ACTA SCIENTIAE

ISSN: 2178-7727

Institutional and Ideological Forces in Mathematics Discourse a Critical Perspective

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ABSTRACT
Classroom discourse often reflects underlying power dynamics and ideological structures shaped by sociocultural contexts. This qualitative study applies Critical Discourse Analysis (CDA) to investigate linguistic practices, authority relations, and ideological influences within a Grade 10 mathematics classroom in an Arab school in Israel, focusing on the teaching of functions. Employing Fairclough's CDA framework, the research analyzes how teacher discourse, interactional routines, and institutional norms impact student engagement and learning outcomes. Key themes identified include the predominance of teacher authority, the use of the Initiation–Response–Evaluation (IRE) pattern, and strategic code-switching between Hebrew and Arabic to address linguistic diversity. While the discourse emphasizes procedural accuracy and mathematical precision, it simultaneously reinforces hierarchical structures that constrain student autonomy. Although code-switching facilitates accessibility, it also poses cognitive and sociolinguistic challenges. The findings suggest that traditional instruction models prioritize efficiency over conceptual depth, aligning with broader neoliberal trends in Israeli education policy. The study advocates for dialogic teaching approaches that promote equitable participation and critical mathematical thinking. Methodologically, the study analyzes transcripts from three consecutive lessons, coding for themes related to language use, power asymmetries, and student participation. The findings underscore the need for pedagogical shifts toward inquiry-based learning and student-centered dialogue. This research contributes to the discourse on mathematics education in multilingual and socio-politically complex settings, highlighting how classroom language can both reproduce and challenge educational hierarchies.

KEYWORDS: Critical Discourse Analysis, mathematics education, Arab students, power structures, code-switching, teacher-student interaction, functions

INTRODUCTION
Mathematics education constitutes a pivotal domain in fostering academic achievement and cognitive development; yet, its pedagogical enactment is frequently shaped by intricate sociocultural and ideological forces that subtly govern instructional practices. In the Arab education system in Israel, these dynamics are particularly salient, as pedagogical interactions are mediated through complex linguistic and institutional structures. Mathematics instruction, often presumed to be ideologically neutral, in fact reflects and reproduces dominant power relations, linguistic conventions, and curricular mandates that bear direct implications for student engagement and epistemic access. The discourse employed in mathematics classrooms not only conveys content but actively shapes students' conceptualization of mathematical ideas, their participation in dialogic processes, and their broader learning trajectories. Accordingly, this study applies Critical Discourse Analysis (CDA) to systematically examine how language, authority, and ideology operate within a Grade 10 mathematics classroom serving Arab-speaking students in Israel, with a focus on teaching the concept of functions.

Conventional mathematics pedagogy is commonly characterized by authoritative instructional modalities in which the teacher serves as the sole epistemic agent, while students are positioned as passive recipients of knowledge (Simile 2024; Hibi, 2021c; Hibi, 2024b; Hibi, 2024c). Such asymmetrical classroom dynamics reinforce educational hierarchies and curtail opportunities for reflective inquiry and substantive engagement.

ISSN: 2178-7727

In multilingual classrooms—such as those in Arab schools where Hebrew often functions as a secondary language of instruction—practices like code-switching further complicate the communication and internalization of mathematical knowledge (Patwa et al. 2020; Hibi, 2018). This study seeks to interrogate how discourse patterns in mathematics instruction either reinforce or destabilize prevailing power structures, and how these linguistic choices affect students' comprehension and participation.

The study pursues the following objectives:
To analyze the discourse strategies employed in a Grade 10 mathematics classroom, particularly focusing on teacher-student dialogic structures;
To examine how linguistic practices and pedagogical choices enact or resist institutionalized power dynamics;
To investigate the role of Arabic-Hebrew code-switching as a mediating strategy in facilitating or impeding conceptual understanding;
To evaluate the broader pedagogical implications of discourse on student participation, voice, and epistemological access.

A nuanced understanding of the linguistic dimensions of mathematics instruction is essential for the development of inclusive, dialogic, and equitable teaching practices. This study contributes to ongoing debates in mathematics education by illuminating the discursive mechanisms that structure or constrain participation and by offering critical insights into how pedagogical discourse may be reimagined to support meaningful and socially just mathematical learning. Furthermore, the research holds relevance for curriculum developers, educators, and policymakers committed to addressing linguistic diversity and systemic inequities within the Israeli educational context.

The study is theoretically grounded in Fairclough's (1992) model of Critical Discourse Analysis, which provides a multidimensional framework for analyzing the intersection of language, power, and ideology in educational discourse. CDA facilitates a layered interrogation of classroom interaction by integrating three analytical dimensions:

Textual Analysis – Focused on linguistic features such as lexical choice, syntactic structure, and modality;
Discursive Practices – Concerned with how classroom dialogues are constructed and interpreted;
Sociocultural Practices – Attuned to institutional, historical, and policy-driven influences on pedagogical discourse.

By applying this framework, the study aims to reveal how mathematics instruction simultaneously transmits content and regulates participation, and how these processes may be critically examined and potentially transformed to foster equitable learning environments.

