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Enacting culturally relevant pedagogy in a grade 10 mathematics classroom: An analysis of lessons on functions

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Abstract

This study, using a qualitative interpretive approach, investigates how culturally relevant pedagogy (CRP) is enacted in a grade 10 mathematics classroom during three lessons on functions. Drawing on classroom observation transcripts, the paper examines pedagogical strategies employed by a mathematics teacher to facilitate conceptual understanding of linear functions. The analysis focused on language use, classroom discourse, instructional methods, and representations of mathematical concepts. Findings reveal that the teacher fostered academic success through scaffolded instruction, multiple representations, and dialogic teaching. While the lessons were predominantly teacher-led, learners engaged in questioning and mathematical reasoning, encouraging active participation. Although explicit sociopolitical content was not addressed, the structure and discourse of the lessons positioned learners as capable thinkers, laying the groundwork for critical mathematical agency. This paper argues that CRP can meaningfully enhance mathematics teaching in multilingual, multicultural classrooms and calls for further research on embedding critical consciousness within content instruction.

Keywords: culturally relevant pedagogy, functions, dialogic spaces, teaching, language

INTRODUCTION

The teaching and learning of functions in secondary mathematics is often marked by persistent learner difficulties in conceptual understanding (Trujillo et al., 2023). In multilingual contexts such as South Africa, these difficulties are compounded by linguistic and cultural factors that shape how learners engage with abstract mathematical concepts (Hossain, 2024). To address these challenges, researchers have advocated for pedagogies that are responsive to learners' cultural and linguistic realities (Caingcoy, 2023).

Culturally relevant pedagogy (CRP) "embodies professional, political, cultural, ethical, and ideological dispositions" (Howard, 2021, p. 1). It is grounded in beliefs about teaching, learning, students, their families, and their communities, as well as an unyielding commitment to student success (Rhodes, 2021). Accordingly, the CRP emphasizes three interconnected goals: academic success, cultural competence, and sociopolitical consciousness (Abdalla & Moussa, 2024). Although CRP has garnered considerable international attention (Nortvedt, 2020), there is a notable lack of empirical research on its implementation in South African mathematics classrooms. This paper examines how CRP principles are operationalized in the teaching of functions in a grade 10 classroom. Specifically, it examines the role of instructional strategies, language practices, and classroom discourse in fostering both mathematical understanding and cultural connectedness. To achieve this objective, the paper addresses the research question: How do grade 10 mathematics teachers implement culturally responsive pedagogy in the teaching of linear functions?

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

CRP

Ladson-Billings (1995, 2014) conceptualizes CRP as a teaching approach that simultaneously promotes academic excellence, affirms learners' cultural identities, and equips them to critique social inequalities. Rather than viewing culture as peripheral, CRP places it at the

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Contribution to the literature

- This study contributes to the use of CRP, which is not adequately researched in the South African context.
- The study suggests ways in which CRP can be integrated in mathematics teaching.
- The study recommends the ways in which CRP can be integrated particularly in linear functions.

center of teaching and learning, positioning learners' lived experiences as valuable resources for knowledge construction (Rhodes, 2021).

The first dimension of CRP is academic success, which emphasizes that learners should master disciplinary knowledge and skills to thrive in educational settings (Ladson-Billings, 1995). This focus ensures that students are not only able to participate in the classroom but also achieve the levels of excellence necessary for broader opportunities and social mobility.

The second dimension, cultural competence, involves validating and incorporating learners' cultural and linguistic backgrounds into the learning process (Solyst et al., 2025). By doing so, teachers affirm the diverse identities of learners, drawing upon their cultural knowledge as an asset rather than treating it as a deficit. This approach supports students in navigating both their home cultures and the dominant culture of schooling.

Finally, the third dimension is sociopolitical consciousness, which encourages learners to apply the knowledge they acquire to critique and challenge wider social inequities (Gutstein, 2003; Ladson-Billings, 1995, 2014). Through this process, education becomes a transformative tool, enabling students to engage critically with issues of power, inequality, and justice. Collectively, these three dimensions form a holistic framework for culturally responsive teaching that is both academically rigorous and socially empowering.

