

Teaching length measurement in rural classrooms: A case of grade 4 mathematics teachers in the Capricorn District

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Abstract

This study explored the challenges Grade 4 mathematics teachers face when teaching length measurement in rural South African classrooms. Guided by the communities of practice (CoP) and rurality frameworks, the research adopted a participatory action research (PAR) design to engage teachers as co-researchers. Data were collected through structured online questions, unstructured interviews, and observation. Twenty-two teachers from eighteen rural schools in the Capricorn District and a subject specialist were purposively selected. Findings revealed that learners struggled with unit conversions owing to conceptual gaps and language barriers. Teachers faced limited access to teaching tools, such as trundle wheels, and insufficient curriculum time to address learning difficulties. Rurality markedly shaped these challenges, as teachers adapted to resource shortages and geographic constraints. Despite this, they demonstrated resilience and creativity through collaboration and improvisation. The study recommends context-sensitive professional development and improved access to resources to enhance mathematics instruction in under-resourced rural schools.

Keywords: Language of conversion, length, linguistic barriers, measurement, system international units.

Introduction

As one of the earliest and most widely used mathematical concepts, length measurement is crucial in academic learning and real-world applications, forming the foundation for understanding perimeter, area, volume, and other geometric concepts. Length measurement refers to the process of determining the distance between two points and is essential in fields such as science, engineering, construction, and everyday life (Dogan Coskun & Isiksal Bostan, 2022). Despite its

importance, learners worldwide encounter difficulties in understanding and applying this concept effectively (Reddy, 2022; Yaish Tahal & Chiş, 2022). International assessments such as the Trends in International Mathematics and Science Study (TIMSS) indicate that students consistently struggle more with measurement than with other topics in the mathematics curriculum (Dogan Coskun & Isiksal Bostan; Reddy, 2022). Length measurement can be represented in various units and often requires learners to convert between them. In South Africa, the metric system is the standard used in education and daily life, with millimetres, centimetres, metres, and kilometres. The imperial system, still used in countries such as the United States, includes inches, feet, yards, and miles. Although metric units dominate scientific and international contexts, exposure to imperial units may still occur through global media and trade (Raje, 2019).

Learners begin engaging with measurement in the Foundation Phase, starting in Grade R with informal tools such as footsteps and strings to understand distance and body circumference (Naude & Meier, 2014). By Grade 4, the South African Curriculum and Assessment Policy Statement (CAPS) prescribes formal measurement activities using standard tools such as rulers, tape measures, and metre sticks, along with problem-solving tasks that involve unit conversions between millimetres, centimetres, metres, and kilometres (DBE, 2012). These skills are essential for mastering school mathematics and building strong problem-solving abilities, critical thinking, and logical reasoning, which are increasingly emphasized in global education systems (Miao et al., 2021). Teaching length measurement, however, presents multifaceted challenges. It involves developing learners' conceptual understanding, supporting practical application, and selecting effective pedagogical strategies. Learners may struggle with aligning objects correctly to measuring tools, iterating units, subdividing lengths evenly, and naming appropriate measurement units (Ellis et al., 2003; Hiebert, 1981; Sarama et al., 2011). Many are taught to simply read values from a ruler without understanding the concepts behind those readings, which can result in shallow or procedural knowledge (Ren et al., 2019).

Although the literature offers considerable insight into learner difficulties, particularly with rulers, interpreting marks and numbers, and converting units (Congdon et al., 2018; Ho & Lowrie, 2013; Sisman & Aksu, 2016), less attention has been given to how teachers perceive and address these challenges. Teachers' pedagogical content knowledge (PCK) is vital in supporting learners in overcoming such difficulties. Teachers can assist learners in aligning measurements from zero, focusing on intervals rather than counting ticks, and building an understanding of conversions (Gomezescobar, 2020; Ren et al., 2019). The issue is especially pressing in developing contexts such as that of South Africa, where many primary school teachers lack adequate subject-specific training in mathematics and science (Hobbs, 2020; Hobbs & Porsch, 2021; Porsch & Whannel, 2019). Resource constraints and lack of professional development support in rural areas further hamper instructional quality, contributing to persistent learning barriers (Tjale et al., 2024).