Theoretical Framework

The theoretical foundation of this study is anchored in Critical Discourse Analysis (CDA), offering a comprehensive framework for investigating how language, power, and ideology intersect within classroom discourse. In the context of mathematics instruction in Arab schools in Israel—where Arabic functions as the primary language of communication and Hebrew often represents the language of assessment and authority—CDA serves as a valuable lens for examining how discourse structures shape access to knowledge, student participation, and epistemological hierarchies. While mathematics is frequently regarded as an ideologically neutral and universally structured discipline, extensive scholarship highlights how language mediates the construction of mathematical meaning and reinforces or challenges social stratifications (Fairclough 1992; Skovsmose 1994; Hibi, 2017; Hibi, 2021b; Hibi, 2022).

Textual Analysis in Teaching Functions

The choice of linguistic formulations in defining mathematical concepts plays a significant role in shaping students' cognitive engagement. For instance, characterizing a function as "a special relationship" may evoke a more abstract and relational interpretation, whereas framing it as "a rule that assigns each input a unique

ISSN: 2178-7727

output" may foster a procedural orientation. Sfard (1991) differentiates between structural and operational conceptions of mathematical ideas, and Skemp (1976) similarly distinguishes between relational and instrumental understandings. These conceptual framings are embedded in the language used by teachers and directly influence how learners internalize mathematical ideas. Moreover, the nature of questioning—open-ended versus closed-ended—bears on the depth of engagement. Research demonstrates that open-ended prompts encourage analytical thinking and discourse (Machaba and Magwiro 2024; Mangwiro and Machaba 2023), while closed questions tend to promote rote recall. The teacher's lexical and syntactic choices, including metaphorical representations, modal verbs, and hedging expressions, function not only as tools of instruction but also as mechanisms for positioning students in epistemic hierarchies (Canonigo 2024). Conversely, an exploratory approach, such as asking, "What do you think happens if...?" aligns with dialogic teaching (Yao 2024; Hibi, 2021a; Hibi, 2021d; Hibi, 2025c), fostering curiosity, discussion, and active participation. This shift from univocal discourse—where knowledge is transmitted—to dialogic discourse—where knowledge is co-constructed (Walls 2021)—enhances students' ability to reason mathematically and engage meaningfully with functions.

Discursive Practices: Teacher-Student Interactions

In Arab mathematics classrooms in Israel, teacher-dominated discourse frequently adheres to the Initiation-Response-Feedback (IRF) pattern (Azizah et al. 2022), wherein the teacher poses a question, a student provides a response, and the teacher offers evaluative feedback. This triadic exchange, while effective in maintaining order and ensuring curriculum coverage, often positions the teacher as the sole epistemic authority and limits opportunities for student-initiated inquiry. Such patterns consolidate hierarchical classroom dynamics, where learners are expected to respond correctly rather than contribute meaningfully to knowledge construction (Hamilton 2023; Hibi, 2024a; Hibi, 2024d; Hibi, 2025b). Conversely, dialogic discourse, as conceptualized by Alexander (2008), cultivates student agency by promoting peer-to-peer dialogue, cooperative problem-solving, and multimodal representations of mathematical concepts—including tabular data, graphical illustrations, and algebraic expressions. Research by Ni et al. (2021) demonstrates that such dialogic interactions foster deeper conceptual understanding and enhance students' capacity to reason mathematically through active engagement, rather than passive assimilation.

Power asymmetries within discursive structures also manifest in how student errors are interpreted and addressed. Within traditional, authority-centered classrooms, mistakes are frequently perceived as indicators of failure, thereby discouraging risk-taking and participation (Langer 2001). In contrast, instructional approaches grounded in the principle of productive struggle (Hiebert and Grouws 2007) conceptualize errors as essential to the learning process, encouraging students to wrestle with complexity and develop resilient problem-solving strategies. Boaler (2016) and Dweck (2006) emphasize that environments in which errors are acknowledged and analyzed critically support the development of a growth mindset, wherein learners regard challenges as integral components of intellectual advancement. Reframing mistakes as sites of inquiry rather than deficits not only democratizes discourse but also repositions students as active participants in the co-construction of mathematical understanding. This pedagogical shift transforms the classroom into a dialogic space that values reasoning, metacognition, and student voice in the pursuit of meaningful mathematical engagement.

Sociocultural Practices: Broader Educational and Institutional Influences

Curricular mandates and assessment frameworks exert a profound influence on the pedagogical framing of mathematical concepts such as functions, particularly within the Arab education system in Israel. These structural mechanisms often dictate whether instruction prioritizes procedural fluency—characterized by rule memorization and algorithmic computation—or cultivates conceptual understanding that encourages abstraction, reasoning, and connections across representations (Dwyer 2017). This dichotomy is deeply shaped by prevailing educational ideologies and systemic constraints, including standardized testing pressures and time-bound curriculum pacing. In practice, the emphasis on procedural mastery frequently marginalizes exploratory practices that could enhance mathematical sense-making.

Moreover, cultural perceptions of mathematics significantly influence the nature of classroom discourse.

ISSN: 2178-7727

When mathematics is socially constructed as a rigid, rule-governed discipline—as is often the case in traditional educational cultures—students may adopt passive learning roles, deferring to teacher authority and avoiding epistemic risk (Zhang and Cao 2022). In contrast, conceptualizing mathematics as an exploratory and creative endeavor fosters learner curiosity, cognitive flexibility, and deeper engagement with content. These culturally embedded attitudes shape not only how students interact with mathematical tasks but also how they position themselves as learners within the classroom discourse.