CRP in Mathematics Education

Scholars argue that mathematics classrooms often privilege abstract, decontextualized, and seemingly "culture-free" presentations of knowledge, which risks alienating learners from diverse linguistic and cultural contexts (Leonard, 2018). Such approaches typically emphasize symbolic manipulation and procedural mastery without connecting mathematical ideas to learners' lived realities. As a result, many students, particularly those from marginalized backgrounds, may view mathematics as irrelevant, inaccessible, or disconnected from their identities and everyday experiences.

In response, integrating CRP into mathematics instruction has been proposed to make learning more inclusive and meaningful (Solyst et al., 2025). The strategic use of multiple representations—such as visual models, symbolic notation, contextualized word problems, and digital tools—enables learners to approach concepts from different entry points and connect them to prior knowledge (Martin, 2009). For example, instead of giving learners a numeric pattern of 3, 5, 7, … to work with, the teacher can contextualize it as follows:

Maria, a grade 5 learner, plays outside while waiting for her mother to return from work. She draws squares to create an L pattern on the ground as shown in Figure 1.

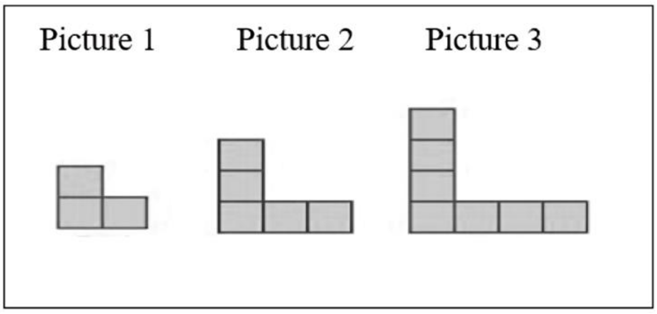

Figure 1. Maria's L-shape pattern (Mphuthi, 2021)

Table 1. Number of squares for Maria's pattern

Picture number (x)	1	2	3	4	n
Number of squares (y)					

In this way, learners immediately get a sense that the next term or picture must also be in L-shape. Then, ask learners to verbalize the pattern by describing how it is generated, encouraging analytical and critical thinking. Lastly, asking learners to complete **Table 1** by counting the number of squares in each picture, before asking them to generalize the pattern by finding the equation $y = 2x + 1$.

The teacher can then use digital tools to show the learners the graphical representation of the pattern. The integration of multiple representations may not only enhance learner engagement but also meaningful learning through scaffolding mathematical concepts, leading to academic achievement (Gardesten, 2023; Hariyani et al., 2023).

Utilizing indigenous knowledge systems (IKS) can also be a transformative pathway for integrating CRP in mathematics teaching, because it is rooted in learners' traditions and cultural practices (Govender & Stott, 2024). For example, in teaching linear functions, teachers can start with geometric patterns that they can use to sketch graphs.

Using **Figure 2** as an example, learners can be given a grid that they can use to create their own patterns. For example, a green bead surrounded by four red beads, then a green bead surrounded by six red beads, and a green bead surrounded by eight red beads, and so on,

Figure 2. Extracted from the San People—Ta Meu Bem (https://share.google/tQcTTa73IJ8F7ecmW)

forming a numeric pattern: 5, 7, 9, …, forming a linear function, $y = 2x + 1$. The inclusion of IKS in mathematics demonstrates affirmation of learners' cultures and can also enhance participation and appreciation of mathematics when they see that it is associated with their cultural practices. Learners are encouraged to be creative, a characteristic that has always been associated with IKS. Furthermore, cultural diversity will be promoted (Blose & Gumbo, 2024) when learners design their own patterns based on their different cultural backgrounds.

The CRP also requires the creation of dialogic spaces where learners can reason, explain, and critique ideas collaboratively (Ladson-Billings, 2023). This positions learners as active contributors to mathematical knowledge rather than passive recipients (Aguirre & Zavala, 2013; García-Carrión et al., 2020). Referring to the previous example of Maria's pattern of squares, dialogic spaces can be created by asking learners what the shape of the next picture will be, and why, as well as how many squares will be on each side, and how the number of squares increases on each side. By so doing, the learners would remain actively engaged in a dialogue. Moreover, CRP in mathematics emphasizes drawing upon learners' cultural and linguistic resources—for instance, using familiar contexts, IKS, or multilingual practices to enrich understanding and validate student identities within the classroom. However, embedding the sociopolitical dimension of CRP in mathematics lessons has proven to be far more challenging (Anderson et al., 2017). While many teachers are comfortable focusing on academic success (ensuring mastery of disciplinary content) and cultural competence (affirming learners' backgrounds), several studies indicate that they often struggle with explicitly fostering critical consciousness (Ladson-Billings, 2014; Sleeter, 2012; Young, 2010).