While research on measurement is growing, it still lags behind topics such as numbers and operations regarding depth and coverage (Sarama et al., 2021). Moreover, little is known about teachers' strategies to support learners with length measurement or how they manage related instructional challenges. Limited time, curriculum constraints, and difficulties with unit conversions further restrict teachers' ability to offer practical, problem-based instruction (Dinçer & Osmanoglu, 2018; Gomezescobar et al., 2020). To address these gaps, this study investigates how Grade 4 mathematics teachers in the Capricorn District of South Africa perceive and respond to learners' difficulties with length measurement. It explores the teaching strategies they use, the challenges they face, and how they attempt to overcome them. The following research questions guide the study:

1. What teaching strategies do Grade 4 mathematics teachers use when teaching length measurement?

2. What are Grade 4 mathematics teachers' perceptions of their learners' challenges with length measurement?
3. What challenges do teachers encounter in measuring length in Grade 4 mathematics?
4. How do Grade 4 mathematics teachers mitigate the challenges of teaching length measurement?

By examining teachers' perspectives and instructional practices, this study aims to contribute to the limited literature on teaching measurement and inform improved strategies for supporting learners' understanding in the primary school mathematics classroom.

Literature Review

This literature review synthesizes existing research on teaching strategies, the challenges teachers face in teaching length measurement, and the methods proposed to address these challenges. The aim is to contextualize previous findings within the scope of this study, which investigates how Grade 4 teachers in the Capricorn District perceive and respond to learners' difficulties with length measurement.

Challenges in Teaching and Learning Measurement

Teaching and learning measurement, particularly length measurement, presents persistent challenges affecting learners and educators. One common difficulty is learners' inability to align objects correctly when using measuring tools. Gómezescobar et al. (2020) found that many young learners struggle to align objects with the starting point of a ruler, which leads to misunderstandings that can persist into later grades. Without mastering these foundational skills, learners may face significant difficulties with more advanced topics such as perimeter or area. Another major obstacle is the ability to convert between different units. Dinçer and Osmanoglu (2018) reported that even prospective science teachers have trouble with metric conversions—for example, converting from milligrams to grams, or millilitres to cubic centimetres. This finding suggests that conversion difficulties extend beyond learners and may point to broader issues in how measurement concepts are taught and understood. Furthermore, Tan-Sisman and Aksu (2016) emphasize that limited instructional time for measurement contributes to misconceptions, as learners do not get enough practice to internalize the relationships between measurement units and tools. These challenges directly relate to this study's second and third research questions: What are Grade 4 mathematics teachers' perceptions of their learners' challenges with length measurement? Moreover, what challenges do teachers encounter in teaching length measurement in Grade 4 Mathematics? Understanding the nature and origin of these difficulties is essential for developing strategies to address them.

Strategies Used to Teach Measurements

Various teaching strategies have been explored in the literature to address these difficulties. McIntosh (2015) highlights using non-standard units, such as paper clips or blocks, as an effective method to provide learners with tactile, concrete experiences that help them grasp the concept of measurement. These early, hands-on approaches support learners' understanding before transitioning to standard tools. Gómezescobar et al. (2023) support using appropriate measurement tools, noting that rulers with clearly marked, discrete units help learners visualize length more accurately. Similarly, Çilingir Altiner (2024) demonstrated that concept cartoons, used within the realistic mathematics education (RME) framework, can assist learners in applying unit iteration and chunking strategies. These visually engaging tools help make abstract concepts more accessible, especially for younger learners. These strategies inform the study's first research question: What strategies do Grade 4 mathematics teachers use when teaching length measurement? The study aims to identify which practices effectively support learners' understanding of length by investigating what strategies are used in local classrooms.

Methods to Overcome Challenges in Teaching Measurement

Beyond specific strategies, researchers have proposed broader instructional methods to overcome the challenges of teaching measurement. Sarama et al. (2021) emphasize the importance of developmental progressions and learning trajectories in supporting conceptual understanding. These frameworks allow instruction to build gradually on learners' prior knowledge, guiding them through increasingly complex ideas. Smith III et al. (2013) advocate for curriculum changes that more explicitly link measurement concepts with real-world applications and related procedures. By helping learners see the practical relevance of what they are measuring, such approaches aim to deepen understanding and improve engagement. These methods are relevant to the fourth research question of this study: How do Grade 4 mathematics teachers mitigate the challenges encountered when teaching length measurement? Investigating how teachers adapt instruction to overcome learners' difficulties provides valuable insights for improving teaching practices in similar contexts.

