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TRANSITIONING MATHEMATICS INSTRUCTION TO XITSONGA HOME LANGUAGE IN GRADE 4 CLASSROOMS: A SOCIOCULTURAL PERSPECTIVE

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Abstract

In South Africa, the Language in Education Policy encourages the use of learners' home languages in the foundation phase while also promoting multilingualism. However, many learners experience a transition in Grade 4 where the language of learning and teaching changes, often from an African home language to English. This shift has significant implications for mathematics learning because mathematical understanding depends heavily on communication, reasoning, interpretation of concepts, and classroom interaction. This qualitative study examined the policy mandating Xitsonga as the LoLT for Grade 4 Mathematics in Limpopo Province. The study was grounded in sociocultural theory and ubuntu principles. The sample comprised two Grade 4 Mathematics and ten Grade 4 learners. Data were collected through semi-structured teacher interviews and textual analysis of Grade 4 Mathematics examination papers. The findings suggest that transitioning mathematics instruction to Xitsonga in Grade 4 classrooms supports meaningful learning, participation, and conceptual understanding when viewed through a sociocultural lens. The study has implications for learners, Department of Basic Education and future research. For learners, this supports confidence, critical thinking, and collaborative learning, which are central principles of sociocultural learning theory. For teachers, the Department of Basic Education may need to invest in teacher training, translation of mathematics resources, and monitoring of multilingual education practices to ensure successful implementation. Future research, more research is needed on the development of mathematics terminology and teaching materials in African languages to strengthen the implementation of multilingual education policies in South Africa.

Keywords: *mathematics instruction; scaffolding; sociocultural theory; translanguaging; ubuntu; Xitsonga home language.*

1. Introduction

The Department of Basic Education's gradual implementation of home language as the Language of Learning and Teaching (LoLT) in Grade 4 Mathematics reflects a broader transformation agenda within South African education. Grounded in the Language in Education Policy (LiEP) of 1997 and operationalised through the Incremental Introduction of

African Languages (IIAL) framework, the policy seeks to reposition African languages from marginalised communicative tools to legitimate mediums for academic knowledge production (Department of Education, 1997; Department of Basic Education, 2013). Central to this reform is the assumption that learners construct foundational mathematical understanding more effectively when instruction occurs in a familiar linguistic and cultural context. In this regard, the Department of Basic Education (2011) argues that mother-tongue instruction enhances conceptual reasoning, participation, and critical engagement, particularly during the intermediate phase where mathematical abstraction becomes increasingly complex.

Yet, despite its emancipatory intent, the transition from policy formulation to classroom implementation reveals significant tensions between ideological aspirations and pedagogical realities. While the policy foregrounds linguistic equity and epistemic inclusion, schools continue to grapple with structural and instructional constraints that complicate its enactment. In the context of Xitsonga as LoLT, challenges such as the scarcity of standardised mathematical terminology, inadequate teaching and learning resources, and insufficient teacher preparation expose the uneven capacity of the education system to support multilingual mathematics instruction. Furthermore, persistent stakeholder anxieties regarding learners' eventual transition to English-medium learning reflect wider societal perceptions that associate English with academic mobility and socioeconomic advancement. As Makalela (2018) observes, these contradictions risk reproducing the very inequalities the policy intends to dismantle, thereby creating a disjuncture between policy discourse and classroom experience.

This study therefore interrogates the complex relationship between language, pedagogy, and mathematical meaning-making in Grade 4 classrooms implementing Xitsonga as LoLT. Drawing on sociocultural theory and the African philosophy of ubuntu, the study conceptualises language not merely as a vehicle for communication, but as a sociocultural mediator through which mathematical knowledge is constructed, negotiated, and shared. From this perspective, learning Mathematics becomes a collaborative and culturally situated process shaped by learners' linguistic repertoires and social interactions. The study further examines how translanguaging and scaffolding practices function as pedagogical resources that enable learners to navigate mathematical discourse across languages. By critically exploring both the transformative possibilities and the practical limitations of home-language mathematics instruction, the study seeks to determine whether the adoption of Xitsonga as LoLT promotes deeper mathematical literacy or inadvertently introduces new barriers to learning. Therefore, this study is guided by the following research questions:

1. How does the transition to Xitsonga as LoLT influence learners' conceptual understanding of Mathematics?
2. What challenges do teachers experience when teaching Mathematics in Xitsonga?
3. How do translanguaging and scaffolding practices support mathematical learning?

2. Literature review

The literature on the shift to mother-tongue instruction in Mathematics focuses on language as a Mathematical cognitive mediator, mother-tongue education policy implementation difficulties and international scholarship multilingual mathematics education.

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2.1 Language as a Mathematical Cognitive Mediator

Contemporary scholarship on multilingual Mathematics education increasingly rejects the assumption that language merely "delivers" mathematical knowledge; instead, it positions language as constitutive of mathematical reasoning itself. Drawing on Vygotsky's (1978) sociocultural theory, researchers argue that mathematical understanding develops through culturally mediated interaction in which language functions as a cognitive tool for abstraction, reasoning, and meaning-making (King & Purpura, 2021; Sihlangu et al., 2025). Vygotsky's assertion that higher-order thinking is mediated through language and cultural artefacts therefore provides a critical foundation for understanding how learners negotiate mathematical concepts in multilingual classrooms. Building on this perspective, Halliday (1978) and Peng et al. (2020) conceptualise Mathematics as a specialised "mathematical register" with its own vocabulary, syntax, and discourse structures, suggesting that success in Mathematics depends not only on procedural competence but also on learners' access to the linguistic forms through which mathematical meaning is constructed.

Within this theoretical framing, multilingual scholars challenge deficit views of African languages in Mathematics education. Barwell (2020) and Swanson et al. (2022) advance the notion of "language-positive" classrooms, arguing that linguistic diversity should be treated as an epistemic resource that expands opportunities for conceptual inquiry. Rather than positioning multilingualism as an obstacle to mathematical achievement, Barwell foregrounds the productive interaction between language practices and mathematical cognition. Similarly, Kazima (2024) contends that effective Mathematics teaching in multilingual contexts requires educators to recognise language as central to conceptual mediation, not simply classroom communication. While Barwell (2020) emphasises the ideological shift toward valuing linguistic diversity, Kazima (2024) extends this argument pedagogically by insisting that teachers deliberately mobilise learners' linguistic repertoires during mathematical engagement. Together, these scholars reposition multilingualism from a compensatory practice to a legitimate intellectual resource in Mathematics learning.

This reconceptualisation is further strengthened through translanguaging theory. Mbatha et al. (2025), Chihobo and Makalela (2025) and Makalela (2018) reject separations between languages and instead argue that bilingual learners draw dynamically from their full linguistic repertoires to construct understanding. Makalela (2018) situates translanguaging within African multilingual realities, demonstrating that learners move fluidly between languages to negotiate mathematical meaning. This perspective sharply contrasts with traditional monolingual approaches that privilege English as the sole legitimate language of Mathematics. The findings of Robertson and Graven (2020), reinforce this argument by showing that bilingual learners strategically use English for formal mathematical representation while relying on their home languages for conceptual exploration and explanation. Their work illustrates that conceptual understanding often deepens when learners can reason through culturally and linguistically familiar expressions before translating ideas into the formal mathematical register. This demonstrates that mathematical difficulty is not always conceptual in isolation, but often linguistic and discursive in nature. Such findings support King and Purpura's (2021) argument that mother-tongue-based instruction enhances conceptual comprehension because it enables learners to access abstract ideas through familiar linguistic and cultural frameworks. However, moves beyond cognitive accessibility to emphasise the structural conditions necessary for successful implementation, including carefully designed materials and pedagogical support. Consequently, the literature collectively suggests that the effectiveness of multilingual

Mathematics instruction depends not merely on translating terminology, but on creating pedagogical spaces where learners can meaningfully negotiate mathematical concepts through their linguistic repertoires.

2.2 Mother-Tongue Education Policy Implementation Difficulties

A dominant theme across international and South African scholarship is the persistent disjuncture between progressive multilingual education policies and the realities of classroom implementation. Although many post-colonial states officially endorse mother-tongue instruction, policy aspirations are frequently undermined by structural inequalities, inadequate teacher preparation, and enduring societal preferences for colonial languages. Scholars therefore argue that the "policy-to-practice" gap reflects not only administrative failure, but also deeper ideological tensions concerning language, power, and socioeconomic mobility. Internationally, King and Purpura's (2021) and Regmi (2021) maintain that mother-tongue education can improve cognitive development, literacy acquisition, and long-term academic achievement when supported by appropriate resources and sustained institutional commitment. However, King and Purpura (2021) simultaneously caution that the benefits of mother-tongue instruction are often gradual rather than immediate, making implementation politically and socially vulnerable. This concern is echoed by Turner and Schools (2019), and Andrino and Arsenal (2022) who argue that transitional phases in multilingual education frequently generate anxiety among teachers, parents, and learners because short-term assessment outcomes may appear weaker before long-term conceptual gains emerge. Their analysis reveals a contradiction at the heart of multilingual policy reform: while research consistently demonstrates the cognitive value of mother-tongue instruction, communities often continue to associate English with economic advancement and global mobility.