Research indicates that mathematics teaching frequently stops short of addressing issues of power, equity, and justice, instead maintaining a neutral stance that avoids controversial or politically charged topics (Matthews, 2020). This tendency may stem from curriculum constraints, high-stakes testing pressures, or teachers' own uncertainties about linking mathematics to social critique. Yet, without the sociopolitical dimension, the transformative potential of CRP remains underutilized, as learners are not fully equipped to apply mathematics as a tool for understanding and addressing real-world inequities.

Functions as a Site of Conceptual Difficulty

The concept of a function is widely regarded as one of the most fundamental yet abstract ideas in mathematics. Understanding functions requires learners to make a significant cognitive shift from arithmetic procedures, which emphasize computation and manipulation of numbers, to relational thinking, which focuses on the correspondence between sets of values (Breidenbach et al., 1992). This transition is often challenging because learners must move beyond perceiving mathematics as a series of operations to recognizing and analyzing the structural relationships that define functions.

A common difficulty is the distinction between relations and functions, as learners may incorrectly assume that any correspondence between two sets qualifies as a function (Leinhardt et al., 1990). For example, learners might struggle to recognize why a relation that assigns multiple outputs to a single input does not meet the formal definition of a function. Similarly, interpreting multiple representations of functions—such as symbolic equations, tables of values, graphs, and verbal descriptions—often poses a barrier. Many learners fail to connect these representations, tending to treat them in isolation rather than as complementary perspectives on the same mathematical idea (Duval, 2006). Even procedural tools like the vertical line test, designed to help learners determine whether a graph represents a function, are sometimes applied mechanically without a deep understanding of the underlying concept (Leinhardt et al., 1990).

Given these challenges, pedagogical strategies that deliberately integrate language scaffolding, visual representations, and active learner engagement become critical. Language scaffolding helps unpack the specialized vocabulary of functions, enabling learners to articulate and internalize the distinction between inputs, outputs, and mappings (Moschkovich, 2010). Visual representations, such as dynamic graphing tools and mapping diagrams, can bridge the gap between abstract definitions and concrete understanding, allowing learners to visualize how inputs relate to outputs across different domains. Furthermore, encouraging learner engagement through problem-solving, discussions, and exploratory tasks enables students to actively construct meaning rather than relying solely on rote procedures. Such approaches support learners in developing a relational view of functions, laying a stronger foundation for advanced mathematical thinking.

METHODOLOGY

This study employed a qualitative interpretive approach (Creswell, 2014), which was deemed appropriate for exploring the complexities of classroom interactions and how teaching practices align with the principles of CRP. The focus was on three consecutive grade 10 mathematics lessons that introduced the concept of functions. In South Africa, secondary schools start from grade 8-12. Grade 8 and grade 9 fall under the general education band, also referred to as the senior phase, whereas grade 10-grade 12 fall under the further education and training (FET) phase. Therefore, grade 10 is the lowest in the FET phase. The grade 10 lessons observed provided a rich context for examining how pedagogical strategies and learner responses unfolded in real time. The primary sources of data included detailed classroom observations and verbatim transcripts of teacher–learner interactions, allowing for close analysis of both instructional practices and learner participation.

The grade 10 class observed consisted of 38 learners, mostly aged 16 to 17 years old. Lessons were observed on three consecutive days. All the lessons were about linear functions; the first lesson was an introduction to linear functions concepts, the second one was about graphing linear functions, while the third was about the effect of the parameters of a, b, and q.

The University of South Africa's College of Education Research Ethics Committee granted ethical approval for the study. Permission to perform the study was given by the participating teacher, the principal of the school, and the Limpopo Department of Education. All participating kids had learner assent and parental approval, and the teacher provided written informed consent.

