the provided materials Technology integration Manipulative usage

Note. Percentages indicate the proportion of teachers demonstrating these behaviours consistently during observations.

Observational data from Table 1 indicated consistently high levels of engagement across various dimensions of professional development activities. Teachers showed remarkable active participation, especially in collaborative environments. The high ratings in group dynamics (80%) suggest that the professional development setting effectively promoted peer learning and knowledge sharing. Additionally, scores for material engagement reflect the effective use of learning resources and tools, which contributed to the development of practical skills.

Table 2: Thematic Analysis of Interview Data (N = 8)

Major Themes	Sub-themes	Representative Quotes
Professional Growth	Skill enhancement Knowledge acquisition Confidence building	"The training significantly improved my ability to handle complex mathematical concepts" (P3) "I feel more confident in implementing new teaching strategies" (P7)
Pedagogical Transformation	Teaching methods Classroom management Assessment approaches	"I have completely changed how I approach problem-solving in class" (P1) "The new strategies helped me manage classroom dynamics better" (P5)
Collaborative Learning	Peer support Knowledge sharing Community of practice	"Working in groups exposed us to different perspectives" (P4) "The collaborative environment made learning more effective" (P2)
Implementation Challenges	Resource constraints Time management Adaptation issues	"Implementing new methods requires more preparation time" (P6) "Some strategies need to be modified for our context" (P8)

Table 2 highlights four significant themes regarding teachers' experiences during their professional development journey. Teachers described their experiences as transformative, with a collaborative learning environment emerging as a crucial factor in enhancing pedagogical competence. Participants consistently emphasised that group work and peer learning offered multiple perspectives on teaching methodologies, fostering deeper understanding and retention of new concepts. This aligns with the phenomenological perspective that shared experiences contribute to meaningful learning. A notable finding was the profound impact on teachers' pedagogical approaches, with participants reporting a shift from traditional to more facilitative teaching methods. This transformation was evident in their improved classroom management skills and enhanced ability to engage students with challenging content, marked by increased confidence and competence in delivering lessons. However, the analysis also highlighted the complexities of implementing new teaching strategies in diverse classroom settings. Teachers discussed how they adapted the techniques they learned to fit their unique environments, demonstrating the practical application of theoretical knowledge from professional development sessions. Additionally, the analysis identified several challenges, including limited resources and difficulties with time management.

Nonetheless, teachers demonstrated resilience by creating innovative solutions through collaborative problem-solving and peer support, emphasising the significance of adaptability in their professional development journey.

Integrating both observational and interview data provides a comprehensive view of the professional development experience. The high levels of engagement observed during training sessions directly correlate with the positive, transformative experiences reported in the interviews. This data triangulation enhances the validity of the findings and offers valuable insights into the effectiveness of the professional development program. The analysis reveals that while teachers experienced significant professional growth and transformation in their teaching methods, they faced implementation challenges that required adaptive strategies. This indicates a need for ongoing support and resources to ensure the sustainable application of the newly acquired pedagogical approaches. The findings highlight a strong correlation between structured professional development interventions and improved pedagogical competence, reinforcing the program's effectiveness in achieving its intended outcomes.

DISCUSSION

The findings of this study provide important insights into the development of pedagogical competence among Grade 4 mathematics teachers in South Africa, particularly emphasising the crucial role of contextually relevant professional development programs. The study shows that teachers engaged in targeted professional development incorporating pedagogical strategies, such as manipulatives, and Pedagogical Content Knowledge (PCK) demonstrate increased confidence and instructional effectiveness. This aligns with the existing literature highlighting the need to bridge the gap between content knowledge and effective teaching strategies, especially in mathematics education, which is fundamental to STEM disciplines.[30] The results reinforce the existing body of knowledge and contribute new empirical evidence on how specific pedagogical strategies can enhance teacher performance and improve student outcomes.