In the South African context, this contradiction is intensified by the historical legacy of apartheid education and the hegemonic status of English. Although the Language in Education Policy (LiEP) of 1997 promotes additive multilingualism, implementation has remained uneven and inconsistent. Probyn (2019) and Khanyile and Awung (2023) argue that many teachers lack both the linguistic confidence and pedagogical preparation necessary to teach effectively through African languages, particularly in cognitively demanding subjects such as Mathematics. Probyn's critique is significant because it shifts attention from policy rhetoric to classroom realities, demonstrating that multilingual education cannot succeed without sustained teacher development. Extending this argument, Essien (2018) and Barruga (2025) contend that teacher education programmes continue to prepare educators for monolingual classrooms despite the multilingual realities of South African schools. Consequently, teachers often default to English-dominant pedagogies even when policy encourages the use of learners' home languages.

Recent local studies further demonstrate that these implementation challenges are especially acute in rural and under-resourced contexts. Mbhiza et al. (2024) and Ngwenya and Ngubane (2024) found that teachers responsible for teaching Mathematics in Xitsonga consistently struggled with mathematical terminology, language proficiency, and appropriate pedagogical strategies. Their findings reveal that the challenge is not simply the absence of translation equivalents, but the broader lack of institutional support for developing African languages as languages of learning and teaching in Mathematics. Similarly, Lorenz et al. (2021) emphasise that positive teacher attitudes and sustained professional development are crucial for multilingual policy implementation. This perspective introduces an important analytical nuance: policy implementation is shaped not only by material resources, but also

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by teachers' beliefs about language legitimacy, learner capability, and mathematical competence.

Taken together, the literature reveals that multilingual Mathematics education in South Africa is characterised by a complex tension between transformative policy ideals and entrenched structural realities. While international and local scholarship strongly supports the cognitive and pedagogical value of mother-tongue instruction, implementation remains constrained by inadequate teacher preparation, limited terminology development, insufficient learning materials, and the persistent social prestige of English. The current study's findings regarding teachers' lack of training and the shortage of suitable Xitsonga Mathematics resources therefore align closely with broader national and international debates. More importantly, the literature suggests that meaningful implementation of multilingual Mathematics education requires more than policy endorsement; it demands systemic investment in teacher education, terminology development, culturally responsive pedagogies, and the intellectual legitimisation of African languages within mathematical discourse.

2.3 International scholarship multilingual mathematics education

International scholarship on multilingual mathematics education increasingly recognises language not as a barrier to mathematical learning, but as a central resource for meaning-making, participation, and cognitive development. Scholars such as Cummins, García, Setati, Moschkovich, and Gutiérrez collectively argue that multilingual learners develop mathematical understanding most effectively when their full linguistic repertoires are legitimised within classroom discourse. Cummins' theories of bilingual cognition and linguistic interdependence demonstrate that conceptual knowledge acquired in the home language can transfer across languages, supporting deeper mathematical reasoning and cognitive flexibility (Cummins, 2024; Le Pichon et al, 2024). García (2020) extends this perspective through translanguaging theory, emphasising that multilingual learners fluidly draw from multiple languages to negotiate meaning, solve problems, and participate in academic discourse. Within the African context, Setati's work in South African mathematics classrooms highlights how learners strategically switch between home languages and English to mediate mathematical understanding, challenge exclusionary language practices, and increase learner participation (Setati, 2008). Similarly, Moschkovich (2021) foregrounds mathematical discourse as a socially situated practice, arguing that multilingual learners should be viewed as competent sense-makers whose everyday linguistic practices are valuable resources for mathematical communication rather than deficits to be corrected. Gutiérrez (2013) further broadens the discussion by linking mathematics education to issues of identity, equity, power, and cultural justice, advocating for pedagogies that affirm learners' linguistic and cultural identities while disrupting dominant monolingual norms in schooling. Together, these scholars provide a strong theoretical foundation for indigenous language pedagogy in mathematics education, demonstrating that linguistic mediation through learners' home languages enhances conceptual access, participation, identity affirmation, and equitable learning opportunities in multilingual classrooms.

Despite its good intentions, the policy requiring the use of Xitsonga Home language to teach Mathematics in Grade 4 faces significant operational issues. These include a critical lack of suitable teaching resources, inadequate training for teachers in subject-specific Xitsonga vocabulary and concerns from teachers over learners' eventual transition to English. The initiative's objectives of enhancing conceptual comprehension and equity in

mathematics education run the risk of being undermined by this disconnect between policy design and classroom practice. A concerning pattern has emerged from preliminary observations, learners who previously demonstrated strong performance in English-medium Mathematics instruction are showing marked underperformance following the transition to Xitsonga Home Language as LoLT, while learners who struggled with English are exhibiting improved conceptual understanding and performance in Xitsonga Home Language. This contradictory outcome raises fundamental questions about the nature of Mathematical competence, the relationship between language proficiency and conceptual understanding, and the hidden cognitive costs of linguistic transition. The study intends to address this gap by examining learner assessment scripts as diagnostic artefacts that reveal how the transition to Xitsonga LoLT shapes Mathematical thinking across different learner profiles.

This study draws on Vygotsky's (1978) sociocultural theory, translanguaging, and Ubuntu as complementary frameworks to understand how the use of Xitsonga in Grade 4 mathematics classrooms mediates learning, supports multilingual meaning-making, and affirms learners' cultural identities through collaborative and socially situated pedagogical practices. Sociocultural theory justifies the use of learners' home language because cognition develops through culturally meaningful communication. In the context of transitioning mathematics instruction to Xitsonga, the teacher scaffolds learning within the learner's Zone of Proximal Development (ZPD) using Xitsonga explanations, examples, and classroom dialogue. The concept of *translanguaging* is also central within Grade 4 mathematics classrooms, because learners naturally move between Xitsonga and English to negotiate meaning and teachers may explain mathematical concepts in Xitsonga while introducing formal mathematical terminology in English (Makalela, 2018). Using Xitsonga aligns with Ubuntu because it affirms learners' identities, cultural dignity, and lived experiences because Ubuntu emphasises that education should serve the community and preserve cultural heritage, making home-language instruction both educationally and socially meaningful. This integrated framework supports the argument that Grade 4 mathematics teaching should move beyond monolingual English instruction toward culturally responsive and linguistically inclusive pedagogies that improve learner comprehension, participation, and achievement.

Grounded in Lev Vygotsky's sociocultural theory, the transition of mathematics instruction to Xitsonga home language in Grade 4 classrooms can be understood as a socially mediated process in which learners construct mathematical knowledge through interaction, dialogue, and culturally meaningful practices. Translanguaging strengthens this process by enabling learners and teachers to flexibly draw on both Xitsonga and English linguistic resources to negotiate meaning, explain mathematical concepts, and participate confidently in mathematical discourse. Within the African philosophy of Ubuntu, learning is further positioned as a collective and relational activity that values cooperation, mutual support, and shared understanding, thereby fostering inclusive classroom participation and learner identity affirmation. Mathematical discourse becomes central in this context, as learners use familiar language practices to reason, justify solutions, ask questions, and communicate mathematical thinking more effectively. Consequently, assessment analysis should move beyond measuring procedural correctness alone and instead evaluate how language, interaction, collaboration, and culturally grounded communication support conceptual understanding and learner participation in mathematics. Together, sociocultural theory, translanguaging, Ubuntu, mathematical discourse, and assessment analysis provide an integrated framework for understanding how Xitsonga home-language instruction can

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enhance meaningful mathematical learning and equitable participation in Grade 4 classrooms.

3. Research Method

This study is conducted at the selected primary school in rural Mafarana Circuit, Mopani West District under the Greater Tzaneen Local Municipality, Limpopo Province, South Africa. The community uses Xitsonga as their home language. In fact, schools within the Mafarana Circuit offer and assess Xitsonga Home Language as part of their curriculum. In the Mafarana Circuit, as with many rural school circuits in South Africa's Mopani West District, the English proficiency of learners varies significantly. Because many learners speak Xitsonga, English is officially taught and assessed as an English First Additional Language (EFAL). Therefore, many learners operate with a restricted English vocabulary, which can lead to a hesitant attitude toward speaking the language in class due to a fear of peers mocking their mistakes. The researchers obtained permission to conduct the study from the University of Limpopo's Research and Ethics Committee (TREC) (Ethical Clearance Certificate, project number: TREC/194/2025: PG) on the 19th of May 2025. Informed consent forms were issued and signed on 10 June 2025 by teachers who were taking part in the study to allow them to take part in the study willingly and understand the procedure that will take place during the investigation. This study ensured that the name of the school was anonymous and the participants' information was kept confidential. Participants' identities were protected through anonymisation, and confidentiality was maintained to encourage free participation.