The analytical lens was explicitly informed by CRP, with attention directed toward the three core dimensions identified in the literature. The fundamental framework put forward by Ladson-Billings (1995) provides an organized method for incorporating relational dynamics, cultural competency, and pertinent topic integration into classroom education. The first dimension, academic success, was examined through evidence of scaffolding (Abdalla & Moussa, 2024), the use of multiple representations such as graphs, tables, equations, and verbal explanations, as well as the teacher's ability to provide conceptual clarity rather than focusing solely on procedural fluency. The second dimension, cultural competence, was investigated by analyzing how the teacher incorporated local language, cultural expressions, and identity validation (Caingcoy, 2023) into the teaching of functions. This included instances where learners' linguistic and cultural resources were acknowledged and leveraged as part of the learning process. The third dimension, sociopolitical consciousness (Solyst et al., 2021), was explored by identifying moments in the lessons where learners were encouraged to exercise critical agency or where mathematical ideas were contextualized within broader social or real-world issues.

The process of data analysis involved systematic coding of transcripts and field notes, focusing on aspects such as language use, discourse patterns, instructional methods, and learner engagement. Codes were developed both deductively, based on the dimensions of CRP, and inductively, emerging from patterns observed in the classroom interactions. To ensure reliability of the coding process, the transcripts were annotated to highlight the participant's major ideas or points (Kurasaki, 2000). This was accomplished by highlighting the key notion with comments on track changes. This dual coding approach ensured that while the analysis remained grounded in the theoretical framework, it also remained responsive to the lived realities of the classroom. Through this interpretive process, the study sought to uncover how CRP principles manifested in the teaching of functions and the implications these had for learners' participation, understanding, and sense of belonging in mathematics.

FINDINGS AND DISCUSSION

Academic Success Through Scaffolded Instruction and Multiple Representations

The teacher's approach to introducing functions illustrated the power of scaffolded instruction in supporting learners' academic success. By sequencing representations from concrete to abstract, the teacher provided learners with multiple opportunities to access the concept of a function and gradually build conceptual complexity. This reflects the emphasis in the literature on scaffolding mathematical understanding through carefully designed tasks and representation shifts (Breidenbach et al., 1992; Leinhardt et al., 1990).

Mapping Diagrams as an Entry Point

The lesson began with **mapping diagrams**, where the teacher drew two ovals on the board and connected elements with arrows. Learners were asked: "If I have 2 going to 4, 3 going to 6, and 4 going to 8, is this a function?" This visual representation highlighted the defining property of a function—that each input has exactly one output. However, some learners misinterpreted the diagrams when arrows crossed, suggesting that the physical layout of arrows influenced their reasoning more than the underlying mathematical rule. Such misconceptions are well documented; for instance, Leinhardt et al. (1990) and Rau (2017) argue that learners often conflate visual cues with structural properties, while Vinner and Dreyfus (1989) caution that surface features can obscure relational meaning.

Tables of Values

The representation then shifted to **tables of values**, where the teacher introduced a structured numerical example: $x = -2, -1, 0$, with corresponding y-values when $x - values$ are substituted into $y = 2x + 1$. Learners calculated outputs and filled in the table, reinforcing the deterministic input–output relationship. This stage provided scaffolded practice and supported procedural fluency while also building towards conceptual understanding of linearity. As Duval (2006) notes, coordinating symbolic and numerical registers is crucial for deepening functional reasoning. The teacher's scaffolding here reflects CRP's academic success dimension (Ladson-Billings, 1995, 2014), as learners were systematically supported in mastering disciplinary knowledge.

Graphical Representations

Using the values from the table, the teacher plotted points on the **Cartesian plane**, producing a straight-line graph. Learners visually observed how discrete input–output pairs connected into a continuous geometric form. For example, the teacher prompted: "What do you see when we connect these points?" to which one learner responded: "It makes a line." This helped learners link symbolic expressions and numerical tables with visual graphs.

The use of mapping diagrams, tables of values, and graphical representations aligns with Pedersen et al.'s (2021) assertion that meaningful mathematical understanding arises from coordinating multiple semiotic representations.

The Vertical Line Test

To consolidate, the teacher introduced the vertical line test, explaining: "If a vertical line intersects the graph more than once, it is not a function." Learners were then invited to apply the rule to examples, such as a straight line (a function) and a circle (not a function). This procedural tool helped learners distinguish functions from non-functions in graphical form. While some applied it mechanically, the dialogic space created opportunities for learners to test and validate their reasoning collaboratively. This echoes findings by Moschkovich (2010), who emphasizes that language-rich interactions allow learners to refine conceptual clarity even when procedural tools are introduced.