Additionally, the study identifies systemic challenges Grade 4 mathematics teachers face, such as resource scarcity and inadequate training programs. This aligns with the literature, which indicates that many professional development initiatives do not effectively address the unique circumstances of teachers in high-poverty areas, such as large class sizes and limited resources.[31] As this research shows, the mismatch between content knowledge and pedagogical skills reflects a broader trend in teacher education, where the focus is often on subject-matter knowledge at the expense of developing pedagogical competencies. This discrepancy is significant because it suggests that without a comprehensive approach integrating content and pedagogy, the effectiveness of instructional practices will be compromised, ultimately affecting student learning outcomes.

The study employed a phenomenological approach, which provided a nuanced understanding of teachers' experiences in their professional development journeys. Using qualitative methods, the research captured the complexities of teachers' perceptions and the meanings attached to their experiences.[32] This deeper understanding is essential for informing the design of future professional development programs, emphasising the importance of tailoring training to meet teachers' specific needs and contexts. The findings suggest that professional development should not only enhance content knowledge but also prioritise the development of pedagogical skills that address the unique challenges teachers face in their educational environments.

Another critical finding of the study is the role of manipulatives in enhancing mathematical understanding. The evidence supports previous research demonstrating that physical manipulatives

[30] Anggoro et al., "Differentiated Instruction Based on Multiple Intelligences as Promising Joyful and Meaningful Learning"; Coleman et al., "Academics' Perspectives on a Student Engagement and Retention Program: Dilemmas and Deficit Discourses"; Furner, "The Best Pedagogical Practices for Teaching Mathematics Revisited: Using Mathematics Manipulatives, Children's Literature, and GeoGebra to Produce Mathematics-Confident Young People for a STEM World."

[31] Anna Elizabeth Du Plessis, Elize Küng, and Elize du Plessis, "Challenges for Pedagogical Effectiveness in an Ever-Changing Education Landscape: Conceptualisation of Pedagogical Mobility and Flexibility as a Context-Consciousness," *Education Sciences* (MDPI, 2024); Chew and Cerbin, "The Cognitive Challenges of Effective Teaching."

[32] Tomaszewski, Zarestky, and Gonzalez, "Planning Qualitative Research: Design and Decision Making for New Researchers."

effectively bridge the gap between abstract mathematical concepts and real-world applications.[33] Teachers who effectively used manipulatives reported increased student engagement and improved comprehension of mathematical ideas. This finding reinforces the case for incorporating innovative teaching strategies into professional development programs, as these tools can significantly enhance students' learning experience, making mathematics more accessible and engaging.[34]

The study emphasises the importance of ongoing support for teachers as they implement new teaching strategies in their classrooms. Research indicates that when teachers receive evidence demonstrating the effectiveness of new approaches, they are more motivated to adopt and sustain these practices.[35] This is consistent with the findings of this research, which show that teachers who received continuous support and feedback during their professional development were more likely to integrate new strategies into their teaching. Therefore, educational systems must provide initial training and establish frameworks for ongoing professional development and support, ensuring that teachers have the necessary resources and encouragement to succeed. This study contributes to the growing literature on the development of pedagogical competence among mathematics teachers, particularly in South Africa. The findings highlight the need for professional development programs, relevant to the context, that integrate pedagogical strategies and provide continuous support for teachers. By addressing the systemic challenges educators face and emphasising the connection between content knowledge and pedagogical skills, educational stakeholders can significantly enhance teaching outcomes in mathematics, ultimately benefiting student learning and engagement in STEM disciplines.

RECOMMENDATIONS

Based on the findings and limitations of this study, several recommendations can be made to improve professional development programs for mathematics teachers. Firstly, training initiatives should integrate pedagogical strategies with content knowledge, ensuring that teachers can effectively apply their understanding of mathematics in the classroom. This approach aligns with Guskey's Model of Teacher Change, emphasising that observable improvements in student learning outcomes can catalyse changing teachers' beliefs and practices.

Secondly, professional development programs must be contextually relevant, addressing teachers' unique challenges in their specific environments. Tailoring training to the realities of large class sizes and limited resources can enhance the practicality and effectiveness of the strategies taught. Additionally, establishing ongoing support systems, such as mentoring and collaborative learning communities, can help sustain the implementation of new teaching practices and reduce teachers' feelings of isolation.