The integration of technological tools—such as graphing software, dynamic geometry applications, and algebraic visualization platforms—offers opportunities to transform classroom interactions and support active learning (Olugbara et al. 2022). When deployed meaningfully, these tools enable students to manipulate variables, explore patterns, and visualize mathematical relationships, thereby fostering interactive and inquiry-based learning. However, if these digital resources are utilized merely as instruments for teacher-led demonstration, they may inadvertently reinforce traditional, didactic modes of instruction that limit student agency and constrain dialogic engagement.

Through the lens of Critical Discourse Analysis, educators can critically examine the influence of these institutional and cultural structures on their instructional practices. Such reflective inquiry enables teachers to identify opportunities for transitioning from teacher-centered to student-centered discourse models. This pedagogical reorientation can enhance students' capacity for mathematical reasoning, promote active classroom participation, and contribute to more equitable learning environments—ultimately enriching Grade 10 students' understanding of functional relationships and empowering them as autonomous mathematical thinkers.

Power and Authority in Classroom Discourse

Mathematics instruction, particularly within the context of Arab schools in Israel, is often organized around hierarchical power dynamics, wherein the teacher is positioned as the central and authoritative source of knowledge, while students are assigned passive, compliant roles within the instructional process (Choy and Dindyal 2022). This asymmetry is frequently operationalized through the Initiation-Response-Evaluation (IRE) discourse structure, in which the teacher initiates a question, the student responds, and the teacher evaluates the answer. Although this triadic model facilitates classroom regulation and content delivery, it simultaneously curtails opportunities for student autonomy, reduces dialogic interaction, and constrains critical engagement with mathematical content (Baker 2024).

Through the analytic lens of Critical Discourse Analysis (CDA), this study interrogates the ways in which teacher-directed discourse practices regulate the transmission of knowledge, delineate legitimate forms of participation, and reinforce traditional hierarchies of authority within mathematics classrooms. By foregrounding the role of language in mediating these dynamics, the analysis seeks to uncover whether pedagogical alternatives—particularly dialogic teaching approaches—can disrupt the epistemic dominance of the teacher and foster a more inclusive and participatory learning environment. Dialogic instruction, with its emphasis on co-construction of meaning, mutual inquiry, and distributed authority, holds the potential to reframe classroom discourse as a site of collaborative knowledge building, thereby empowering students as active contributors to mathematical reasoning and understanding.

Linguistic Strategies: Code-Switching in Mathematics Classrooms

In multilingual educational environments, such as Arab schools in Israel where Arabic is the primary language of instruction and Hebrew frequently appears in standardized assessments and official curricular materials, language functions as a central mediating force in shaping comprehension and access to mathematical meaning. One prevalent linguistic strategy employed by teachers in these contexts is code-switching—the deliberate alternation between Arabic and Hebrew during instruction—to scaffold understanding, clarify abstract concepts, and maintain classroom engagement (Vilakazi et al. 2024).

Research supports the pedagogical value of code-switching, particularly in facilitating the accessibility of

ISSN: 2178-7727

mathematical discourse for learners whose linguistic repertoires span multiple languages. Adler (2001) notes that shifting between languages can contextualize abstract mathematical ideas within students' familiar linguistic and cultural frameworks, thereby enhancing their ability to grasp complex content. However, this practice is not without its tensions. Scholars such as Setati and Adler (2000) caution that code-switching, while intended to support inclusivity, may unintentionally reinforce hierarchical language ideologies, wherein the dominant language—in this case, Hebrew—is implicitly constructed as the language of formal academic knowledge, while Arabic is relegated to informal or supplementary status.

This study critically examines the deployment of code-switching within teacher-student interactions in the mathematics classroom, attending to its dual role as both a facilitative and regulatory discourse strategy. Specifically, it investigates how code-switching is used to navigate conceptual explanations, manage classroom dynamics, and construct relational proximity with learners, while also interrogating its potential to reproduce linguistic asymmetries. By situating code-switching within the broader sociolinguistic and political context of Arab education in Israel, this analysis illuminates the complex pedagogical implications of bilingual discourse practices on students' mathematical learning experiences.

Sociocultural and Institutional Influences

Educational discourse within Arab schools in Israel is not developed in isolation but is significantly shaped by overarching institutional frameworks and policy-driven imperatives that prioritize curricular efficiency, standardized assessment performance, and comprehensive syllabus coverage (Ball 2003). These systemic pressures, reflective of broader neoliberal educational paradigms, emphasize measurable outcomes and accountability metrics, often at the expense of deep, inquiry-based learning. As a result, instructional practices tend to favor procedural fluency—characterized by the mastery of algorithms and symbolic manipulation—over conceptual understanding that encourages relational thinking, abstraction, and critical engagement (Lubienski 2000).

Within the analytic frame of Critical Discourse Analysis (CDA), this study interrogates how such institutional mandates are discursively manifested in classroom interactions. Specifically, it examines whether these external constraints limit teachers' capacity to adopt exploratory, student-centered pedagogies, particularly within mathematics instruction where content is frequently treated as rigid and assessment-driven. In Arab schools, where additional sociopolitical and linguistic marginalizations intersect with curricular demands, these institutional forces may exert heightened influence, further narrowing the discursive space available for critical thinking and collaborative knowledge construction.