The study employed qualitative design with a focused textual analysis approach, a methodological stance well-supported by Creswell and Poth (2016) who emphasise understanding meaning in context. The sample comprised two Grade 4 Mathematics teachers who participated in semi-structured interviews, and ten Grade 4 learners whose Mathematics examination scripts were analysed. A total of ten examination scripts were analysed at the selected school's Grade 4 class implementing Xitsonga as LoLT. Data was collected through document analysis of learner Mathematics assessment scripts, and semi-structured interviews of teachers (DeMarrais et al., 2024). The primary data sources were Mathematics examination papers from Grade 4 learners, selected through non-probability purposive sampling from the primary school implementing the Xitsonga LoLT policy in Intermediate Phase at Mafarana Circuit, Mopani West District, Limpopo Province, South Africa. Semi-structured interviews were also conducted to create a dialogic space where participants share their experiences and co-construct insights about the transition to Xitsonga as LoLT in Mathematics. These documents were selected because they represent authentic, naturally occurring evidence of how learners comprehend and apply mathematical concepts under assessment conditions, aligning with the use of documents as stable, context-rich sources for analysis (Kutsyuruba, 2023). The collected documentary data were analysed using qualitative content analysis with an inductive approach, a method recognised for generating insights directly from textual data (Ravindran, 2019).

The coding and theme generation process for examination scripts in this study followed a qualitative thematic analysis approach informed by Lev Vygotsky's Sociocultural Theory, translanguaging pedagogy, and Ubuntu philosophy. The purpose was to identify patterns in learners' mathematical understanding, language use, participation, and meaning-making when mathematics instruction transitions to Xitsonga as the home language. The researchers familiarized themselves with data by repeatedly reading the scripts to

understand learners' mathematical reasoning, language patterns, conceptual understanding, translanguaging practices, misconceptions, cultural references and learner participation through written expression. Thus, the coding and theme generation process enabled the researchers to systematically analyse Grade 4 examination scripts and uncover how transitioning mathematics instruction to Xitsonga influences learners' understanding, participation, and achievement. The researchers repeatedly read the transcripts while listening to the recordings to ensure transcription accuracy and to become familiar with the data. Field notes taken during interviews were integrated into the transcripts to capture non-verbal cues, classroom experiences, and contextual observations. During this stage, preliminary ideas, recurring concepts, and noteworthy statements were noted in the margins of the transcripts. The researchers carefully examined each transcript line by line to identify meaningful units of information related to teachers' experiences of transitioning mathematics instruction into Xitsonga.

Codes were generated directly from participants' words and experiences rather than from predetermined categories. Similar phrases, concepts, and explanations were grouped under descriptive labels. After generating the initial codes, the researchers compared codes across all interview transcripts to identify similarities, differences, and recurring patterns. Related codes were clustered into broader categories representing shared meanings. Themes were developed by examining relationships among the categories and identifying broader patterns that addressed the research questions and the sociocultural framework underpinning the study. Themes represented recurring meanings regarding how teachers experienced and understood the transition of mathematics instruction into Xitsonga. During this stage, categories were refined, combined, or reorganised until coherent themes emerged. The qualitative data generated from the semi-structured interviews with Grade 4 mathematics teachers were analysed using thematic analysis. The process followed an inductive and interpretive approach guided by sociocultural theory, particularly the principles of language mediation, social interaction, and culturally responsive learning. The coding procedures involved several systematic stages to ensure credibility, consistency, and meaningful interpretation of participants' experiences.

To ensure trustworthiness in this study, the researchers employed credibility, transferability, dependability, and confirmability strategies. Credibility was enhanced through triangulation of interviews and document analysis, as well as member checking with participating teachers. Transferability was ensured through thick descriptions of the Grade 4 classroom contexts and purposive sampling of Xitsonga-speaking participants. Dependability was maintained by keeping a detailed audit trail and clearly documenting the research procedures and analytical processes. Confirmability was strengthened through reflexive journaling, triangulation, and the use of verbatim participant quotations to ensure that findings reflected participants' perspectives rather than researcher bias. To ensure ethical integrity, participants' identities were anonymized, data were stored securely on password-protected devices, and participation was voluntary.

4. Results and Discussion

The researchers analysed Grade 4 learners' Mathematics examination scripts to understand their cognitive processing and conceptual understanding when solving problems presented in Xitsonga Home Language. The analysis was based on learners' responses to various question types including multiple choice questions on fractions (Xivutiso 1), fraction

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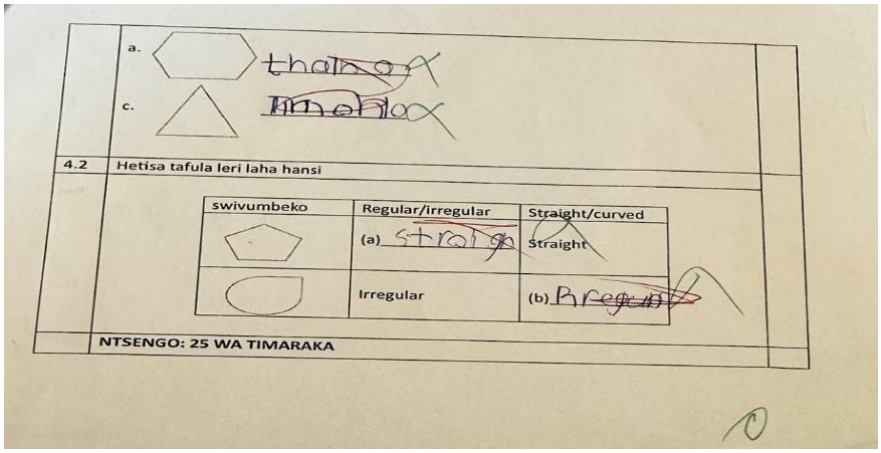
operations and word problems (Xivutiso 2), time and measurement conversions (Xivutiso 3), and properties of 2D shapes (Xivutiso 4) examining how language, terminology, and cultural context influenced mathematical comprehension. The analysis of learners' responses is presented according to emerging themes from the textual review and interview findings.

4.1 Inadequate teaching and learning resources

This theme seeks to determine how the shortage of culturally relevant Xitsonga Mathematics resources impacts learners' ability to understand and solve Mathematical problems. This theme also seeks to analyse learners' responses to word problems that use either direct translations from English or culturally familiar contexts. The analysis in this section is based on learners' performance on problems testing shapes concepts and word problems with varying cultural contexts, as illustrated by the following examples from the examination.

Extract 1.



Question 4.2 from the examination paper required learners to complete a table classifying shapes according to whether they are regular/irregular and straight/curved:

Table 1.
Classification of Shapes According to Whether They are Regular/Irregular and Straight/Curved

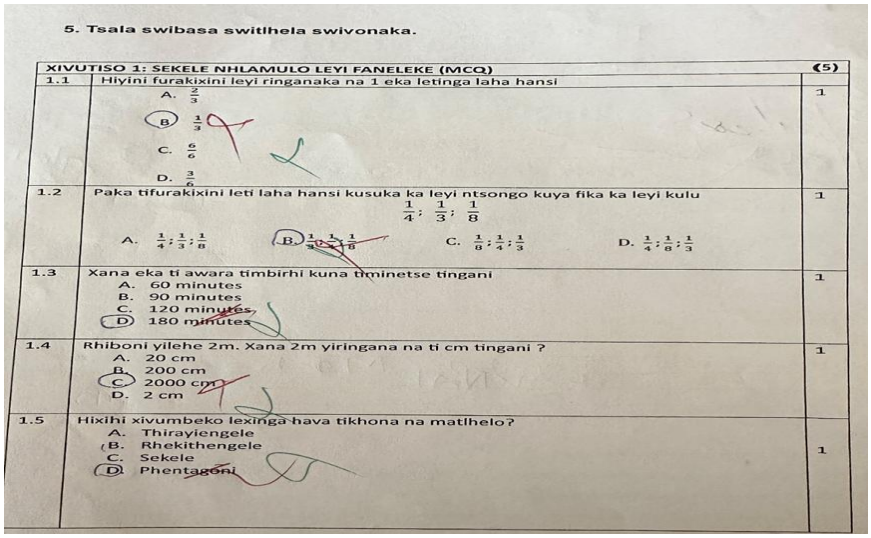
Swivumbeko	Regular/irregular	Straight/curved
	(a)	Straight
	Irregular	(b)

The analysis demonstrates strong engagement with learner responses and links effectively to multilingual mathematics education literature. One important issue emerging from the data is the semantic complexity of the terms “regular” and “irregular.” In everyday language, “irregular” is often associated with something that is “wrong,” “untidy,” or “unusual,” whereas in mathematics it has a precise geometric meaning related to equal sides and equal angles. The learner who questioned “xana i regular?” illustrates not simply a vocabulary gap, but uncertainty about the mathematical register itself. This suggests that learners may rely on everyday linguistic meanings when formal mathematical meanings have not yet been fully internalised. The finding aligns with Maluleke’s (2019) argument that

learners in multilingual settings must constantly negotiate between informal home-language meanings and specialised academic discourse. The responses also indicate that translation alone may not support conceptual understanding. Although mathematical terminology was presented in Xitsonga, learners still experienced difficulty interpreting the concept. This supports Benson's (2021) view that effective mother-tongue-based multilingual education requires culturally and conceptually meaningful resources rather than direct linguistic substitution from English. If terminology is translated without sufficient contextualisation, learners may memorise words without understanding the underlying properties of shapes.