CONCLUSION

Employing a qualitative phenomenological approach, this study has explored the development of pedagogical competence among Grade 4 mathematics teachers in South Africa, addressing the critical gap between content knowledge and effective teaching strategies. In conclusion, this study highlighted the critical need for comprehensive and contextually relevant professional development programs that enhance the pedagogical competence of mathematics teachers. By integrating pedagogical strategies with content knowledge, providing ongoing support, and addressing educators' unique challenges, educational authorities can significantly improve teaching practices and, ultimately, student learning outcomes in mathematics. Future research should explore practical strategies for professional development to ensure that teachers are well-prepared to meet the diverse needs of their students in an ever-evolving educational landscape.

[33] Furner, "The Best Pedagogical Practices for Teaching Mathematics Revisited: Using Mathematics Manipulatives, Children's Literature, and GeoGebra to Produce Mathematics-Confident Young People for a STEM World"; Tjandra, "Effectiveness of Using Manipulatives in Mathematics Teaching in Inclusive Education Programs in an Elementary School."

[34] Baidoo and Luneta, "Implementing Blended Learning to Enhance the Teaching of 3-Dimensional Trigonometry."

[35] Nwuba et al., "Innovative Pedagogical Approaches for Classroom Delivery: The Science Teachers' Perspective"; Jair J. Aguilar, "High School Students' Reasons for Disliking Mathematics: The Intersection Between Teacher's Role and Student's Emotions, Belief and Self-Efficacy," *International Electronic Journal of Mathematics Education* 16, no. 3 (October 21, 2021): em0658, https://doi.org/10.29333/iejme/11294.

Implications of the Study Findings for Teaching

The findings of this study have important implications for the professional development of Grade 4 mathematics teachers in South Africa. The research highlights the necessity for training programs that combine content knowledge with teaching skills to address the significant gaps in teacher education. Many current programs focus primarily on subject-matter knowledge while overlooking the pedagogical skills essential to effective teaching, which can negatively impact student outcomes. Therefore, professional development initiatives should be relevant to teachers' specific contexts and challenges, such as large class sizes and limited resources.

The study emphasises the importance of using effective teaching strategies, such as manipulatives and Pedagogical Content Knowledge (PCK), which have been proven to enhance teachers' instructional effectiveness and confidence. By providing teachers with these resources, educational systems can promote a deeper understanding of mathematical concepts among students, ultimately leading to improved engagement and learning outcomes. Additionally, continuous support and feedback mechanisms are vital, as they help teachers implement new strategies effectively and maintain their professional growth over time. The findings of this study suggest a comprehensive approach to professional development that not only focuses on content knowledge but also prioritises pedagogical skills and ongoing support. By addressing these areas, educational stakeholders can significantly improve the teaching and learning of mathematics, thereby contributing to better educational outcomes in STEM fields.

Limitations of the Study

This study offers valuable insights into the professional development of Grade 4 mathematics teachers in South Africa; however, it is important to recognise its limitations. One significant limitation is the focus on a specific geographic region, which may restrict the generalizability of the findings to other contexts. The challenges teachers face in South Africa, such as resource constraints and large class sizes, may not represent those in other countries or regions. Additionally, the reliance on self-reported data from teachers could introduce bias, as participants may overestimate their confidence or the effectiveness of the training they received. Future research should consider a broader sample that includes diverse educational contexts to enhance the applicability of the findings.

Another limitation is the study's short-term nature, which primarily captures teachers' immediate responses to professional development initiatives. Longitudinal studies are needed to assess the sustained impact of these training programs on teachers' pedagogical competence and student learning outcomes. Furthermore, while the study emphasises the importance of Pedagogical Content Knowledge (PCK) and manipulatives, it does not explore how these strategies are implemented in practice. Future research should investigate teachers' specific challenges when integrating new pedagogical strategies into their teaching and identify effective support mechanisms.

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