Grounded in CDA, this theoretical framework offers a robust and multidimensional approach to examining the interplay between language, power, and ideology in mathematics education. By critically analyzing discourse patterns, hierarchical relations, and linguistic strategies within classroom contexts, the study seeks to expose the mechanisms through which traditional teaching structures are maintained—and to envision pathways for their transformation. The framework thus positions classroom discourse not only as a reflection of pedagogical choices but also as a site of ideological reproduction and potential resistance. In doing so, it contributes meaningfully to the ongoing discourse on reforming mathematics education through principles of critical pedagogy, inclusivity, and dialogic participation.

LITERATURE REVIEW

Mathematics education has long occupied a central place in educational research, given its foundational role in cultivating analytical reasoning and problem-solving competencies. However, despite its perceived neutrality, traditional mathematics instruction is often situated within rigid, transmission-oriented pedagogical frameworks that privilege procedural fluency over conceptual depth. These approaches, prevalent in diverse educational contexts including Arab schools in Israel, tend to emphasize algorithmic proficiency and accuracy, while offering limited space for exploration, interpretation, and epistemic agency.

In response to these limitations, recent scholarship has increasingly explored the ways in which discourse shapes the nature and quality of mathematical learning, particularly through the application of Critical

ISSN: 2178-7727

Discourse Analysis (CDA). This literature review synthesizes theoretical and empirical studies that examine the intersection of language, power, and ideology in mathematics classrooms. The discussion foregrounds how discourse not only reflects pedagogical choices but also enacts broader sociocultural and institutional logics, with direct implications for student engagement, identity formation, and equity in learning outcomes.

Critical Discourse Analysis in Education

Critical Discourse Analysis (CDA) offers a powerful framework for interrogating the role of language in constructing and sustaining power relations within educational settings. According to Fairclough (1992), discourse is not a neutral vehicle of communication but an ideological practice that both reflects and reinforces dominant social structures. Within educational contexts, CDA has been employed to uncover the subtle ways in which classroom interactions position learners, authorize certain forms of knowledge, and reproduce hierarchical relations of control and legitimacy (Rogers 2011).

Empirical research utilizing CDA has identified consistent patterns in teacher-student discourse, particularly the dominance of the Initiation-Response-Evaluation (IRE) model (Myklebust and Guadie 2024). In this model, the teacher initiates a question, the student responds, and the teacher evaluates—typically affirming or correcting the answer. While this structure contributes to the maintenance of classroom discipline and instructional clarity, it simultaneously constrains student agency, limits opportunities for divergent thinking, and reduces classroom talk to a performance of correctness (Mercer 1995; Tao and Chen 2024; Hibi, 2024e; Hibi, 2025a). In Arab classrooms in Israel, where sociolinguistic and cultural hierarchies already influence participation, such patterns may further marginalize learners and silence alternative mathematical narratives. CDA thus enables a rethinking of how discourse operates not only as a pedagogical tool but as a mechanism of power, shaping who speaks, whose knowledge is validated, and what kinds of mathematical reasoning are recognized as legitimate. This analytic lens is especially salient in contexts of multilingualism and sociopolitical complexity, such as the Arab education system in Israel, where discourse choices are deeply embedded in broader ideological configurations.

Power and Authority in Mathematics Classrooms

Mathematics has long been regarded as an objective and culturally neutral discipline. However, growing critical scholarship reveals that its instructional practices are deeply embedded within broader structures of authority and control (Martell et al. 2021; Skovsmose 1994). In classroom settings—particularly within hierarchically organized systems such as Arab schools in Israel—teachers often assert themselves as the sole arbiters of mathematical knowledge. This positioning is reinforced through directive discourse and closed-ended questioning techniques, which are employed to maintain control over classroom interaction and limit discursive deviation (Bettini et al. 2022; Nystrand 1997).

Such authoritative instructional models tend to foster rigid learning environments in which students are expected to reproduce knowledge rather than interrogate or co-construct it (Boaler 2016). Emphasis on accuracy and procedural compliance over conceptual reasoning contributes to a classroom culture dominated by memorization, often at the expense of deep understanding (Sfard 2008). In contrast, dialogic pedagogies promote instructional flexibility by encouraging learners to ask questions, justify their thinking, and explore mathematical relationships collaboratively (Wegerif 2011). These approaches position students as epistemic agents and allow for the development of reasoning skills through discourse rather than repetition.

Language and Code-Switching in Mathematics Instruction

In multilingual classrooms—such as those in Arab communities in Israel where Arabic and Hebrew coexist—language plays a pivotal role in mediating student access to mathematical meaning. Code-switching, defined as the alternation between two languages within a single instructional context, is widely adopted by teachers as a strategy to bridge both linguistic and conceptual divides (Muico et al. 2021; Setati 2005). Empirical studies suggest that code-switching can enhance learner comprehension by aligning abstract mathematical concepts with students' lived linguistic and cultural frameworks (Adler 2001).

ISSN: 2178-7727

Nonetheless, critical perspectives caution against the unexamined use of code-switching. Setati and Adler (2000) highlight the risk of reinforcing linguistic hierarchies, wherein the dominant or officially sanctioned language—in this case, Hebrew—may be perceived as inherently more academic than Arabic. This perception may marginalize students' home language and contribute to epistemic exclusion. Moreover, from a cognitive standpoint, Moschkovich (2002) argues that frequent language shifts may increase cognitive load, particularly for students with developing bilingual proficiency, potentially obstructing conceptual clarity.