In addition, the learners' classification errors may reflect limited exposure to explicit visual and conceptual teaching of geometric attributes. A square being identified as "irregular" suggests that some learners may focus on superficial appearance rather than the defining properties of regular polygons. This points to the need for instructional strategies that combine language explanation with concrete visual examples, hands-on manipulation of shapes, and repeated discussion of mathematical vocabulary in context. The evidence further highlights the broader relationship between language proficiency and mathematical reasoning. Learners who are uncertain about terminology may struggle to demonstrate conceptual knowledge even when they can visually recognise shapes. Consequently, assessment performance may underestimate actual mathematical understanding because language becomes a barrier to expressing knowledge. the findings suggest that the challenge was not merely one of incorrect classification, but of access to mathematical meaning itself. The learners' responses reveal how gaps between everyday language, translated terminology, and formal mathematical discourse can hinder conceptual understanding in geometry.

Extract 2.



5. Tsala swibasa switlhela swivonaka.

XIVUTISO 1: SEKELE NHLAMULO LEYI FANELEKE (MCQ)		(5)
1.1	Hiyini furakixini leyi ringanaka na 1 eka letinga laha hansi A. $\frac{2}{3}$ B. $\frac{1}{3}$ C. $\frac{6}{6}$ D. $\frac{3}{6}$	1
1.2	Paka tifurakixini leti laha hansi kusuka ka leyi ntsongo kuya fika ka leyi kulu $\frac{1}{4}; \frac{1}{3}; \frac{1}{8}$ A. $\frac{1}{4};\frac{1}{3};\frac{1}{8}$ B. $\frac{1}{8};\frac{1}{4};\frac{1}{3}$ C. $\frac{1}{8};\frac{1}{4};\frac{1}{3}$ D. $\frac{1}{4};\frac{1}{8};\frac{1}{3}$	1
1.3	Xana eka ti awara timbirhi kuna timinetse tingani A. 60 minutes B. 90 minutes C. 120 minutes D. 180 minutes	1
1.4	Rhiboni yilehe 2m. Xana 2m yiringana na ti cm tingani ? A. 20 cm B. 200 cm C. 2000 cm D. 2 cm	1
1.5	Hixihi xivumbeko lexinga hava tikhona na matlhelo? A. Thirayiengele B. Rhekithengele C. Sekele D. Phentagoni	1

The responses to Question 1.5 reveal an important relationship between language, conceptual understanding, and mathematical performance among learners. Although many learners correctly identified *sekele* (circle) as the shape without corners and sides, the explanatory comments written in Xitsonga provide deeper evidence that learners were not merely guessing the answer, but were actively reasoning about the geometric properties of shapes. Statements such as "*sekele a yi na tikhona*" [a circle has no corners] indicate that learners were able to articulate mathematical concepts more confidently and meaningfully in

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their home language. This suggests that the use of familiar linguistic structures supports cognitive processing and allows learners to demonstrate understanding beyond simple recall.

The learner responses also highlight the importance of conceptual language in mathematics education. By expressing explanations in Xitsonga, learners connected classroom knowledge with their everyday linguistic experiences. This supports sociocultural perspectives of learning, which argue that knowledge construction is strengthened when learners engage with content through culturally and linguistically familiar mediums. The ability of learners to explain why a circle has no corners reflects higher-order understanding because they were identifying defining geometric attributes rather than simply naming the shape. Such responses demonstrate that home language functions not only as a communication tool but also as a cognitive resource that enhances mathematical reasoning and comprehension. At the same time, the responses from learners who selected incorrect answers and later wrote "*ndzi koxisile*" [I made a mistake] suggest that the challenge may not have been the mathematical concept itself, but rather the interpretation of terminology or instructions. This indicates that learners may have possessed partial conceptual understanding but struggled with the formal mathematical vocabulary used in the assessment. The confusion highlights how linguistic complexity can interfere with mathematical performance, particularly in multilingual classrooms where learners transition between home language and formal school language. In such cases, errors may reflect language barriers rather than a lack of conceptual knowledge.

These findings strongly support Benson's (2021) argument that direct translations from dominant languages are often insufficient for achieving meaningful conceptual understanding. Simply translating mathematical terms into local languages does not automatically guarantee comprehension if learners are unfamiliar with the translated terminology or if the translation lacks contextual relevance. Instead, conceptual understanding develops when learners are able to discuss, explain, and internalize mathematical ideas in ways that connect with their linguistic and cultural realities. Similarly, the findings reinforce Maluleke's (2019) view that language and culture play a central role in mathematics teaching and learning. Learners' use of Xitsonga explanations demonstrates how culturally grounded language practices can facilitate engagement, confidence, and understanding in mathematics classrooms.

4.2 Teacher Preparedness and Professional Development

This theme reveals a significant gap between language policy expectations and the actual pedagogical preparation of teachers in multilingual mathematics classrooms. The findings suggest that teachers' limited confidence in teaching Mathematics in Xitsonga is not merely a matter of language preference, but a structural issue linked to inadequate teacher preparation, insufficient professional development, and the absence of standardised mathematical terminology in African languages. Teachers' struggles with explaining concepts such as fractions and multiplication in Xitsonga indicate that they are expected to implement mother-tongue instruction without being adequately equipped with the linguistic and pedagogical tools required to do so effectively.

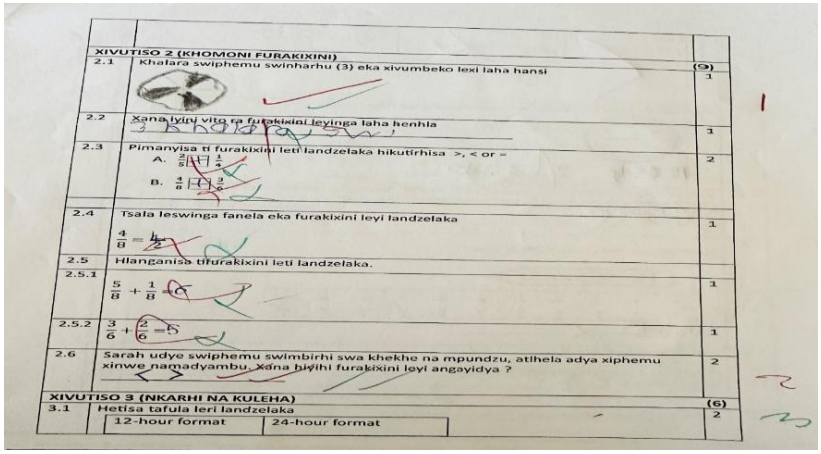
The teachers' experiences highlight how language and mathematical meaning are deeply interconnected. Mathematics relies heavily on precise terminology, conceptual explanation, and symbolic representation. When teachers are uncertain about how to translate or explain mathematical concepts in Xitsonga, classroom communication becomes constrained, which may limit learners' conceptual understanding and participation. The

concern that mathematical terms are not commonly used in everyday Xitsonga further reflects the historical marginalisation of African languages in formal scientific and mathematical discourse. This reinforces the dominance of English as the perceived legitimate language of mathematics, despite policies promoting home-language instruction in the foundation phase.

The findings align with Probyn (2019), who argues that many South African teachers lack adequate linguistic and pedagogical preparation for multilingual classrooms. As a result, teachers often rely on code-switching, rote teaching, or English-dominant practices that may unintentionally exclude learners who are more proficient in their home language. In this study, the teachers' uncertainty regarding mathematical vocabulary in Xitsonga suggests that their instructional practices may become restricted to procedural teaching rather than deeper conceptual engagement. This can negatively affect learners' mathematical reasoning and confidence. Similarly, the findings corroborate the work of Mbhiza et al. (2024), who found that teachers in rural Acornhoek experienced challenges related to both language proficiency and pedagogical strategies when teaching Mathematics in Xitsonga. The similarity between the current findings and those of Mbhiza et al. suggests that these challenges are systemic rather than isolated. Rural schools, in particular, may experience greater difficulty due to limited access to teaching resources, professional development opportunities, and standardised terminology guides in African languages.

