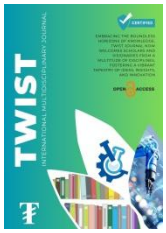
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Negotiating Multilingual Mathematical Discourse in South African Secondary School Township Classrooms

Teachers' Pedagogical Practices for Supporting Mathematics Learning

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Abstract
Mathematics teaching in South African township secondary schools is characterised by significant linguistic diversity, where English serves as the language of learning and teaching despite many learners speaking African languages as their home languages. This creates challenges for learners' participation, mathematical communication, and conceptual understanding while simultaneously presenting opportunities for multilingual pedagogical practices. This study investigated how mathematics teachers negotiate multilingual mathematical discourse to support conceptual understanding and learner participation in township secondary school classrooms. The study was underpinned by Sociocultural Theory, which conceptualises learning as a socially mediated process in which knowledge is constructed through dialogue, interaction, and culturally situated activities. An interpretivist paradigm and exploratory qualitative research design were adopted. Twelve purposively selected mathematics teachers from multilingual township secondary schools participated in the study. Data were collected through semi-structured interviews and non-participant classroom observations to capture teachers' pedagogical practices and classroom interactions. Data were analysed thematically using Braun and Clarke's thematic analysis approach. The findings revealed that teachers employed translanguaging, scaffolding, contextualisation of mathematical concepts, collaborative classroom discourse, flexible language practices, and questioning strategies to enhance mathematical meaning-making and learner participation. The study demonstrates that multilingualism is a valuable pedagogical resource that can improve equitable access to mathematics learning and provides contextually relevant evidence to inform teacher education, multilingual language policy, and mathematics pedagogy in linguistically diverse educational settings.

Keywords
multilingual mathematics education, translanguaging, mathematical discourse, township secondary schools, sociocultural theory, conceptual understanding

INTRODUCTION

Globally, mathematics is widely recognised as a universal language of science, technology, engineering, and innovation (Makonye & Moodley, 2023). However, the teaching and learning of mathematics is fundamentally mediated through natural language. Mathematics education research increasingly demonstrates that learners' opportunities to develop conceptual understanding depend not only on their mathematical competence but also on their ability to participate meaningfully in classroom discourse. Mathematical meaning-making and problem-solving are constructed through language. This makes classroom communication a central component of mathematics learning rather than just a conduit for transmitting content. Consequently, teachers' pedagogical practices leveraging multilingual resources particularly translanguaging and code-switching significantly enhance conceptual understanding and learner engagement in South

African township mathematics classrooms. Multilingual classrooms present both pedagogical opportunities and instructional challenges especially where the language of learning and teaching differs from learners' primary home languages. Scholars such as Mulaudzi (2024), Essien and Moleko (2025) and Rodriguez, Krause and Adams-Corral (2025) argues that multilingualism should no longer be viewed as a deficit requiring mediation but as a valuable cognitive and pedagogical resource capable of enriching mathematical meaning-making when effectively integrated into classroom practice.

Internationally, growing attention has been directed towards understanding how teachers navigate linguistic diversity while maintaining conceptual rigour in mathematics instruction. In a study conducted with teachers from seven countries, Planas, McKinley, Smith, Ingram, Essien and Moore (2025) reported that students face linguistic challenges in mathematics learning, particularly with vocabulary, reasoning, and topic-specific language demands. The study highlighted the need for integrated linguistic and mathematical support in diverse settings. In a related study, Lüssenhop and Kaiser (2024) observed that teachers in German schools struggle to adapt mathematics teaching to diverse linguistic and mathematical needs due to lack of institutional support. Additionally, international research highlights the importance of mathematical discourse, translanguaging, dialogic teaching, and multilingual interaction in supporting conceptual understanding and equitable participation. Lunz et al., (2025) observed that teaching with a translanguaging stance can access multilingual students' full linguistic repertoires and develop deep mathematical understanding. Similarly, Yi, Sourwine, Erden, Shrestha and Grando (2024) highlighted that translanguaging empowers bilingual students in mathematics classrooms by supporting linguistics identities and creating inclusive learning environments.