Given these dual potentials—both as a scaffold for inclusion and a source of cognitive or ideological tension—this study investigates how code-switching functions within mathematics instruction on functions. It seeks to determine whether this practice facilitates or constrains conceptual understanding in the linguistically complex environment of Arab classrooms in Israel.

Student Participation and Classroom Discourse

Patterns of discourse in mathematics classrooms play a pivotal role in shaping student engagement. In many instructional settings—particularly within rigid or exam-driven systems such as those in Arab schools in Israel—teacher-dominated talk restricts opportunities for student expression and interaction. Studies have shown that such environments result in limited learner participation and promote superficial engagement with mathematical concepts (Alexander 2008; Khong et al. 2019). By contrast, research on dialogic teaching underscores the pedagogical value of student-led discourse, wherein learners are encouraged to ask questions, engage in argumentation, and co-construct mathematical meaning (Kazemi and Stipek 2001).

Boaler (2016) emphasizes that when students are given discursive space to explore mathematical ideas collaboratively, they gain deeper conceptual understanding and increased self-efficacy in problem-solving. Furthermore, scaffolding strategies—such as activating prior knowledge or embedding tasks within real-life contexts—have been found to significantly enhance both engagement and long-term retention (Kim et al. 2020; Wood, Bruner, and Ross 1976). These instructional moves, when embedded within a dialogic framework, reposition students as active participants in their own learning process.

Sociocultural and Institutional Influences on Mathematics Education

Mathematics education is profoundly shaped by sociocultural norms and institutional constraints, rather than operating in an ideologically neutral vacuum. In the Israeli educational system—including Arab-sector schools—policy frameworks that emphasize standardization and measurable performance frequently reinforce procedural modes of instruction that prioritize speed and accuracy over conceptual depth (Ball 2003). Neoliberal educational ideologies further entrench this approach by advancing a results-driven culture in which the learning process is subordinated to outcome-based metrics (Lubienski 2000).

These systemic logics exert pressure on educators to deliver content within rigid curricular timelines, leaving little room for exploratory or student-centered learning. Research suggests that such policy-driven constraints exacerbate educational inequities, particularly for students from marginalized communities, who are less likely to benefit from inquiry-based or culturally responsive pedagogies (Valero and Zevenbergen 2004). Within Arab classrooms, where linguistic diversity and cultural identity intersect with structural inequalities, these issues are especially pronounced.

This literature review thus reveals the intricate entanglement of discourse, power, and pedagogy in mathematics education. Traditional interactional patterns—characterized by teacher authority and reliance on the IRE model—limit student voice and critical engagement. While code-switching offers a linguistic bridge in multilingual contexts, it also introduces challenges related to status hierarchies and cognitive burden. Recent scholarship (Cohen 2018; Laird-Gentle et al. 2023) advocates for dialogic instructional models that promote meaningful participation and conceptual inquiry. Yet, institutional and ideological constraints continue to shape teaching practices in ways that prioritize efficiency over epistemic richness. This study builds on these insights by examining discourse in a Grade 10 Arab mathematics classroom, interrogating how interactional structures sustain or disrupt traditional hierarchies and what this reveals about the pursuit of equitable mathematics education.

Methodology

This study adopts a qualitative research approach grounded in Critical Discourse Analysis (CDA) to explore the role of language, power relations, and ideological positioning in a Grade 10 mathematics classroom within the Arab education sector in Israel. The methodology is aimed at critically analysing teacher-student interactions, recurring discourse patterns, and the pedagogical implications of linguistic strategies—particularly code-switching—on students' mathematical comprehension. Through a close examination of classroom transcripts, the study investigates how instructional discourse serves to either reinforce or disrupt hierarchical pedagogical structures within mathematics education.

Research Design

The research is framed as a qualitative case study, enabling an in-depth, context-sensitive exploration of discursive practices within a bounded educational setting (Hancock et al. 2021). The case study design allows for a comprehensive understanding of how discourse mediates teaching and learning processes, especially in multilingual and culturally specific environments. CDA functions in this study both as a theoretical orientation and an analytical methodology, providing tools to examine the enactment of authority, participation structures, and linguistic decision-making in the classroom.

Data Collection

Data were obtained through non-participant observation of three sequential Grade 10 mathematics lessons focused on the topic of functions. Each lesson was audio-recorded and fully transcribed to capture the nuances of verbal interaction between the teacher and students. The transcripts include teacher explanations, student responses, questioning formats, feedback mechanisms, and instances of code-switching between Arabic and Hebrew.

The selected classroom—identified through purposive sampling—was situated in an Arab public high school in Israel and reflected a linguistically hybrid instructional context. The teacher and students were native Arabic speakers, while Hebrew functioned as a secondary language, particularly in formal academic contexts such as national examinations and textbook content. This linguistic duality made the setting particularly relevant for analysing how language mediates mathematical meaning and power relations.

Analytical Framework

Data analysis was conducted using Fairclough's (1992) three-dimensional model of CDA, which integrates three interrelated levels of analysis:
Textual Analysis – Examining micro-linguistic features such as lexical choice, syntax, modality, repetition, and question framing.
Discursive Practice – Investigating how interactions are structured, how turns are distributed, and how roles of authority and knowledge are assigned or contested through dialogue.
Sociocultural Practice – Contextualizing discourse patterns within the wider institutional, cultural, and policy-driven constraints that shape instructional discourse in Arab schools in Israel.
This multi-layered analytical framework facilitates a comprehensive understanding of how discourse operates not merely as a medium of instruction but as a social and ideological mechanism within mathematics education.