The theme also reflects broader concerns raised by Essien regarding teacher education in multilingual contexts. Essien's argument that teacher education programmes should intentionally prepare teachers for multilingual mathematics instruction is highly relevant to these findings. The absence of specialised preparation means that teachers are left to navigate language-related challenges independently, often without curriculum support, glossaries, or pedagogical models for integrating learners' home languages into mathematics teaching. Consequently, teachers may revert to English or avoid complex explanations in Xitsonga, thereby undermining the goals of inclusive and equitable education. From a sociocultural perspective, the findings demonstrate how language functions as a mediating tool for learning. When teachers are unable to use learners' home language effectively in mathematics instruction, opportunities for meaningful interaction, scaffolding, and conceptual development may be reduced. Learners may struggle to connect abstract mathematical ideas with familiar linguistic and cultural experiences. This weakens the pedagogical value of mother-tongue instruction, even when the policy framework supports it.

Extract 3.



XIVUTISO 2 (KHOMONI FURAKIXINI) (9)

2.1 Khalara swiphemu swinharhu (3) eka xivumbeko lexi laha hansi — 1

2.2 Xana lyini vito ra furakixini leyinga laha henhla — 1

2.3 Pimanyisa ti furakixini leti landzelaka hikutirhisa >, < or = — 2

A. $\frac{5}{8} \square \frac{1}{4}$

B. $\frac{4}{8} \square \frac{3}{2}$

2.4 Tsala leswinga fanela eka furakixini leyi landzelaka — 1

$\frac{4}{8} = \frac{1}{2}$

2.5 Hlanganisa tifurakixini leti landzelaka.

2.5.1 $\frac{5}{8} + \frac{1}{8} =$ — 1

2.5.2 $\frac{3}{6} + \frac{2}{6} =$ — 1

2.6 Sarah udye swiphemu swimbirhi swa khekhe na mpundzu, atihela adya xiphemu xinwe namadyambu. Xana hiyihi furakixini leyi angayidya ? — 2

XIVUTISO 3 (NKARHI NA KULEHA) (6)

3.1 Hetisa tafula leri landzelaka — 2

12-hour format	24-hour format

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The extract reveals a complex relationship between language, conceptual understanding, and mathematical communication in multilingual classrooms. At a deeper analytical level, the findings suggest that inconsistency in mathematical terminology should not automatically be interpreted as conceptual weakness. Instead, the variation in learner explanations demonstrates how learners negotiate meaning through multiple linguistic and cultural resources while constructing mathematical understanding. A key issue emerging from the extract is the tension between standardised mathematical language and culturally grounded meaning-making practices. Learners used different expressions such as “ku ava” (sharing), “ku hambanyisa” (separating), and English-derived terms like “compare” or “divide” to explain the same mathematical concepts. On the surface, this inconsistency may appear problematic because it reduces terminological precision and creates challenges for formal mathematical communication. Learners who used standardised terminology often produced clearer and more academically recognisable justifications, indicating that mastery of formal mathematical discourse remains important for assessment and participation in school mathematics.

However, the extract also demonstrates that conceptual understanding cannot be measured solely with formal terminology. The learner who explained that 2/5 is larger than 1/4 because “when sharing equally, the pieces of 2/5 are larger” displayed strong relational understanding of fractions through a culturally meaningful explanation rooted in everyday practices of equal sharing. This suggests that learners’ home-language expressions function as cognitive tools that support sense-making rather than as barriers to mathematical reasoning. The use of “ku ava hi ku ringana” (sharing equally) reflects conceptual reasoning connected to lived experiences, allowing learners to internalise abstract fraction concepts through familiar social practices. The findings therefore challenge deficit perspectives that position translanguaging or code-switching as evidence of linguistic inadequacy. Instead, the extract supports sociocultural theories of learning, particularly the idea that knowledge is mediated through language and cultural experience. Learners moved flexibly between indigenous language expressions and English mathematical vocabulary to construct meaning, demonstrating that multilingual practices can enhance conceptual access to mathematics. In this context, translanguaging becomes a pedagogical resource rather than a linguistic problem.

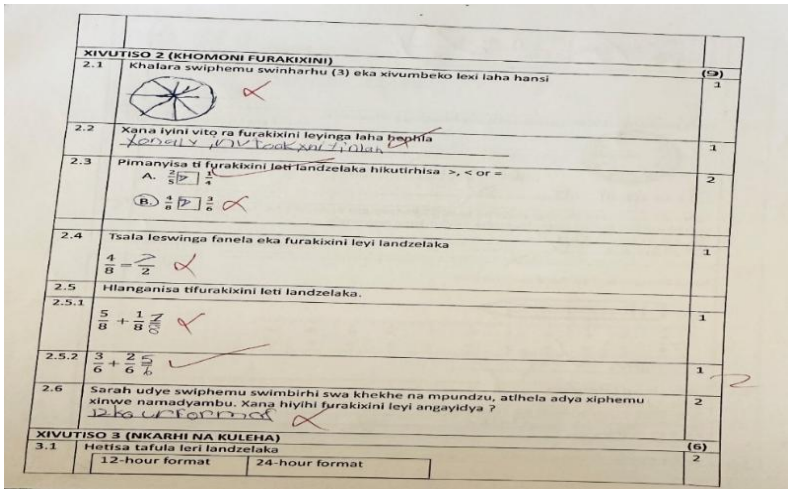
At the same time, the extract highlights an important pedagogical dilemma. While culturally grounded explanations promoted deeper conceptual understanding, inconsistent terminology sometimes limited learners’ ability to communicate mathematically with precision. This indicates that effective Mathematics teaching in multilingual classrooms should not aim to replace home-language explanations with English terminology, but rather to bridge the two. Teachers need to support learners in connecting culturally meaningful concepts such as sharing equally with formal mathematical language such as equivalent fractions, comparison, and simplification. Such an approach would strengthen both conceptual understanding and academic mathematical communication. The variation in explanations of equivalent fractions further reinforces this point. Some learners focused on procedural simplification, while others relied on sharing-based interpretations. This suggests that learners approached equivalent fractions from different conceptual pathways. Procedural explanations may indicate familiarity with algorithmic processes, whereas sharing-based explanations demonstrate contextual reasoning. The coexistence of these

approaches illustrates the multidimensional nature of mathematical understanding in multilingual settings. The findings strongly support Makalela's (2018) argument that translanguaging enables learners to engage more meaningfully with mathematical content. By drawing on both home-language resources and formal school discourse, learners can negotiate understanding in ways that are cognitively and culturally relevant. Consequently, multilingual Mathematics pedagogy should value linguistic flexibility while gradually developing standardised mathematical terminology to support both conceptual depth and formal academic participation.

4.3 Sociolinguistic Anxieties and Transition to English

Teachers voiced concerns that early Mathematics instruction in Xitsonga might delay learners' acquisition of English, potentially disadvantaging them in later grades and national assessments. This anxiety reflects a persistent tension between mother-tongue education and the perceived dominance of English in academic and economic mobility. Sibanda and Tshehla (2025) documented similar tensions in their analysis of language of instruction in South African primary schools, noting the complex trade-offs between mother-tongue instruction and English proficiency development.

Extract 4.



XIVUTISO 2 (KHOMONI FURAKIXINI)

2.1 Khalara swiphemu swinharhu (3) eka xivumbeko lexi laha hansi (3) 1

2.2 Xana iyini vito ra furakixini leyinga laha hephla 1

2.3 Pimanyisa ti furakixini leti landzelaka hikutirhisa >, < or = 2

A. $\frac{2}{5}$ ▷ $\frac{1}{4}$

B. $\frac{4}{8}$ ▷ $\frac{3}{6}$

2.4 Tsala leswinga fanela eka furakixini leyi landzelaka 1

$\frac{4}{8} = \frac{2}{2}$

2.5 Hlanganisa tifurakixini leti landzelaka.

2.5.1 $\frac{5}{8} + \frac{1}{8}$ 1

2.5.2 $\frac{3}{6} + \frac{2}{6}$ 1

2.6 Sarah udye swiphemu swimbirhi swa khekhe na mpundzu, atlhela adya xiphemu xinwe namadyambu. Xana hiyihi furakixini leyi angayidya ? 2

12ko uniformal

XIVUTISO 3 (NKARHI NA KULEHA)