Instead of relying exclusively on monolingual instructional practices, effective mathematics teachers strategically draw upon students' linguistic repertoires to clarify abstract concepts, scaffold reasoning, and encourage collaborative problem-solving. Jiménez-Silva, et al, (2025) opines that effective mathematics teachers use multilingual students' linguistic repertoires to enhance reasoning and communication through integrated language math instruction. Luz et al., (2025) indicated that effective mathematics teaching involves a translanguaging stance to leverage multilingual students' full linguistic repertoires for deeper understanding. In agreement with Luz et al., (2025), Wilson and Smith (2022) argue that effective mathematics teaching support multilingual students by drawing on their linguistic repertoires. Nevertheless, the literature also demonstrates that these pedagogical practices require sophisticated instructional decision-making, as teachers must continually negotiate tensions between curriculum requirements.

These issues are particularly significant within South African township schools where multilingualism represents the educational norm rather the exception. Sibanda and Tshehla (2025) observed that the use of English as a medium of instruction in South African township schools poses barriers to effective learning and teaching in multilingual township schools due to limited English proficiency among learners and teachers. Although the Language in Education Policy promotes multilingualism, English continues to dominate mathematics instruction beyond the Foundation Phase. Makupe and Machaba (2024) highlighted that English is the preferred language for learning mathematics among high school learners in a South African township context. Additionally, Makupe and Machaba (2025) found that learners in rural Eastern Cape mathematics classrooms prefer a bilingual approach, integrating isiXhosa and English in an endeavour to enhance understanding and participation, because of the context of the Eastern Cape as a province. This preference highlights a tension between policy and practice, suggesting bilingual pedagogical strategies could improve equity and inclusion. The South African language policy framework is implemented despite many students speaking African languages as their primary means of communication. In reality, township classrooms constitute linguistically complex environments in which teachers regularly vacillate between English and indigenous home languages to explain mathematical ideas and facilitate participation. While these practices reflect important pedagogical adaptations, they also raise critical questions regarding how multilingual discourse shapes conceptual understanding, mathematical communication and equitable access to mathematical knowledge. In the Ethiopian context, Opare-Kumi (2024) observed that students taught in English medium instruction have lower mathematics test scores compared to those taught in their mother tongue. The challenge is therefore not multilingualism itself but how teachers negotiate multiple languages while preserving the conceptual integrity and specialised discourse of mathematics.

Despite increasing international interest in multilingual mathematics education, important gaps remain within the existing literature in South Africa (McLachlan & Essien, 2022; Essien & Moleko, 2025). Much of the available research has concentrated on documenting language barriers, teachers' perceptions, or code-switching practices. Comparatively limited attention has been devoted to the pedagogical processes through which teachers negotiate multilingual mathematical discourse to promote conceptual understanding. Furthermore, very few studies have examined these issues within South African township classrooms where linguistic diversity intersects with historical educational inequalities, resource constraints, and curriculum demands. Consequently, insufficient evidence exists regarding the instructional practices that enable teachers to transform multilingualism from a potential barrier into a pedagogical resource for learning mathematics.

Against this backdrop, our study investigated how mathematics teachers negotiate multilingual mathematical discourse in South African township classrooms to support students' conceptual understanding. Rather than framing multilingualism as a classroom challenge alone, the study conceptualises it as a dynamic pedagogical resource through which teachers mediate mathematical meaning, facilitate student participation and promote conceptual reasoning. By foregrounding teachers' pedagogical practices, the study contributes to contemporary debates on multilingual mathematics education, extends scholarship on mathematical discourse in linguistically diverse settings, and provides

contextually grounded evidence capable of informing teacher education, language policy, and mathematics pedagogy in multilingual educational environments.