Literature Gap and Study Relevance

While the literature provides valuable insights into the teaching and learning of length measurement, limited research focuses on the South African context, particularly in under-resourced areas such as the Capricorn District. Much of the existing work highlights what learners struggle with; however, few studies explore how teachers perceive these challenges or respond to them in practice. This study addresses this gap by examining the instructional practices, tools, and classroom strategies used by Grade 4 teachers to support learners' understanding of length measurement. By doing so, it seeks to contribute practical solutions informed by local realities and grounded in everyday teaching experiences.

Theoretical Framework

This study draws on two complementary theoretical frameworks—community of practice (CoP) by Wenger (1998) and rurality as conceptualized by Moletsane (2012)—to explore how Grade 4 mathematics teachers in the Capricorn District collaborate, adapt, and support one another in teaching length measurement. The CoP framework provides a lens through which to understand the shared practices, relationships, and learning processes among teachers. According to Wenger (1998), CoP is characterized by three key elements: a domain of shared interest, a community engaged in joint activities, and a body of practice developed over time. In this study, the domain is the teaching of length measurement in Grade 4; the community consists of 22 Grade 4 mathematics teachers, supported by a subject facilitator and researchers; and the practice includes the strategies, reflections, and resources developed through ongoing collaboration (Collins, 2023; Cotter et al., 2017). This framework is beneficial in analysing how teachers share knowledge, exchange instructional resources, and reflect on pedagogical approaches to address learners' difficulties with length measurement, directly relating to the study's focus on teaching strategies and mitigation efforts (Gómezescobar, 2020; Ren et al., 2019). The CoP lens also supports the design of collaborative workshops aimed at enhancing teachers' content knowledge and pedagogical skills (Mukeredzi, 2013).

Complementing this, the rurality framework by Moletsane (2012) helps to situate these teaching practices within rural schools' broader socio-economic and cultural realities. Moletsane challenges deficit views of rural education that emphasize isolation, poverty, and under-resourcing (Bonilla-Mejía & Londoño-Ortega, 2021), instead promoting a strength-based perspective. This approach highlights the resilience, adaptability, and community-based knowledge rural teachers and learners bring to education. In this context, rurality is a geographical location and a dynamic condition that shapes how teachers approach instruction with limited resources (Hannaway et al., 2018; Omodan & Makena, 2023). The rural context influences teachers' ability to implement standardised

strategies and demands flexible, locally responsive methods. As Pillay (2024) notes, "...the rural context, characterised by resource limitations and unique cultural influences, plays a crucial role in shaping these experiences" (p. 15).

By combining CoP and rurality, this study highlights both the collaborative learning processes among teachers and the contextual constraints and opportunities that shape their instructional decisions. The integration of these frameworks allows for a nuanced understanding of how rural teachers develop and share teaching strategies (RQ1), perceive and respond to learner challenges (RQ2), navigate systemic obstacles (RQ3), and adapt or co-create context-specific solutions (RQ4). Ultimately, the theoretical framework informs both the design of the intervention (collaborative workshops) and the analysis of how rural teachers engage with length measurement as a curriculum topic. It positions teacher development as a transfer of knowledge and a socially embedded, resourceful, and community-driven process.

Methodology

Research Design

This study was guided by an interpretive paradigm, which aims to understand how individuals make sense of their experiences within a specific context (Thanh & Thanh, 2015). The interpretive lens was appropriate for this research as it foregrounded the voices and lived experiences of Grade 4 mathematics teachers in rural schools, particularly about the challenges and strategies involved in teaching length measurement. To explore these experiences in depth, the study adopted a qualitative approach using a participatory action research (PAR) design. PAR was chosen because it supports collaborative inquiry and empowers participants to reflect on their practice and co-develop solutions to challenges (Cornish et al., 2023). This design was suitable given the study's focus on professional development in a rural context, where collaboration among educators is key. Teachers were not passive subjects but active participants in a workshop setting, contributing directly to knowledge generation.

This approach is consistent with the CoP framework (Wenger, 1998), which emphasizes learning as a social and participatory process where shared goals and reflective dialogue contribute to developing teaching practices. It also aligns with Moletsane's (2012) rurality framework, highlighting the contextual realities of under-resourced environments and the importance of leveraging local strengths and knowledge. By integrating these frameworks, the study's design reflects the collaborative nature of teacher learning and the unique challenges of teaching mathematics in rural schools.