3.1 Hetisa tafula leri landzelaka (6)

12-hour format	24-hour format

2

The extract demonstrates a nuanced and analytically rich contradiction in learner achievement, exposing the complex relationship between language proficiency and mathematical understanding. At surface level, learners previously regarded as successful under English-medium Mathematics instruction unexpectedly underperformed on the fraction word problem, while those who had struggled in English showed notable improvement when allowed to engage conceptually through Xitsonga. This paradox challenges assumptions that performance in English-medium classrooms necessarily reflects deep mathematical competence. Instead, it suggests that apparent success in English may often mask superficial procedural fluency rather than genuine conceptual understanding. The responses of the previously high-performing learners reveal an overreliance on memorised procedures detached from contextual meaning. Their calculation of $\frac{2}{8} + \frac{1}{8} = \frac{3}{8}$ demonstrates mechanical competence in fraction addition, yet their failure to recognise the need to specify the total number of cake pieces indicates incomplete conceptual processing

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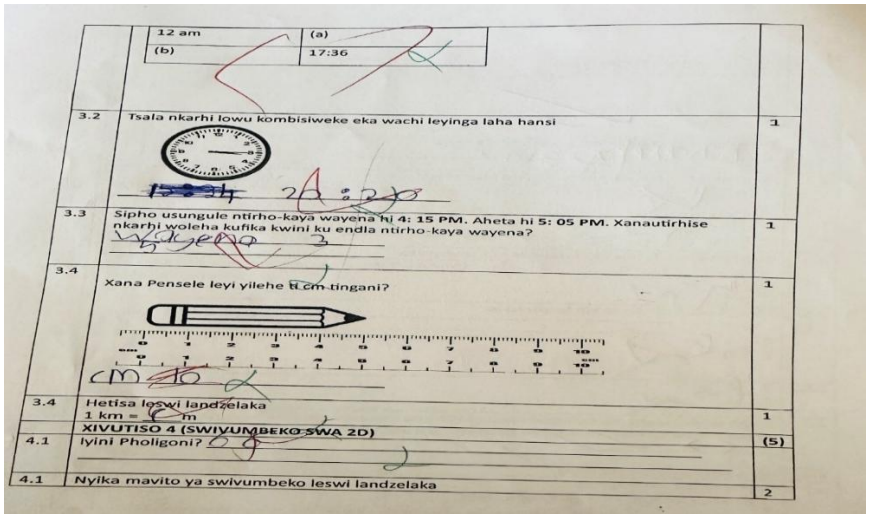
of the problem situation. The learner who added a note reflecting uncertainty further highlights the role of language as a mediating barrier. Although mathematically capable, the learner appeared unable to fully interpret or communicate the meaning embedded in the word problem due to linguistic constraints. This finding supports sociocultural perspectives of learning, which argue that language is not merely a vehicle for communication but a cognitive tool through which meaning is constructed.

Conversely, the improvement shown by learners who previously struggled in English-medium instruction suggests that mother-tongue use enabled deeper conceptual engagement with the mathematical task. The learner who explained in Xitsonga that the pieces eaten should be added while referencing the total of eight cake pieces demonstrated both procedural accuracy and relational understanding. Importantly, the learner's explanation reflected reasoning rather than rote application of rules, indicating that conceptual understanding became more accessible once linguistic barriers were reduced. The extract therefore reveals that learners previously categorised as "weak" in Mathematics may in fact possess latent mathematical competence obscured by the demands of operating in a second language. The extract also aligns strongly with the findings of Turner and Schools, who argue that mother-tongue instruction yields long-term cognitive and academic advantages, even if transitional phases may initially create inconsistent performance patterns. The "transition period" referenced in the study is evident here: learners accustomed to English instruction experienced disruption when confronted with conceptually demanding language tasks, whereas learners using their home language displayed stronger reasoning and interpretive skills. This suggests that mother-tongue instruction facilitates cognitive transfer by enabling learners to connect mathematical ideas with familiar linguistic structures and lived experiences. It challenges deficit interpretations of multilingual learners and calls into question assessment systems that equate English proficiency with intellectual competence. The findings imply that improving mathematical outcomes may depend not only on teaching procedures effectively but also on ensuring that learners can access conceptual meaning through linguistically familiar forms of instruction. Consequently, the extract strengthens arguments for multilingual pedagogies and sustained mother-tongue support in Mathematics education, particularly in early and intermediate phases where conceptual foundations are formed.

Extract 5.



The extract demonstrates a significant tension between procedural mathematical performance and conceptual understanding expressed through language. At surface level, learners educated successfully through English-medium instruction appeared academically stronger because they arrived at the correct answer of 50 minutes. However, their inability to articulate the reasoning process in Xitsonga reveals that their understanding may have been procedural rather than deeply internalised. Many learners either provided only the answer or explicitly stated that they could not explain their thinking, suggesting dependence on memorised routines and linguistic limitations in expressing mathematical reasoning across languages. In contrast, learners with strong Xitsonga oral proficiency demonstrated metacognitive and analytical competence by explaining the calculation step by step. Their reasoning process—identifying the 45 minutes from 4:15 PM to 5:00 PM and then adding the remaining 5 minutes to reach 5:05 PM—shows not only computational accuracy but also conceptual decomposition of time intervals. This indicates that these learners were engaging cognitively with the problem rather than merely recalling a learned procedure. The ability to verbalise reasoning in the mother tongue reflects deeper comprehension because learners could organise, justify, and communicate their thought processes effectively. This distinction aligns with the argument by Turner and Schools (2019) that mother-tongue instruction nurtures long-term cognitive development, critical thinking, and meaningful understanding, even if immediate performance during language transition phases may appear weaker.

Furthermore, the finding highlights the close relationship between language and cognition in mathematics learning. Mathematical understanding is not limited to obtaining correct answers; it also involves reasoning, explanation, and the ability to communicate logic coherently. Learners who can explain concepts in their home language are often better positioned to construct meaning because they draw from familiar linguistic and cultural frameworks. The excerpt therefore suggests that mother-tongue proficiency supports higher-order thinking skills such as analysis, justification, and problem-solving. The evidence also has pedagogical implications. It suggests that assessing learners solely on final answers may conceal important differences in conceptual understanding. Teachers should therefore encourage multilingual mathematical discourse, allowing learners to explain reasoning in both the home language and the language of learning and teaching. Such practices may bridge the gap between procedural performance and conceptual mastery while supporting cognitive development during educational transitions.

4.4 The Role of Translanguaging and Scaffolding

The teachers' use of translanguaging strategies demonstrates how multilingual practices can bridge the gap between learners' everyday linguistic experiences and the abstract language of mathematics. In contexts where English functions as the language of learning and teaching, many learners struggle because mathematical concepts are introduced through a language in which they are not yet fully proficient. By moving flexibly between Xitsonga, English, and other familiar languages, teachers reduce linguistic barriers and create opportunities for deeper conceptual engagement. The finding that learner engagement and understanding improved through translanguaging reflects sociocultural theories of learning, particularly the idea that knowledge construction occurs through social interaction and culturally meaningful communication. When learners are permitted to first discuss mathematical problems in their home language, they are able to process ideas within a familiar cognitive and cultural framework. This allows them to focus on understanding the

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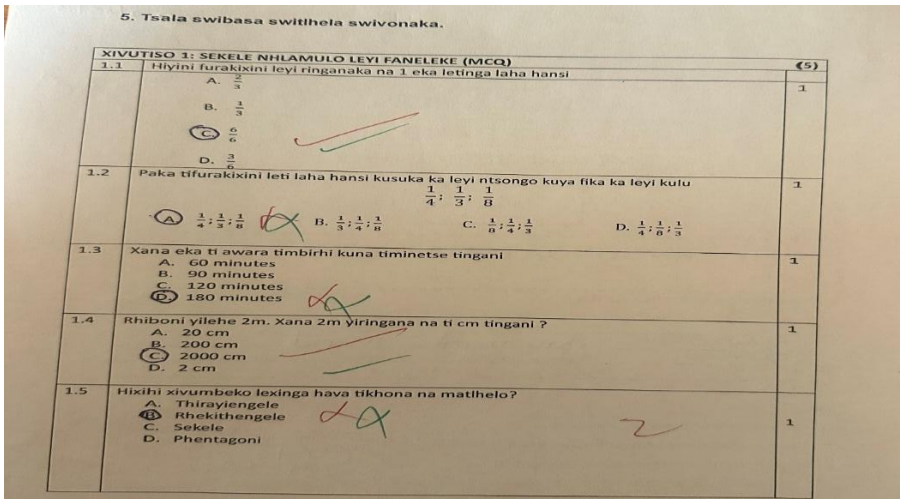
mathematical logic itself rather than simultaneously struggling with unfamiliar English terminology. The gradual introduction of English mathematical vocabulary afterwards serves as a scaffold, enabling learners to connect conceptual understanding with formal academic language. The teachers' use of scaffolding techniques, such as peer collaboration and culturally familiar examples, further strengthens this process. Familiar cultural references contextualize mathematical ideas within learners' lived realities, making abstract concepts more accessible and relevant. Peer discussions also create collaborative spaces where learners can negotiate meaning, explain procedures to one another, and build confidence before presenting answers in English. Such interaction aligns with learner-centred pedagogies that emphasize participation, dialogue, and co-construction of knowledge. Thus, this demonstrates that translanguaging and scaffolding are not remedial practices but powerful pedagogical approaches that support conceptual development, learner participation, and inclusive mathematics education in multilingual classrooms.