The objectives our study were:

- To examine the pedagogical strategies mathematics teachers employ to facilitate mathematical meaning-making in multilingual township secondary school mathematics classrooms.
- secondary school classrooms.
- To explore pedagogical strategies used by mathematics teachers to facilitate student participation in multilingual township mathematics classrooms

Mulaudzi (2024) proposes a Multilingual Integrated Pedagogical Model emphasising linguistic diversity as a cognitive asset for mathematical literacy. Guzula and Abdulatief (2024) and Probyn (2024) document how translanguaging and bi/multilingual pedagogies improve learner participation, motivation, and epistemic access across 10 township schools. Olawale et al., (2024) identifies collaborative lesson planning, code-switching, and mother-tongue resources as effective teacher preparation strategies. Supporting conceptual understanding specifically, Ncube and Luneta (2025) demonstrates concept-based instruction yields deep understanding and long-term retention. Coetzer et al., (2023) emphasises that mathematical language requires scaffolding aligned with learners' linguistic demands. Collectively, these studies establish that multilingual pedagogical practices are essential for supporting both mathematical discourse and conceptual understanding in township contexts.

THEORETICAL FRAMEWORK

This study was underpinned by Vygotsky's (1978) Sociocultural Theory (SCT). This theory viewed mathematics learning as a socially mediated process involving participation in culturally situated practices and discourse (Erath et al., 2021). From this perspective, learners developed mathematical understanding through opportunities to explain ideas, justify procedures, and negotiate meanings through interaction with lecturers and peers. Language and classroom dialogue therefore served as central resources for developing conceptual understanding and participating in mathematical practices (Zahner et al., 2021). The theory was considered particularly appropriate for multilingual township mathematics classrooms, where teachers negotiated multiple linguistic resources to scaffold learners' mathematical reasoning and participation. Recent methodological and mathematics education scholarship suggested that sociocultural perspectives provided a robust explanatory framework for examining how classroom interactions and discourse shaped mathematical meaning-making in linguistically diverse educational contexts.

Although SCT was criticised for paying insufficient attention to structural constraints such as curriculum demands, language policy, and unequal educational resources that could influence teachers' pedagogical choices, its emphasis on mediation, dialogue, and collaborative knowledge construction aligned closely with the purpose of this study. Consequently, the theory provided an appropriate analytical lens for examining how mathematics teachers negotiated multilingual mathematical discourse to support conceptual understanding. It enabled the study to move beyond describing language-related challenges by critically examining how teachers strategically employed multilingual pedagogical practices to facilitate mathematical meaning-making and meaningful learner participation within South African township mathematics classrooms. I suggest that you also add a reference in this paragraph because you were discussing a theory

MATERIALS AND METHODS

This exploratory research adopts an interpretivist epistemological paradigm (Ahmad & Esposito, 2024). This methodological approach emphasises qualitative research methods and understanding meanings over causal explanation (Aithal & Maiya, 2023; Ma & Ma, 2022). Mosquera, Barrios and Chica (2026) further confirm that the interpretive paradigm grounds qualitative research in social and human sciences, prioritising understanding of meanings. An exploratory research design was employed to gain an understanding of the phenomenon at hand, focusing on negotiating multilingual mathematical discourse in South African secondary school township classrooms and teachers' pedagogical practices for supporting mathematics learning. Interpretivism was therefore employed because it enabled an in-depth exploration of how teachers constructed, adapted, and justified their pedagogical decisions in linguistically diverse classrooms. Recent qualitative scholarship argued that interpretivism provided a robust philosophical foundation for studies investigating educational practice because it privileged participants' perspectives while recognising the influence of context and researcher interpretation. Nevertheless, critics contended that interpretivist research limited statistical generalisation because findings were context-specific. This limitation was mitigated through rich contextual description and transparent reporting, enabling readers to determine the transferability of the findings to similar educational contexts.

Population and sample

A purposive sampling strategy was adopted to select 12 participants who possessed direct experience of teaching mathematics in multilingual township classrooms. Purposive sampling was preferred because it enabled the deliberate selection of teachers who met predefined inclusion criteria, including a minimum of three years' teaching experience, current teaching responsibility for mathematics, and experience of teaching linguistically diverse learners. Approximately 12 mathematics teachers were selected, with the final sample size being determined by data saturation, the point at which no new themes or insights emerged from successive interviews and classroom observations.