Teacher Questioning and Learner Definitions

Throughout the lesson, **teacher questioning** was a central scaffolding strategy. The teacher encouraged learners to articulate definitions in their own words. For example, when one learner asserted, "Many to one is not a function," the teacher probed further: "Why not? What does each input need to have?" This exchange revealed a common misconception: conflating "many-to-one" with "not a function." Rather than correcting immediately, the teacher revoiced and pressed for reasoning, enabling learners to confront and clarify their misunderstandings. Such dialogic scaffolding resonates with Boaler and Staples' (2008) argument that pressing learners to explain their reasoning promotes deeper mathematical thinking.

The teacher's systematic scaffolding through mapping diagrams, tables, graphs, questioning, and the vertical line test exemplified how multiple representations can foster learners' **academic success** in understanding functions. Despite persistent misconceptions, the combination of visual supports, procedural tools, and dialogic questioning enabled learners to engage meaningfully with the relational nature of functions. However, as the literature suggests, these strategies require continual reinforcement to move learners from surface-level descriptions toward relational and conceptual understanding (Breidenbach et al., 1992; Leinhardt et al., 1990).

Cultural Competence Through Language and Expressions

The teacher leveraged Setswana expressions and strategic code-switching to foster cultural connectedness and sustain positive classroom relationships, highlighting the role of culturally responsive pedagogy in mathematics instruction (Gay, 2018; Ladson-Billings, 1995). Drawing on learners' linguistic and cultural resources created an inclusive environment that valued their identities and facilitated engagement in mathematical discourse.

Relational Address: "Bana ba ka" (My Children)

On multiple occasions, the teacher referred to learners as "bana ba ka" ("my children"), softening the hierarchical authority structure traditionally present in the classroom. This relational language positioned learners as members of a collective learning community, promoting a sense of belonging and emotional security. Research indicates that such relational approaches strengthen learner-teacher rapport, increase participation, and reduce anxiety in academic settings (Moll et al., 1992; Villegas & Lucas, 2007). By framing learners as part of a "family," the teacher created a supportive atmosphere where students felt safe to contribute ideas, even when their responses were not fully correct.

Strategic Code-Switching For Clarity and Encouraging Participation

When learners struggled to differentiate between a "relation" and a "function," the teacher briefly code-switched into Setswana, simplifying the explanation: "One input cannot go to two different outputs—ga go a tshwanela gore e nne jalo (it should not be like that)." Code-switching in mathematics classrooms has been shown to mediate access to complex conceptual knowledge by connecting abstract terminology with learners' everyday linguistic resources (Planas & Civil, 2013; Setati, 2005). This strategy not only clarified the content but also validated learners' home languages, reinforcing cultural competence and cognitive accessibility.

Learners responded more readily when the teacher incorporated culturally familiar language, participating chorally or echoing the teacher's phrasing. Even hesitant learners engaged in the discourse, suggesting that linguistic familiarity reduced participation barriers. Studies indicate that culturally responsive language practices enhance learner engagement, collaborative problem-solving, and conceptual understanding in mathematics (Barton & Kaya, 2015; Franke et al., 2009). By integrating learners' linguistic repertoires, the teacher fostered an inclusive, participatory classroom culture.

Overall, these practices illustrate how culturally responsive language use supports both affective and cognitive dimensions of learning. By bridging the gap between learners' cultural-linguistic knowledge and formal mathematical discourse, the teacher cultivated a classroom environment conducive to understanding, participation, and relational trust.

Knowledge Construction Through Dialogic Teaching

Although the lessons were predominantly teacher-led, learners were consistently drawn into dialogic interactions that positioned them as active participants in constructing mathematical meaning. Dialogic teaching emphasizes the co-construction of knowledge through interaction, questioning, and reflective discussion, rather than passive reception of information (Alexander, 2008; Mercer & Howe, 2012). The observed classroom strategies illustrate how dialogic approaches can foster engagement, reasoning, and collective understanding.