Research Participants and Sampling Process

The study used purposive sampling to select participants with direct experience of teaching length measurement in rural primary schools. A total of 22 Grade 4 mathematics teachers were selected from 18 rural schools in the Capricorn District, along with one Intermediate Phase subject specialist. Purposive sampling was appropriate for this study because it enabled the selecting of individuals with specific knowledge and experience relevant to the research questions (Etikan et al., 2016). The group included 16 women and six men with varied academic backgrounds and teaching experience. Some participants held Bachelor of Education Honours degrees, Advanced Certificates in Education, or Master's degrees. Teaching experience ranged from 1–5 years to over 30 years, with most participants aged 41 to 60. This diversity enhanced the study by providing multiple perspectives on teaching length measurement in rural contexts.

Data Collection and Instruments

Data were collected using a triangulated approach that combined structured interviews, unstructured interviews, and observation. The structured interviews consisted of open-ended

questions that guided teachers to describe their strategies to teach length measurement, their challenges, and their learners' difficulties. These interviews provided consistent baseline information across all participants. Unstructured interviews followed, allowing for more flexible and conversational interactions. These sessions offered more profound insights into participants' daily classroom experiences, enabling them to reflect on their teaching practices in more detail and explore issues beyond the structured prompts. Observational data were gathered during a professional development workshop facilitated by the researchers. The workshop provided a collaborative setting where teachers discussed and demonstrated their teaching approaches, shared resources, and explored strategies for addressing challenges in teaching length. These interactions were captured through detailed field notes and audio recordings, allowing for rich contextual understanding (Creswell & Poth, 2018).

Data Analysis

The study employed thematic analysis to identify patterns and themes within the qualitative data. Interview transcripts and observation notes were transcribed verbatim, after which significant statements were coded line-by-line. Codes were then grouped into themes that reflected recurring challenges, teaching strategies, and solutions (Braun & Clarke, 2021). The process was iterative, allowing themes to evolve as deeper analysis was conducted. NVivo software was used to manage and organize the data, enhancing the rigour and transparency of the analytical process (Zamawe, 2015).

Trustworthiness

To ensure the trustworthiness of the findings, the study adhered to Lincoln and Guba's (1985) four criteria: credibility, transferability, dependability, and confirmability. Credibility was established through triangulation, using multiple data sources and methods, such as interviews and observations (Denzin, 2012). Transferability was enhanced by providing a detailed description of the research context and participants, enabling readers to assess relevance to other settings. Dependability was supported through consistent documentation of the research process and peer debriefing. Finally, confirmability was achieved by maintaining an audit trail and grounding interpretations in direct participant quotes to minimize researcher bias.

Ethical Considerations

Ethical approval for this study was obtained from the University of South Africa College of Education Ethics Review Committee, under clearance reference number 2022/11/09/1123408/08/AM. The study adhered strictly to ethical research practices. All participants received informed consent forms, clearly outlining the study's purpose, voluntary participation, and the right to withdraw without penalty. Participants were assured that their identities would remain anonymous, and all data were handled with confidentiality (BERA, 2018). Ethical approval was obtained before data collection, and researchers remained sensitive to the participants' contexts throughout the process.

Findings

This section presents the results of the qualitative data analysis conducted through structured and unstructured interviews and observations during a professional development workshop. Key themes and subthemes were generated using thematic analysis. Each is introduced and illustrated with relevant participant quotes and brief interpretive commentary. The structure follows the four research questions guiding the study.

Findings Related to Research Question 1

What teaching strategies do Grade 4 mathematics teachers use when teaching length measurement?

Theme 1. Hands-On, Real-World Measurement with Standard Tools

Teachers commonly used tactile, real-world activities to make abstract measurement concepts meaningful. These strategies guided learners in measuring real objects and spaces using standard tools.

T1, T2, T3, T4, and T8. *“...learners measure length using the example of a toddler and a grown-up’s steps for cm and mm... some of us bring different tools... like rulers, T-square, tape measure, trundle wheel... learners measure concrete things like rubber, tables... outside using trundle wheel...”*

This theme demonstrates experiential, active learning to help learners internalize length concepts. It aligns with CoP through teachers’ shared practices and with Rurality using locally available materials.

Theme 2. Adapting Tools in Resource-Constrained Contexts

Teachers reported having limited access to formal tools but were compensated through creativity and peer support. They found ways to make measurement meaningful despite these constraints.