Data collection

Data were collected using semi-structured individual interviews and non-participant classroom observations. These tools were adopted to obtain a comprehensive understanding of how mathematics teachers negotiated multilingual mathematical discourse to support learners' conceptual understanding. Semi-structured interviews provided sufficient flexibility to explore teachers' experiences while maintaining consistency across participants through an interview guide. This approach allowed participants to explain how they selected languages during instruction, scaffolded mathematical concepts, and facilitated learner participation in multilingual classrooms.

Classroom observations complemented the interview data by providing direct evidence of how multilingual discourse was enacted during mathematics instruction. Observations enabled the researcher to examine language choices, teacher-learner interactions, questioning techniques, code-switching practices, and strategies used to promote conceptual understanding. This approach reduced reliance on self-reported accounts and strengthened methodological rigour through data triangulation. An observation schedule was developed to ensure systematic recording of instructional practices while allowing flexibility to document unexpected pedagogical interactions. The combination of interviews and classroom observations enhanced the depth, credibility, and contextual richness of the findings by enabling comparison between what teachers reported and what they actually practised in multilingual township mathematics classrooms. This methodological complementarity strengthened the study's ability to explain how multilingual discourse was negotiated to facilitate meaningful mathematical learning.

Data analysis

Data were analysed thematically using coding and categorisation techniques (Braun & Clarke, 2006). Interview transcripts and lesson observation notes were coded to identify patterns and themes related to negotiating multilingual mathematical discourse in South African secondary school township classrooms and teachers' pedagogical practices for supporting mathematics learning.

Ethical considerations

Ethical clearance was obtained from the Tshwane University of Technology and the Department of Basic Education. Participants were requested to provide informed consent and were assured that their rights such as confidentiality and anonymity will be preserved through the use of pseudonyms. Data were securely stored and were to be destroyed after a period of five years. Participation in the study was mainly voluntary and all participants were free to withdraw at any stage without facing any prejudice or penalties.

FINDINGS AND DISCUSSION

The study explored the pedagogical practices used by mathematics teachers to negotiate multilingual mathematical discourse in South African secondary school township classrooms in order to support mathematics learning. Two themes emerged: (i) pedagogical strategies employed by mathematics teachers to facilitate meaning-making; and (ii) pedagogical strategies used by mathematics teachers to facilitate student participation. Table 1 below provides a summary of the themes and emerging sub-themes.

Theme	Sub-themes
Theme 1: Pedagogical strategies employed by mathematics teachers to facilitate meaning-making	1.1 Translanguaging as a pedagogical resource 1.2 Scaffolding mathematical concepts 1.3 Contextualising mathematics using learners' everyday experiences
Theme 2: Pedagogical strategies used by mathematics teachers to facilitate student participation	2.1 Collaborative classroom discourses 2.2 Inclusive participation through flexible language practices 2.2 Questioning and peer interaction strategies

Pedagogical strategies mathematics teachers employ to facilitate mathematical meaning-making

From this theme, three sub-themes emerged (i) translanguaging as a pedagogical resource; (ii) scaffolding mathematical concepts as a pedagogical resource; and (iii) contextualising mathematics using learners' everyday experiences. Teachers described how they facilitate mathematical meaning making. These findings resonate with Guzula and Abdulatief (2024) who demonstrated that translanguaging in Grade 8-9 mathematics classrooms enhances meaning-making and participation, with teachers using code-switching to support learners' engagement. Similarly, Rodríguez et al., (2025) argue that adopting a translanguaging stance allows teachers to access multilingual students' full linguistic repertoires and develop deep mathematical understanding.

Translanguaging as a pedagogical resource

Translanguaging serves as a critical pedagogical resource in multilingual mathematics classrooms, enabling teachers to facilitate mathematical meaning-making by leveraging students' full linguistic repertoires. Ngcobo et al. (2021) argue that through translanguaging, teachers and students can utilize their different language abilities in education to break down language barriers in multilingual settings and foster linguistic diversity. Makalela & da Silva (2023) suggest that students

who do not have English as their first language should receive essential assistance to achieve academic excellence. Translanguaging enables students to utilize all their language skills in learning, as long as they grasp the concepts (Mbirimi-Hungwe, 2021).