Extract 6


5. Tsala swibasa switlhela swivonaka.

XIVUTISO 1: SEKELE NHLAMULO LEYI FANELEKE (MCQ) (5)

1.1 Hiyini furakixini leyi ringanaka na 1 eka letinga laha hansi
A. $\frac{2}{3}$
B. $\frac{3}{3}$
C. $\frac{6}{6}$
D. $\frac{3}{6}$
1

1.2 Paka tifurakixini leti laha hansi kusuka ka leyi ntsongo kuya fika ka leyi kulu $\frac{1}{4}; \frac{1}{3}; \frac{1}{8}$
A. $\frac{1}{4}; \frac{1}{3}; \frac{1}{8}$ B. $\frac{1}{3}; \frac{1}{4}; \frac{1}{8}$ C. $\frac{1}{8}; \frac{1}{4}; \frac{1}{3}$ D. $\frac{1}{4}; \frac{1}{8}; \frac{1}{3}$
1

1.3 Xana eka ti awara timbirhi kuna timinetse tingani
A. 60 minutes
B. 90 minutes
C. 120 minutes
D. 180 minutes
1

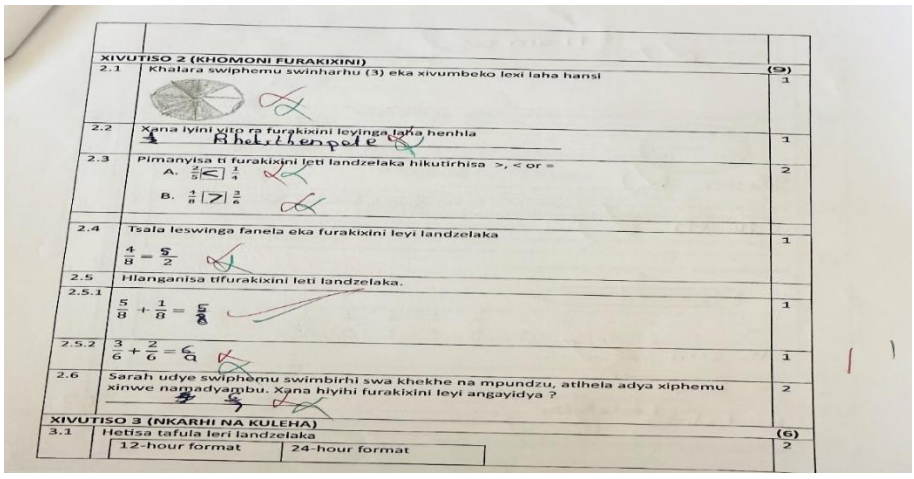
1.4 Rhiboni yilehe 2m. Xana 2m yiringana na ti cm tingani ?
A. 20 cm
B. 200 cm
C. 2000 cm
D. 2 cm
1

1.5 Hixihi xivumbeko lexinga hava tikhona na matihelo?
A. Thirayiengele
B. Rhekithengele
C. Sekele
D. Phentagoni
1

The learners' responses to the fraction-identification task reveal more than procedural knowledge of fractions; they demonstrate how translanguaging practices can deepen conceptual understanding and mathematical reasoning. In identifying 6/66/66/6 as equal to one, learners did not simply select the correct option mechanically. Instead, they articulated mathematical meaning through flexible movement between Xitsonga and English, showing that understanding was constructed through access to their full linguistic repertoires rather than through a single language of instruction. The first learner's explanation illustrates layered conceptual reasoning. By stating in Xitsonga that "all six pieces are present," the learner used a concrete and visual interpretation of fractions, connecting the symbolic notation 6/66/66/6 to the idea of a complete whole. This indicates conceptual understanding of fractions as part-whole relationships rather than rote memorisation of rules. The learner then shifted into English to explain that "the denominator and numerator are the same," introducing formal mathematical vocabulary and symbolic reasoning. This movement between languages demonstrates cognitive flexibility and suggests that translanguaging enabled the learner to bridge informal conceptual knowledge with formal mathematical terminology. Rather than causing confusion, the alternation between languages supported meaning-making at multiple levels.

Similarly, the second learner's explanation in Xitsonga that "when they are equal, it means 1" reflects abstraction and generalisation. The learner moved beyond the specific example of 6/66/66/6 to articulate a broader mathematical principle: any fraction with equal numerator and denominator equals one. This response indicates emerging algebraic reasoning and conceptual transfer, showing that the learner was not only solving the immediate problem but also recognising an underlying mathematical pattern. These findings strongly support the translanguaging perspective advanced by Makalela (2018), which challenges rigid separations between languages in classroom learning. According to translanguaging theory, bilingual learners do not compartmentalise languages cognitively; instead, they draw fluidly and strategically from their entire linguistic repertoires to process information, negotiate meaning, and express understanding. The learners' responses in this activity exemplify this process. Xitsonga functioned as a resource for conceptual explanation and sense-making, while English provided access to formal mathematical terminology and school-based discourse. The interaction between the two languages created a richer meaning-making environment than either language could provide independently. Furthermore, the learners' explanations suggest that translanguaging supports learner agency and confidence in mathematics classrooms. By allowing learners to reason in familiar linguistic forms, the classroom reduced linguistic barriers that often prevent multilingual learners from demonstrating mathematical understanding. The learners were able to participate more fully, explain their reasoning in detail, and connect everyday language with academic concepts. This indicates that translanguaging does not merely assist communication; it enhances higher-order thinking, conceptual clarity, and mathematical discourse. The learners' ability to explain why 6/6=16/6 = 16/6=1 through both Xitsonga and English demonstrates that translanguaging can facilitate deeper mathematical understanding, conceptual generalisation, and meaningful participation. Their responses provide evidence that multilingual learners benefit when classrooms legitimise flexible language practices, supporting Makalela's argument that bilingual cognition operates holistically rather than through separated language systems.

Extract 7.



XIVUTISO 2 (KHOMONI FURAKIXINI) (9)

2.1 Khalara swiphemu swinharhu (3) eka xivumbeko lexi laha hansi — 1

2.2 Xana lyini xito ra furakixini leyinga laha henhla — Bhekithepele — 1

2.3 Pimanyisa ti furakixini leti landzelaka hikutirhisa >, < or = — 2

A. $\frac{2}{5} < \frac{1}{4}$

B. $\frac{1}{8} > \frac{3}{8}$

2.4 Tsala leswinga fanela eka furakixini leyi landzelaka — 1

$\frac{4}{8} = \frac{5}{2}$

2.5 Hlanganisa tifurakixini leti landzelaka.

2.5.1 $\frac{5}{8} + \frac{1}{8} = \frac{6}{8}$ — 1

2.5.2 $\frac{3}{6} + \frac{2}{6} = \frac{6}{a}$ — 1

2.6 Sarah udye swiphemu swimbirhi swa khekhe na mpundzu, atlhela adya xiphemu xinwe namadyambu. Xana hiyihi furakixini leyi angayidya ? — 2

XIVUTISO 3 (NKARHI NA KULEHA)

3.1 Hetisa tafula leri landzelaka (6)

12-hour format	24-hour format

The extract demonstrates a high level of analytical depth because it moves beyond describing learner responses to interpreting the linguistic and cognitive significance of those responses within bilingual mathematics learning. Rather than merely stating that learners used both Xitsonga and English, the analysis explains how each language functioned differently in the mathematical process. Xitsonga was used for conceptual reasoning and

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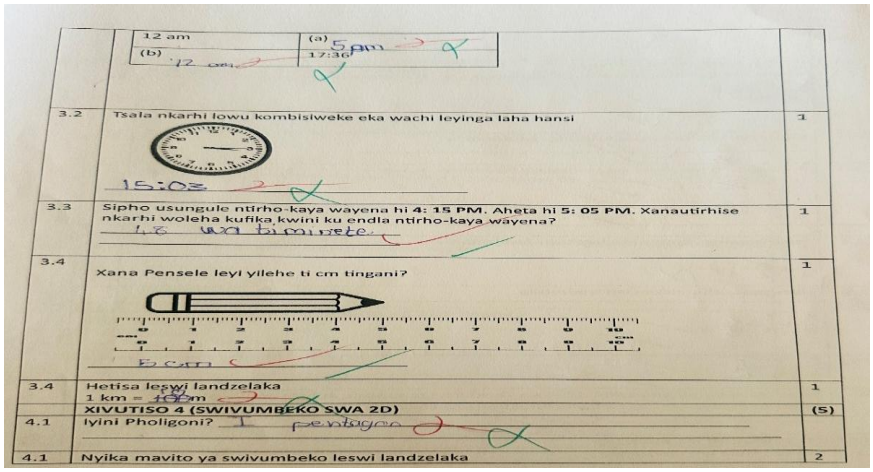
procedural explanation, while English was employed for formal mathematical terminology and technical observations about simplification. This distinction shows that translanguaging was purposeful and strategic rather than random code-switching. In addition, the analysis demonstrates depth through its engagement with theory and literature. By linking the findings to the work of Robertson and Graven (2020), the discussion situates the classroom observations within broader research on bilingual mathematical practices in South African classrooms. This strengthens the credibility of the interpretation and shows that the observed learner behaviour reflects an established pattern among proficient bilingual learners. The extract is also analytically nuanced because it interprets language choice as evidence of cognitive flexibility and mathematical identity development. The learners are not simply translating between languages; they are selecting linguistic resources according to the demands of the task. This suggests growing metalinguistic awareness, where learners recognise which language is most effective for explaining concepts versus expressing formal mathematical conventions.