T1, T2, T3, T6, T9, and T10: *“...some learners can identify correct measurement tools... though we teachers improvise due to a lack of resources, the little we bring to class makes some difference...”*

This theme highlights how teachers in rural schools lean on one another to exchange knowledge and improvise with available resources, showing the functionality of CoP and the adaptability described in rurality.

Theme 3. Visual and Demonstrative Methods

Teachers employed simple, low-tech demonstrations and visual cues to help learners visualize measurement concepts, especially in schools with limited technological tools.

T1, T2, T3, T4, T6, and T7: *“...use the demonstrative approach to gain learners’ attention... keep them engaged... learners measure sides of shapes...”*

This approach enhances learner understanding by breaking down abstract ideas into observable steps. It also reflects the rural teaching context, where teachers innovate within material limitations.

Findings Related to Research Question 2

What are Grade 4 Mathematics teachers’ perceptions of their learners’ challenges with length measurement?

Theme 4. Learners Struggling to Navigate Abstract Measurement Systems

Subtheme 4.1: Challenges in Unit Conversion

Teachers noted that many learners did not understand how metric units relate, particularly when converting between units.

T1–T6: *“...some learners cannot convert metric units... even after repeated explanations...”*

This subtheme points to a common conceptual gap among learners, which makes it difficult for them to engage meaningfully with measurement tasks. The issue is compounded by limited exposure and foundational instruction.

Confusion with Units and Tools

Teachers reported that even when learners could identify the right tools, they often misused them or confused similar units.

T1–T4: *“...learners confuse the units... some can identify the right devices... but still struggle with accurate measurement...”*

This confusion highlights a lack of embedded understanding, where learners can name tools but do not yet grasp their function or relationship to units of length.

Difficulty with Estimation

Many learners showed limited capacity for estimating lengths or distances, an important skill for real-world measurement applications.

T1, T2, T3, and T7: *“...the estimation of lengths is a challenge... learners struggle with estimating the length of objects and distances...”*

This aligns with broader findings that estimation requires both spatial reasoning and real-world experience, often lacking in under-resourced rural contexts.

Limited Reading Comprehension

Teachers highlighted learners’ difficulties with reading and interpreting measurement instructions as a barrier to understanding length.

T1, T2, T3, T5, and T8: *“...most of my learners cannot read with understanding... this hinders their ability to follow conversion instructions...”*

This indicates that comprehension, not just content knowledge, is critical in learning measurement. A dual focus on literacy and numeracy is necessary, especially in rural schools.

Findings Related to Research Question 3

What challenges do teachers encounter in teaching length measurement in Grade 4 Mathematics?

Theme 5. Navigating Systemic Barriers in Rural Measurement Instruction

Insufficient Instructional Time

Teachers expressed concern that the time allocated in the Annual Teaching Plan (ATP) was insufficient for learners to grasp measurement concepts fully.

T1–T6: *“...not enough time dedicated to teaching length according to ATP... should revisit the ATP...”*

This reflects broader structural issues in curriculum design, particularly when teaching complex concepts in rural schools where learners may need more time and reinforcement.

Lack of Measurement Tools and Familiarity

Teachers also mentioned a lack of measuring tools; some teachers were unfamiliar with or untrained in their use even when tools were available.

T1, T3, T4, T5, and T8: “...we do not have tape measures... some teachers lack familiarity with tools like trundle wheels...”

This points to a professional development gap. Teachers may recognize tools but not feel equipped to teach with them effectively, further complicating instruction in under-resourced schools.

Findings Related to Research Question 4

How do Grade 4 mathematics teachers mitigate the challenges of teaching length measurement?

Theme 6. Making Measurement Meaningful through Memory and Metaphor

Conceptual Instruction for Unit Conversions

Teachers began to shift from procedural drills to conceptual teaching methods, helping learners understand the logic behind conversions. This shift represents an important step toward deeper mathematical understanding and reflects how reflective practice can lead to pedagogical change.

T1, T2, T6, and T9: “...just teach them to multiply, but there is no deeper understanding... help with the best way to convert...”

Use of Mnemonics

Teachers adopted mnemonic devices introduced during workshops to help learners remember the order of metric units. Mnemonics provided a culturally familiar, easy-to-remember tool for learning and were quickly integrated into everyday teaching.

T1, T2, T5, T6, and T7: “...used ‘Kyk Hoe Die Man Die Cents Maak’ with learners... it helps them...”