Teachers frequently used translanguaging as a pedagogical resource to facilitate mathematical meaning-making in multilingual township secondary school classrooms. As one teacher reflected, *"You must incorporate home languages alongside English as this enhances learners' comprehension and engagement"* Teacher 1, T1). Teacher 3, T3 also indicated that, *"I use translanguaging because it allows complex concepts to be processed in the home language before transitioning to English."* One teacher remarked, *"I've been using translanguaging as a resource enhances meaning-making and participation among my students."* (Teacher 6, T6). This reflects the teacher's strong belief that translanguaging can enhance mathematical learning and students' meaning making. The findings confirm that translanguaging creates inclusive learning spaces where learners can draw on familiar linguistic resources to access new knowledge. Additionally, the findings also complement the observations made by Mulaudzi (2024), who proposes leveraging linguistic diversity as a cognitive asset through integrated pedagogical models.

Scaffolding Mathematical Concepts through Multilingual Dialogue

The study identified five different scaffolding strategies as observed by Kosko (2020) who highlighted that teachers can use to help students gain conceptual understanding: These strategies include offering explanations; inviting student participation; verifying and clarifying student understanding; modeling desired behavior and inviting students to provide clues. Teachers consistently reported that they adopted scaffolding in the form of guidance, instructions, or other aids, which were gradually reduced as students' abilities increase. One teacher explained, *"By using scaffolding strategies, students are encouraged to complete tasks that may be too difficult to do alone, so that they can build new knowledge and skills"* (T5). Additionally, Teacher 7, stated: *"I modify the cognitive difficulties that the students face when they are unable to solve problems at their current developmental level. As time goes on when my students are able to work on their own competently I withdraw the scaffolding"* These findings echo the scaffolding strategies documented by Ayalon and Wilkie (2020) and Rezat et al., (2021) who found that it is important that such support is temporary.

Moreover, the study highlighted that applying scaffolding encourages independent learning, some teachers also noted that this strategy helps students become more independent in their learning. One teacher shared, *"This strategy allows students to think for themselves and develop their problem-solving skills. Along the way they become more aware of their own thinking process."* (T11). Thus, scaffolding strategies do not only assist in understanding the material but also enhance students' critical thinking skills and independence. The findings align with researcher which indicates that scaffolding aims to help students not only understand mathematics material but also become more independent and reflective learners. This is in line with the opinion of (Cevikbas & Kaiser, 2020; Kosko, 2020; Manik et al., 2023) who stated that the role of Scaffolding-Metacognitive is a stimulus to develop students' abilities in the thinking process.

Contextualising mathematics using learners' everyday experiences

From the collected data it emerged that teachers enhanced students' meaning making through contextualising mathematics using learners' everyday experiences.

One participant teacher stated: *"I integrate examples from local contexts, including shopping, taxi fares, budgeting, street trading, construction, and household activities, to make abstract mathematical concepts more meaningful and accessible."* (T12). These outcomes align with previous empirical research that argues that contextualised learning strengthens conceptual understanding because knowledge is more effectively constructed when learning activities are embedded within authentic contexts that reflect learners' experiences and needs (Abu-Rasheed, Weber & Fathi, 2023). Rather than treating mathematics as an abstract and decontextualised discipline, teachers positioned it within learners' social and cultural realities, enabling them to relate new knowledge to prior experiences. From a sociocultural perspective, these findings suggest that contextualisation functioned as a mediational tool through which learners constructed mathematical understanding by connecting familiar experiences with formal mathematical concepts. Likewise, recent research on culturally responsive mathematics education emphasised that recognising learners' cultural knowledge and everyday practices enhances mathematical reasoning by validating multiple ways of knowing and supporting meaningful participation in classroom discourse (Xu & Ball, 2024).

Pedagogical strategies used by mathematics teachers to facilitate student participation

Collaborative classroom discourse

Teachers involved in the study reported that collaborative strategies such as cooperative learning, group projects, and educational technologies are effective in fostering student participation and developing social skills in mathematics classroom (Franco et al., 2024). One teacher explained, "I engage students in mathematical discussions by using explicit instructions." (T7). Another teacher highlighted the strategy of acting as a facilitator by directing specific mathematical questions to all students in groups (T4).