Question-Response Exchanges to Encourage Critical Thinking

The teacher regularly posed tasks that required learners to determine whether particular relations qualified as functions, for example: "If I map 2 to 4, 2 to 5, and 3 to 6—is this a function?" Learners responded chorally, occasionally disagreeing with one another, which opened space for the teacher to probe reasoning further. Research shows that such structured questioning promotes critical thinking and encourages learners to verbalize mathematical reasoning (Nystrand et al., 2003; Wegerif, 2007). Disagreements among learners can be productive, stimulating cognitive conflict and deeper conceptual engagement (Forman et al., 1998).

Eliciting Examples and Definitions in Learners' Own Words

Learners were invited to define a function in their own words, with one learner stating: "Many to one is not a function." Rather than dismissing the response, the teacher probed further: "Why not? What must each input have?" This strategy encouraged learners to explain their reasoning and exposed misconceptions for whole-class discussion. Literature on formative assessment and dialogic teaching shows that eliciting learners' explanations helps teachers identify gaps in understanding while developing learners' metacognitive and verbal reasoning skills (Black & Wiliam, 2009; Mercer et al., 2010).

At one stage, learners were asked to provide examples of relations and test them using the vertical line test. Learners suggested various shapes, including circles and parabolas, which were then examined collectively. Allowing learners to contribute examples supports procedural fluency and conceptual understanding simultaneously (Hiebert & Grouws, 2007). Shared exploration reinforces learning because learners engage in authentic problem-solving and collectively validate mathematical rules. This aligns with Vygotsky's (1978) sociocultural perspective, which underscores the importance of social interaction in the development of higher-order thinking.

Collective Participation Through Conversational Check-ins "Akere?" (Isn't It?) and Choral Responses

The teacher frequently appended the Setswana expression "akere?" to explanations, such as "Each input must go to one output, akere?" This served as a comprehension check and simultaneously functioned as a cultural cue, encouraging learners to actively confirm understanding in a familiar, dialogic format. Research on classroom talk and culturally responsive pedagogy shows that using familiar linguistic cues fosters engagement and scaffolds learner reasoning, particularly in contexts where English is not the learners' first language (Gutiérrez, 2008; Moschkovich, 2010). This approach transformed questioning from a formal assessment into an interactive, culturally meaningful practice.

Conversational markers such as "akere?" prompted learners to respond in unison, demonstrating attentiveness and shared ownership of the lesson's progression. Research on dialogic teaching suggests that choral responses, when structured effectively, can enhance engagement, maintain attention, and provide formative feedback on learner understanding (Alexander, 2008; Howe & Mercer, 2007). Such collective responses also create a classroom culture where participation is normalized, reducing anxiety and encouraging even hesitant learners to contribute.

Through these dialogic strategies, the teacher positioned learners not as passive recipients but as capable contributors to mathematical reasoning. Misconceptions were not treated as errors to be corrected immediately; instead, they were leveraged as opportunities for collective reasoning and conceptual refinement. This approach reflects findings that dialogic classrooms—where learners' ideas are elicited, discussed, and elaborated—promote both procedural fluency and conceptual understanding in mathematics (Michaels et al., 2008; Nystrand et al., 2003).

Limited Sociopolitical Content

The CRP emphasizes the importance of nurturing learners' sociopolitical consciousness by connecting academic learning to broader societal issues of equity, justice, and community context (Gay, 2018; Ladson-Billings, 1995). In mathematics education, this involves linking abstract concepts to real-world phenomena, encouraging learners to critically engage with social structures, and fostering agency through socially meaningful problem-solving (Frankenstein, 1983; Gutstein, 2006).

In the observed lessons, however, explicit links between mathematics content and sociopolitical realities were limited. The teacher's examples focused primarily on content-specific representations—mapping diagrams, input–output tables, graphs, and the vertical line test—without connecting these concepts to community-based or societal applications, such as economic patterns, transport systems, social statistics, or environmental data. Research suggests that when mathematics instruction neglects real-world, socially relevant contexts, learners may miss opportunities to see the discipline as a tool for understanding and critiquing societal structures (Gutstein & Peterson, 2005; Skovsmose, 1994).

Nevertheless, traces of sociopolitical dimensions were evident in the teacher's interactions and stance toward learners. By affirming learner responses—even when incorrect—the teacher cultivated a classroom culture that recognized learners' reasoning and positioned them as capable contributors to mathematical discourse. For instance, when a learner incorrectly stated, "many to one is not a function," the teacher engaged the learner in further questioning rather than dismissal. Such practices reflect what Ladson-Billings (1995) describes as nurturing learners' academic and personal agency, fostering confidence, and challenging deficit-oriented narratives.