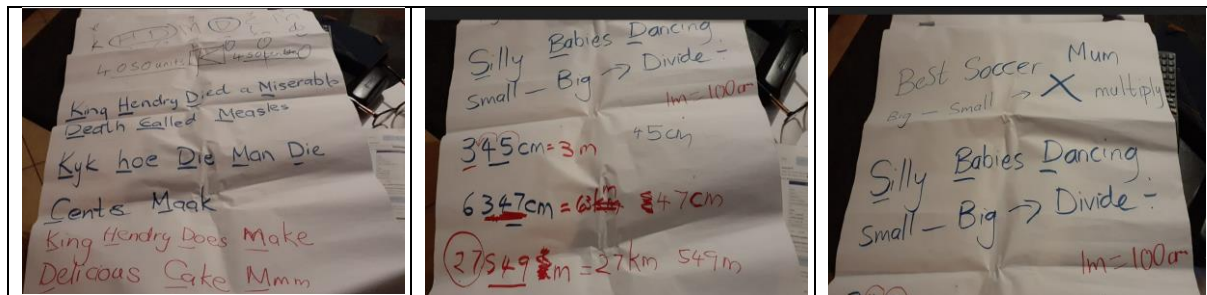


Figure 1. Mnemonic strategy discussed and developed during the workshop

Use of Analogies

Analogies were introduced to help learners conceptualize relationships between units and support visual thinking. These metaphors helped bridge conceptual gaps, giving learners a frame of reference for understanding abstract comparisons such as inequalities and conversions.

T3, T4, T5, T7, and T9: “...learners often forget to think about the units... which makes comparing measurements difficult...”

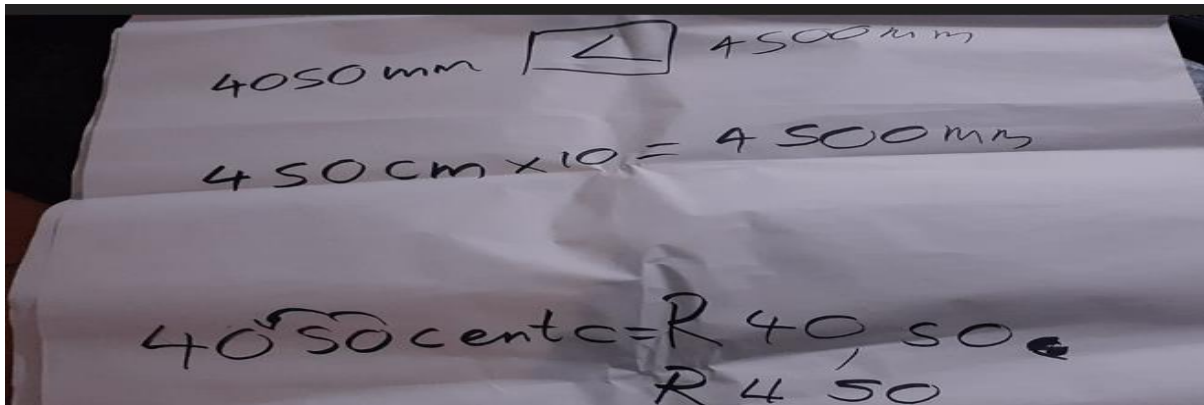


Figure 2. Analogy-based strategy used to teach inequality signs and reinforce unit comparison

Discussion

Summary of Major Findings

This study identified several strategies Grade 4 mathematics teachers used to teach length measurement in rural classrooms. These include hands-on, real-world activities; adapting tools in resource-constrained contexts; and visual and demonstrative techniques. Teachers perceived significant challenges among learners, particularly with abstract measurement concepts such as unit conversion, estimation, and interpreting written instructions. Teachers also faced challenges such as limited resources, restricted instructional time, and unfamiliarity with some standard tools. They implemented mnemonic devices, analogies, and conceptual teaching methods to make measurement more accessible and memorable.

Interpretation of Findings and Theoretical Insights

The findings support the framework of CoP (Wenger, 1998), where teachers collaboratively developed and refined their measurement instruction through shared professional engagement. This was evident in how teachers reported using workshop-based activities to improve their practices and support one another. These shared experiences helped bridge gaps in training and practice, consistent with the work of Cotter et al. (2017) and Tran and Kelle (2023), who highlight how collective knowledge in CoPs enhances instructional confidence and effectiveness in underserved contexts. Moletsane's (2012) rurality framework is reflected in the teachers' adaptive use of locally available tools and responses to geographic and material limitations. Rather than emphasizing deficits, the findings highlight rural teachers' resilience and innovation. For instance, using improvised tools and mnemonic strategies shows how contextual constraints stimulate the development of novel solutions (Omodan & Makena, 2023).