Inclusive participation through flexible language practices

Teachers consistently reported the use of flexible language practices including code-switching, translanguaging, and bilingual instruction in order to effectively facilitate inclusive student participation in multilingual township mathematics

classrooms. The findings align with the work of Probyn (2024) who observed that bi/multilingual pedagogies impacted positively on learners' participation, motivation and opportunities to learn. Olawale et al., (2024) identified code-switching and mother-tongue resources as key strategies for enhancing students' participation.

Questioning and peer interaction strategies

The findings provide substantial evidence that questioning is an effective pedagogical strategy for facilitating student participation in mathematics classrooms. Teachers consistently reported enhanced student participation when the questioning strategies are effectively used in classroom mathematics discourses. One teacher explained, *"In order to enhance participation I used question modification strategies such as repetition, rephrasing, clarification, and decomposition*." (T8). The findings align with Othman et al., (2022) who found that effective questioning techniques improve teacher-student instructional dialogues in primary mathematics classrooms. Another (T4) highlighted how probing and factual questioning strategies enhance students' participation during lessons. These findings are collaborated by Rahman et al., (2023) who demonstrated that probing and factual questioning strategies increased student activeness and engagement. T9 reflects: *"Providing students with an opportunity to interact in pairs with peers has proved to be effective for enhancing students' participation."* This practice aligns with the work of Sjöblom et al., (2022) who showed that teachers could refine strategies for engaging students in small-group mathematical discussions through purposeful questioning.

Lesson observations

Classroom observations were further employed to illuminate the pedagogical practices used by mathematics teachers to negotiate multilingual mathematical discourse in South African secondary school township classrooms in order to support mathematics learning. Across the 12 lessons observed teachers routinely used translanguaging and scaffolding. For instance, one teacher explained mathematical processes in English and translate each line in Setswana. Students generally expressed themselves more fluently in their home languages during peer discussions but hesitated when responding in English. This finding reflects recent scholarship suggesting that multilingual learners often possess conceptual understanding but experience difficulty articulating disciplinary knowledge in the language of instruction because of the linguistic demands of academic discourse rather than a lack of mathematical competence (Prediger, Erath, Weinert & Quabeck, 2022). The findings further corroborate the work of Guzula and Abdulatie (2024), who found that translanguaging emerges naturally as teachers respond to learners' communicative needs in multilingual mathematics classrooms, enabling learners to draw on their full linguistic repertoires to negotiate mathematical meaning. Similar findings were reported by Valencia Mazzanti (2022), whose study demonstrated that multilingual learners used translanguaging strategically to explain mathematical concepts, solve problems collaboratively, and participate more confidently in classroom discussions.

CONCLUSION

This study concludes that mathematics teachers in South African township secondary schools negotiate multilingual mathematical discourse through pedagogical practices such as translanguaging, scaffolding, contextualisation, collaborative learning, flexible language use, and effective questioning to enhance learners' conceptual understanding and classroom participation. These strategies enable learners to draw on their home languages alongside English, thereby improving mathematical meaning-making, reducing language-related barriers, and fostering more inclusive learning environments. The findings underscore that multilingualism should be recognised as a valuable pedagogical resource rather than a constraint, highlighting the need for mathematics instruction that deliberately integrates learners' linguistic repertoires to promote equitable access to quality mathematics education.

RECOMMENDATIONS

- The Department of Basic Education should develop clear curriculum guidelines that support the systematic integration of translanguaging and multilingual pedagogical practices in mathematics classrooms.
- Teacher education institutions should provide continuous professional development programmes that equip mathematics teachers with effective strategies for teaching in multilingual classrooms.
- Schools should provide bilingual and multilingual mathematics teaching and learning resources to enhance learners' conceptual understanding and participation.
- Mathematics teachers should intentionally incorporate collaborative learning, contextualised examples, and flexible language practices to promote meaningful mathematical discourse and learner engagement.

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DECLARATION OF CONFLICT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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