Furthermore, the use of inclusive and relational discourse—e.g., addressing learners as "bana ba ka" ("my children")—reinforced a sense of belonging, dignity, and respect. While not explicitly sociopolitical in content, these discursive strategies function as subtle forms of resistance to marginalization and inequity in multilingual, under-resourced classrooms (Moll et al., 1992; Villegas & Lucas, 2007). They establish the social and emotional foundations necessary for learners to engage critically and confidently with mathematics.

Thus, although the lessons did not foreground sociopolitical content through real-world applications, the teacher's discourse and relational positioning provided an implicit platform for developing critical mathematical agency. This foundation could be strengthened in future instruction by intentionally integrating socially relevant contexts and problems, enabling learners to connect abstract mathematical concepts with issues of equity, justice, and community life (Gutstein, 2006; Frankenstein, 1983).

CONCLUSION

This study provides empirical insight into the enactment of CRP in South African mathematics classrooms, with a focus on the teaching of functions. The findings show that CRP was primarily operationalized through fostering academic success and cultural competence. The following key findings were observed:

- The teacher effectively scaffolded learners' understanding of functions using multiple representations—mapping diagrams, input–output tables, graphs, and the vertical line test—aligning with cognitive and representational strategies recommended in mathematics education research (Duval, 2006).
- Additionally, questioning and conversational check-ins were used as a scaffolding strategy to elicit and confirm learners' understanding.
- Codeswitching to Setswana is utilized to mediate access to complex conceptual knowledge and encourage learner participation, creating a classroom environment that validates learners' identities and promotes engagement.

All these practices resonate strongly with CRP's emphasis on cultural competence and identity affirmation (Gay, 2010; Ladson-Billings, 1995). However, explicit integration of sociopolitical consciousness was limited. This echoes prior studies that highlight the difficulty mathematics teachers face in embedding critical or political dimensions within traditionally content-focused lessons (Aguirre & Zavala, 2013; Maloney & Matthews, 2020). Nonetheless, by encouraging learner participation, dialogic reasoning, and collective exploration, the teacher established a foundation for critical mathematical agency, suggesting that the affective and cognitive dimensions of CRP can create a springboard for deeper sociopolitical engagement.

Recommendations

Based on these findings, it is recommended that professional development for mathematics teachers extend beyond cultural and linguistic responsiveness to include strategies for embedding sociopolitical and critical consciousness into lessons. Teachers could explore ways to link abstract mathematical concepts, such as functions, to real-world contexts, including community-based datasets, economic trends, or social statistics, thereby fostering learners' capacity to apply mathematical reasoning in socially meaningful ways (Gutstein, 2006; Skovsmose, 1994). In addition, curriculum developers should consider incorporating culturally and socially relevant examples in teaching materials, textbooks, and digital resources to provide learners with opportunities to connect mathematics to their lived experiences. Teachers are also encouraged to continue using dialogic classroom strategies, such as eliciting learner-generated definitions, encouraging choral responses, and promoting collaborative exploration, which enhance engagement, reasoning, and collective ownership of learning (Alexander, 2008; Mercer & Howe, 2012). Finally, establishing collaborative teacher communities within schools can provide spaces for educators to share strategies and reflect on practices for integrating CRP, supporting continuous professional growth and reflective teaching.

Implications

The findings have several implications for teaching practice, curriculum development, and future research. For teaching practice, the study highlights the potential of CRP to enhance both academic success and cultural competence, demonstrating that strategic scaffolding, multiple representations, and the integration of learners' cultural and linguistic resources can create inclusive classrooms where learners feel recognized and empowered. In terms of curriculum development, the study suggests that mathematics programs should provide explicit opportunities for incorporating culturally and socially relevant contexts, allowing learners to apply mathematical reasoning to real-world and socially meaningful problems without compromising disciplinary rigor. For future research, the study points to the need to investigate practical approaches for integrating sociopolitical and community-based content into mathematics lessons, examining how different domains of mathematics, learner demographics, and cultural settings influence the enactment of CRP and the development of critical mathematical agency. Overall, the study underscores the importance of balancing content knowledge with cultural and social responsiveness to promote equitable, meaningful, and engaging mathematics learning.

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