4.5 Ubuntu Principles and Collaborative Learning

This theme is drawing a connection between collaborative learning in mathematics education and the ubuntu philosophical framework, positioning ubuntu not as a cultural add-on but as a pedagogical foundation that reshapes how mathematical knowledge is constructed in classrooms. At the conceptual level, the argument hinges on the alignment between collaborative learning theory and ubuntu's core values of *interdependence, relationality, and shared responsibility*. Collaborative learning in education research (e.g., socio-constructivist traditions) assumes that knowledge is co-constructed through interaction rather than individually acquired. Ubuntu intensifies this assumption by making relationality not just a strategy but an ethical orientation: learners are understood as existing through and because of others. Ngubane and Makua's (2021) position therefore frames ubuntu as more than cultural relevance—it becomes a theoretical justification for group-based cognition, especially in contexts where Western individualistic pedagogies may feel socially and culturally misaligned. Waghid's (2020) contribution deepens this by shifting the focus from *efficiency of group work* to the moral and ontological nature of learning communities. In his framing, ubuntu is not simply "working together," but an ethic of *mutual becoming*—where learners' intellectual development is inseparable from their responsibility toward others. This challenges traditional classroom hierarchies where mathematical success is often individualised, ranked, and competitive. Instead, knowledge construction becomes a shared moral project.

From a mathematics education perspective, the most significant implication is the reframing of mathematical understanding itself. Mathematics is often treated as abstract, decontextualised, and individually mastered. However, through an ubuntu-informed collaborative lens, mathematical reasoning becomes dialogic: learners justify, negotiate, and refine ideas collectively. This can support deeper conceptual understanding, particularly in problem-solving contexts where multiple strategies are compared and evaluated socially. The argument is strongest when viewed as a transformative pedagogy proposal: ubuntu-informed collaborative learning can potentially enhance mathematical understanding by fostering dialogue, shared reasoning, and collective responsibility. Its limitations, however, lie not in the philosophy itself but in the institutional and classroom constraints that may prevent its full enactment.

Extract 8.



This extract is illustrating two things at once: describing learner discourse and interpreting it through a sociocultural lens (ubuntu-informed pedagogy). To deepen the analysis, it helps to separate *what the data clearly shows* from *what is being inferred*, and then test the strength of that inference. First, at the descriptive level, the linguistic evidence is fairly consistent: learners are not framing knowledge as individually owned. The shift from "I" to "we" ("hi") is not just a grammatical choice but a discourse marker of distributed cognition. It suggests that learners are positioning understanding as something formed through interaction rather than isolated reasoning. Similarly, references to "we discussed" or "our group concluded" in the clock-reading task indicate that epistemic authority is being negotiated socially. In other words, correctness is not only tied to what *one learner sees*, but what *the group arrived at*, even when that group conclusion is later revised against the physical artifact (the clock).

Second, the polygon example is particularly interesting because it shows *concept stabilization through analogy and exclusion*. Learners use prototypical shapes ("triangle or rectangle") to construct the category "polygon," and then correctly exclude circles based on the property of straight sides. The key analytical point here is that the concept is not emerging from formal definition-first instruction but from *collective categorization practices*. This is a classic feature of socially mediated concept formation: learners anchor abstract definitions in shared exemplars and peer-mediated clarification. Where the interpretation becomes more complex is in the invocation of ubuntu (Ngubane & Makua, 2021). The claim that these linguistic patterns "support ubuntu principles of interdependence and collective responsibility" is plausible, but it risks being slightly over-determined unless carefully bounded. The strongest version of the argument is not that ubuntu explains the data, but that the data illustrates a form of learning that is compatible with ubuntu-informed interpretations of knowledge as relational, dialogic, and socially validated—while still being structurally shaped by classroom interaction patterns that may operate independently of cultural ideology.

5. Conclusion

The findings of this study demonstrate that the transition to Xitsonga as the Language of Learning and Teaching (LoLT) in Grade 4 Mathematics generates complex and uneven outcomes that are closely shaped by learners' prior linguistic and educational experiences. Learners who possess strong oral proficiency in Xitsonga generally display

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deeper conceptual understanding and more sophisticated mathematical reasoning. Their responses often reveal greater confidence in explaining procedures, interpreting problems contextually, and articulating mathematical ideas through familiar linguistic structures rooted in their home language. In contrast, learners who had previously benefited from English-medium instruction appear to encounter new challenges during the transition, suggesting that while the policy creates opportunities for some learners, it may simultaneously disrupt the learning trajectories of others.

The learners' examination scripts further function as important diagnostic artefacts of cognition, illustrating how language access fundamentally mediates mathematical understanding rather than merely accompanying it. The findings therefore challenge the assumption that mathematical competence is language-neutral. Instead, they reveal that learners' mathematical performance is deeply intertwined with the linguistic and cultural resources available within their learning environments. This supports broader scholarship on multilingual mathematics education, which positions language not as an obstacle to overcome, but as a critical cognitive and pedagogical resource for meaning-making in the classroom.

In light of these findings, several implications emerge for policy and practice. First, there is a pressing need to develop culturally relevant Xitsonga mathematics materials that resonate with learners' lived experiences. The Department of Basic Education should work collaboratively with linguists, mathematics educators, and cultural practitioners to design resources grounded in familiar contexts such as local markets, agricultural practices, and indigenous measurement systems. These materials should also incorporate bilingual glossaries and strong visual representations to support conceptual understanding while reducing excessive dependence on language proficiency alone. Second, teacher preparation and professional development programmes must place greater emphasis on multilingual mathematics pedagogy. Continuous professional development initiatives should equip teachers with appropriate Xitsonga mathematical terminology, translanguaging strategies, and sociocultural teaching approaches that enable more inclusive and effective classroom practices. Such programmes should also provide practical opportunities for resource development, mentorship, and critical reflection on teacher attitudes toward Xitsonga-medium instruction. Third, translanguaging should be recognised and promoted as a legitimate and productive classroom practice. Learners should be encouraged to draw on their full linguistic repertoires when engaging with mathematical concepts. Allowing learners to discuss ideas in Xitsonga before expressing them formally in mathematical language can strengthen conceptual understanding and reduce cognitive barriers. Equally important is the explicit bridging of Xitsonga and English mathematical terminology to support long-term bilingual academic development. The study also highlights the importance of differentiated instructional support across diverse language proficiency profiles. Both English-proficient and Xitsonga-proficient learners require targeted scaffolding to navigate the linguistic demands of mathematics learning. Strategies such as peer collaboration, mixed-ability grouping, terminology bridging, and learner-led explanations can foster more equitable participation and understanding within multilingual classrooms. Furthermore, meaningful parental and community engagement remains essential in strengthening mother-tongue mathematics education. Schools and educational stakeholders should implement awareness programmes that communicate the academic value of mother-tongue instruction while also clarifying pathways for the gradual transition to English. Encouraging positive community

attitudes toward Xitsonga as a language of intellectual and academic reasoning is crucial for sustaining learner confidence and educational success.

Finally, assessment practices and bilingual transition pathways require careful reconsideration. Mathematics assessments should move beyond narrow linguistic dependence by prioritising conceptual understanding through varied, contextually grounded tasks that allow for multilingual expression where appropriate. At the same time, structured progression models should be implemented to systematically introduce English mathematical terminology while continuously monitoring learner development throughout the transition process.

Ultimately, this study underscores the importance of viewing language not simply as a medium of instruction, but as a powerful epistemic resource through which mathematical knowledge is constructed, negotiated, and understood. In multilingual educational contexts, equitable mathematics learning depends not only on what learners are taught, but also on the languages through which they are given opportunities to think, reason, and make meaning.

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