Coding and Thematic Analysis

The collected data were subjected to iterative coding to identify recurring themes associated with teacher authority and the reproduction of hierarchical power structures—particularly through the use of the Initiation-Response-Evaluation (IRE) pattern. Attention was also given to indicators of student participation and cognitive engagement, including instances of choral responses, brief factual answers, and episodes of independent mathematical reasoning. These interactional markers were analysed to assess the extent to which classroom discourse either enabled or constrained active student involvement.

ISSN: 2178-7727

In addition, the study examined specific linguistic strategies employed by the teacher, such as code-switching between Arabic and Hebrew, metaphorical expressions, and repetition. These features were analysed not only for their potential in facilitating comprehension of abstract mathematical concepts, but also for their ideological implications—particularly in terms of whose language practices are legitimized and how meaning is constructed.

Institutional factors were also critically assessed, including curricular expectations, instructional time constraints, and adherence to standardized teaching methods. These structural elements were evaluated for their influence on the teacher's discursive choices and on the overall nature of classroom interaction. By comparing patterns across the three observed lessons, the analysis sought to identify both consistencies and contextual variations, thereby providing a nuanced understanding of how power, pedagogy, and language intersect in shaping the mathematics learning environment within Arab secondary schools in Israel.

Ethical Considerations

conducting research within educational settings. All procedures were designed to ensure adherence to ethical standards concerning participant rights, data confidentiality, and voluntary involvement. Informed consent was formally obtained from the mathematics teacher and the school administration, following a detailed explanation of the study's objectives, methods, and scope.

To safeguard student privacy, all identifying information was removed from the data, and pseudonyms were used in the transcript. Classroom interactions—including teacher explanations and student responses—were audio-recorded only after receiving explicit permission, with all participants assured of their right to withdraw at any time without consequence. These measures ensured that the research process maintained transparency, protected participant anonymity, and upheld ethical responsibility throughout its implementation in the Arab educational context.

FINDINGS AND DISCUSSIONS

Language Use and Ideology

The teacher's discourse in the observed Grade 10 mathematics classroom places a strong emphasis on linguistic precision and authoritative instruction, evident in repeated use of formal definitions and directive speech acts. For instance, the teacher defines a function as "a mathematical relationship between two variables where every input value has one or another output value." This formality reflects an ideological positioning of mathematics as an objective, structured, and rule-governed discipline (Fender 2024), a characterization that aligns with broader educational traditions that treat mathematical knowledge as fixed and indisputable (Santagata et al. 2021; Skovsmose 1994).

At the same time, the teacher strategically incorporates code-switching and metaphorical language to render abstract mathematical ideas more accessible within the cultural and linguistic context of Arab students in Israel. Phrases such as "Sho hiyye el-domain?" ("What is the domain?") illustrate an intentional shift to Arabic to bridge the cognitive and linguistic divide between formal Hebrew-based mathematical discourse and students' everyday language practices. This hybrid approach reflects pedagogical sensitivity to learners' cultural backgrounds and is consistent with findings that support the use of students' home languages to enhance comprehension (Setati 2005).

However, this practice is not without tension. While code-switching has been shown to support inclusivity and comprehension (Miller et al. 2022), it may also reinforce implicit linguistic hierarchies, particularly when the dominant language—Hebrew in this context—is perceived as the language of formal knowledge and academic legitimacy (Adler 2001). Furthermore, the alternation between languages may impose additional cognitive demands on students with limited proficiency in either language, potentially impeding the internalization of complex mathematical ideas. These dynamics underscore the ideological dimension of language use in mathematics instruction, where discourse choices both mediate and structure access to disciplinary knowledge.

ISSN: 2178-7727

Power Dynamics and Classroom Roles

Power within the observed mathematics classroom is largely centralized in the figure of the teacher, who orchestrates the discourse primarily through the Initiation-Response-Evaluation (IRE) structure (Myklebust and Guadie 2024). For example:

Initiation: "What is the domain?"

Response: "....." (Students reply in chorus, often hesitantly)

Evaluation: "Yes, correct. The domain refers to…"

This interactional pattern reaffirms the teacher's position as the principal knowledge authority, simultaneously framing students as dependent recipients of information, with limited scope for autonomous reasoning or inquiry (Myklebust and Guadie 2024). In Lesson 1, the teacher consistently exercises control through rapid questioning, declarative explanations, and frequent use of imperative forms and rhetorical devices, such as:

"So, before we go any further, who can tell me what a function is?"

"What is a domain, what is range? Ahmad, sho hiyye el-domain? Sho hiyye el-domain?"

The repetition of students' names and the expectation of immediate response reinforce the teacher's control over participation. In instances of student silence, the teacher supplies the answer, further asserting dominance over the discursive space (Alexander 2008; Kolovou 2023).