Teachers' identification of learners' struggles with conversions, estimation, and comprehension aligns with earlier work by Sarama et al. (2011) and Tan-Sisman and Aksu (2016), who documented similar conceptual and procedural difficulties in early mathematics learning. Gómezescobar et al. (2020) also reported challenges with students' interpreting measurement tools and symbols accurately, reinforcing the need for clearer, more structured instructional methods.

Adopting mnemonics and analogies to support learning echoes strategies was found effective in studies such as those of Çilingir Altiner (2024) and McIntosh (2015), in which concrete, visual, and story-based learning tools made abstract content more accessible. These learner-friendly adaptations show how pedagogical content knowledge and creativity intersect in response to learner needs and limited teaching aids.

Implications of the Findings

The study offers key implications for educational practice and policy. First, it emphasizes the value of community-based professional development, especially in rural areas with weak formal support structures. Facilitated workshops can help teachers share strategies, co-create solutions, and reinforce core instructional practices. Second, the findings support integrating literacy strategies into mathematics instruction, particularly in topics that rely on comprehension, such as unit conversions and interpreting measurement instructions. Finally, curriculum pacing tools such as the ATP may need to be adjusted to accommodate the time required for deep conceptual learning in under-resourced environments. This study contributes to the existing literature by illustrating how rural teachers innovate with limited means, drawing from their training and collaborative interactions. It affirms prior work on the efficacy of teacher-led strategies and strengthens calls for resource-sensitive, context-driven instructional support in mathematics education.

Limitations and Recommendations

This study was limited to a single district, and the findings may not generalize to all rural contexts. The self-reported data may also introduce subjectivity, as it depends on participants' perceptions of their practices. Additionally, while workshop interactions were observed, the study did not include long-term classroom observation or learner assessment to validate reported outcomes.

Despite these limitations, the study offers a valuable model for rural teacher development in mathematics. Future research could explore the long-term effects of workshop-based interventions, especially the sustained use of mnemonics, analogies, and collaborative strategies. Broader studies involving multiple rural regions could offer comparative insights and inform national policy planning in foundational mathematics education.

Conclusion

This study explored the challenges Grade 4 mathematics teachers face in teaching length measurement and their strategies to support learning in rural school contexts. The goal was to understand how teachers navigate resource constraints, conceptual difficulties, and curriculum demands while still striving to deliver effective mathematics instruction. The findings reveal teachers rely on practical, hands-on strategies to engage learners in meaningful measurement activities. These include adapting tools in resource-constrained environments, using demonstrations, and contextualizing measurement through everyday examples. Teachers identified persistent learner challenges, especially in navigating abstract concepts such as unit conversions, estimation, and understanding instructions. They also noted systemic barriers such as limited instructional time and unfamiliar measurement tools. Teachers introduced learner-friendly approaches such as mnemonics, analogies, and concept-based instruction strategies to mitigate these challenges, making measurement more memorable and accessible. These approaches were developed and strengthened through collaborative professional workshops, demonstrating the value of shared learning and support among rural educators. This study emphasizes the importance of targeted, practical teacher development that responds to the unique realities of rural schools. Moving forward, initiatives focusing on conceptual clarity, resource adaptation, and collaborative learning environments can help teachers improve instruction and learner outcomes in measurement.

Author Contributions

Conceptualization (E.G.M, C.N & K.G.P.); Literature review (E.G.M. & C. N); methodology (E.G.M, K.G.P & CN); software (K.G.P); validation (E.G.M, C.N & K.G.P.); formal analysis (E.G.M, C.N & K.G.P); investigation (E.G.M. & C.N.); data curation (E.G.M. & C.N.); drafting and preparation (E.G.M, C.N & K.G.P); review and editing (E.G.M.); supervision (E.G.M. & C.N.); project administration (E.G.M. & C.N); and funding acquisition (N/A). All authors have read and approved the published version of the article.

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Conflict of interest

The authors declare no conflict of interest.

Data availability

The data must remain confidential owing to ethical standards and the conditions outlined in the consent agreement with participants. However, interested persons may contact the corresponding author for more information.

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