Lesson 2 continues this pattern through tightly managed question-and-answer exchanges. Questions such as, "Did the graph shift upwards or downwards?" serve to prompt predictable responses rather than stimulate genuine dialogue. Corrective feedback, exemplified in statements like, "You cannot write it in this way because you need to make sure that you no longer have y on the other side," further consolidates teacher authority (Burns et al. 2021). Nonetheless, moments of partial discursive openness do emerge—for instance, when the teacher introduces an alternative method by saying, "I was just showing you the alternate way of dealing with fractions." Such instances suggest an attempt to foster collaboration, albeit within a tightly controlled pedagogical framework.

In Lesson 3, the teacher retains firm control over the flow and interpretation of discourse, guiding students toward predetermined conclusions (Kim 2022). This is evident when the teacher reformulates a student's vague response—"0 is to 3"—into a precise statement:

"Okay, so which means, because we are saying q is the value of the y-intercept, the y-intercept will be… q will be at 3, neh?"

This rephrasing not only clarifies the concept but also reasserts the teacher's epistemic authority. The use of directive language such as, "We need to use the second coordinate in order to be able to calculate what? The value of a," structures the interaction in a way that channels student responses toward teacher-defined goals. Moreover, the teacher's allocation of marks reinforces evaluative dominance:

"And then we will award a mark for saying q = 3, the rest of the two marks will be for the value of a, and also rewriting the equation like that."

Such discourse positions the teacher as the arbiter of correctness and validates a performative approach to knowledge, where procedural compliance is rewarded more than exploratory reasoning.

Participation Structures and Student Engagement

In Lesson 1, student responses primarily take the form of choral answers or brief, single-word replies, reflecting a discourse structure grounded in the Initiation-Response-Feedback (IRF) pattern (Sinclair and Coulthard 1975):

Teacher: "What is range? Yes?"

Learners: "The set of all y-values."

Teacher: "So, is it a function or not?"

ISSN: 2178-7727

Learners: “No.”

Participation is thus organized through Initiation-Response-Evaluation (IRE) sequences (Myklebust and Guadie 2024), in which the teacher poses a question, students respond—often in unison—and the teacher evaluates or redirects. For example, the teacher asks:
“What should I do this time? -1 will be equal to? 8a + 3 and then I am looking for a. What do I do?”
Students reply: “Transpose.”
The teacher confirms and continues the calculation, maintaining control over the learning trajectory.
The teacher also frequently employs inclusive pronouns such as “we,” as in:
“We also need the value of a, and also the value of q,”
which fosters a sense of collective purpose while still preserving authoritative control over the discourse. Despite the inclusive tone, students remain largely reactive, responding to direct prompts rather than initiating questions or proposing alternative methods of problem-solving.

This interactional model constrains student autonomy and reinforces the teacher’s position as the central epistemic figure. Empirical findings suggest that dialogic teaching—where students generate their own questions, offer explanations, and engage in collaborative reasoning—promotes richer conceptual understanding and more meaningful engagement with mathematical content (Analita et al. 2023).

Code-Switching as a Pedagogical Strategy
In Lesson 1, the teacher employs code-switching as a purposeful instructional technique, evident in statements such as “only once, it means the graph satisfies the condition of being a function” and “my children, this will be defined because one set of x-values gives us only one set of y-values.” These utterances integrate students’ home language with the language of instruction, supporting comprehension by anchoring abstract mathematical concepts in familiar linguistic frameworks. This aligns with research suggesting that code-switching can serve as a bridge in multilingual classrooms, facilitating understanding (Setati 2008; Hartono et al. 2023). Moreover, the phrase “my children” conveys a tone of care and familiarity, potentially increasing student attentiveness. However, when coupled with prompts like “right?” or similar confirmation tags, such language may signal an expectation of agreement rather than encourage open dialogue, thereby limiting critical engagement.

In Lesson 3, code-switching is again used to scaffold understanding, as in the instruction “You replace q by 3.” This approach makes abstract procedures more accessible by connecting known linguistic structures to unfamiliar content, reinforcing the pedagogical value of integrating the home language into instruction (Moschkovich 2010). The use of informal classroom expressions contributes to a more conversational tone, which can reduce perceived formality and promote a supportive learning environment. Studies indicate that such informality can foster inclusivity and increase student willingness to participate (Adler 2001).

Lesson 2 also illustrates the strategic use of repetition, as in the phrase: “That’s how the effect of q affects the graph.” Repetition can strengthen retention, but it may also suggest the need for further conceptual clarification. This aligns with findings from Setati (2008) and Hartono et al. (2023), who note that while code-switching and repetition can aid in comprehension, overuse may inadvertently encourage reliance on translation rather than independent conceptual reasoning. Thus, although multilingual strategies and repeated phrasing can support learning, their implementation should promote inquiry and cognitive engagement rather than passive affirmation.

Reinforcement Through Repetition
In Lesson 1, the teacher employs repetition as a reinforcement technique, as seen in the recurring question, “What should we do with the rule in order to get the set of output values? What should we do with the rule in order to get the set of output values?” While this repetition functions to solidify understanding, it also serves as a means to prompt student responses and encourage active participation. Likewise, in Lesson 3, the teacher repeats the question, “What is the value of q representing?” until students respond with confidence: “y-

ISSN: 2178-7727

intercept." This aligns with research suggesting that repetition in instructional discourse aids cognitive processing, strengthens memory of key ideas, and supports long-term retention (Mercer 2000; Sfard 2001). Beyond repetition, the teacher incorporates metaphors and visual representations in Lesson 1, as illustrated in the explanation, "A function can also be defined as a rule…" and the use of graphical displays to differentiate between one-to-one and one-to-many relations. These strategies enhance conceptual clarity by translating abstract mathematical ideas into more accessible forms. Studies in mathematics education emphasize that exposure to multiple representations—verbal, symbolic, visual—facilitates the connection between concrete and abstract reasoning (Duval 2006; Goldin 2002). Through visual tools and analogies, students can better understand relationships between mathematical objects, promoting deeper conceptual development (Presmeg 2006).

In Lesson 3, the teacher emphasizes procedural accuracy and structured reasoning, as demonstrated in the statement: "So you say therefore, Y =, you know the value of a is 2x, you know the value of q is 4." This attention to clarity and completeness in mathematical expression reflects a pedagogical commitment to precise communication, a factor shown to support students' problem-solving competence (Moschkovich 2010). However, the recurring need for repetition due to delayed or hesitant responses may point to limited engagement or gaps in comprehension, reinforcing the importance of incorporating more interactive, student-centered approaches (Kazemi and Stipek 2001; Boaler 2016).

Conceptual Framing and Mathematical Discourse

The observed lessons prioritize procedural instruction over deeper conceptual engagement. Although students are occasionally prompted with questions such as, "What do you think will happen to the mother graph?", these opportunities are short-lived, with responses quickly evaluated rather than explored. This approach constrains learner talk and reflects a teacher-dominated discourse structure (Khong et al. 2019). Encouraging students to articulate reasoning could enhance conceptual development and foster mathematical discourse (Boaler 2016). Additionally, the integration of differentiated or open-ended tasks may help sustain motivation and promote autonomy in learning (Vygotsky 1978).

Sociocultural and Institutional Influences

The classroom discourse mirrors broader institutional constraints, including strict curriculum pacing and limited instructional time. The teacher's directive, "You need to finish before you go home," exemplifies an efficiency-driven approach aligned with neoliberal educational ideologies that prioritise measurable performance over conceptual depth (Ball 2003). The rigid structure of lessons—centered on definitions, procedural fluency, and standardized techniques—perpetuates hierarchical norms in mathematics education and may marginalize students who struggle with procedural demands, thus reinforcing systemic inequities (Lubienski 2000).

Classroom management is primarily maintained through verbal regulation, with few behavioral disruptions. However, brief signs of student disengagement (e.g., "Learner: Complaining") suggest occasional resistance, potentially linked to poor task timing—such as assigning work immediately before dismissal. These interruptions point to contextual limitations that may undermine sustained learner focus.

Scaffolding Through Prior Knowledge

Statements such as, "I believe you have done functions in Grade 8 and maybe 9 also," and "You remember this from Grade 8 and 9?" illustrate reliance on students' prior knowledge as an entry point to new content. While this strategy reflects a traditional teacher-led model, where past learning is referenced rather than deeply re-engaged, such an approach may constrain opportunities for meaningful conceptual development. Research highlights that teacher-centered methods can limit deeper understanding and restrict inquiry (Fuchs 2023; Kazemi and Stipek 2001).

Contemporary scholarship in mathematics education emphasizes inquiry-based instruction, where students explore, discuss, and reason through concepts collaboratively (Hiebert et al. 1996). These approaches enhance

ISSN: 2178-7727

problem-solving and critical thinking by helping students connect prior experiences with new ideas (Boaler 2016). Vygotsky's (1978) theory of social constructivism supports this pedagogical shift, asserting that knowledge is best constructed through interactive dialogue and shared exploration.

Therefore, the dependence on recall-based prompts, while efficient, may fall short in fostering engagement or conceptual growth. A shift toward inquiry-oriented strategies—such as guided discovery or collaborative problem-solving—could create richer mathematical experiences. This aligns with research advocating for student-centered environments that promote exploration and deeper comprehension (Sfard 1991; Kazemi and Stipek 2001).

Conclusion and recommendations

This study highlights the complex interplay between language, power relations, and instructional discourse in mathematics classrooms. The analysis demonstrates that while the teacher's structured and methodical approach supports procedural clarity and content accuracy, it also maintains a predominantly hierarchical dynamic in which the teacher is positioned as the central authority and students operate largely as passive recipients of knowledge (Fuchs 2023). The discourse structure observed—dominated by Initiation-Response-Evaluation patterns, directive language, and fixed answer formats—limits opportunities for learners to engage in independent reasoning, conceptual exploration, or dialogic interaction.

At the same time, pedagogical strategies such as repetition, scaffolding through prior knowledge, and selective use of code-switching do contribute positively to accessibility and comprehension. These approaches help bridge cognitive and linguistic gaps, particularly in multilingual settings, and reflect the teacher's effort to ensure all students remain on task and attain procedural mastery. However, even these strategies are implemented within a largely teacher-centered framework that constrains student agency and limits the potential for critical engagement and reflective mathematical discourse.

Moreover, the instructional focus remains primarily on definitions, calculations, and procedural execution, with minimal space allotted for open-ended questions, collaborative problem-solving, or conceptual discussion. Student participation is often limited to short, factual responses, and there are few instances where students are invited to articulate reasoning, pose questions, or justify mathematical thinking. The overarching instructional model aligns with broader institutional constraints—such as curriculum pacing and time pressures—that privilege efficiency and standardization over exploration and depth.

To cultivate more inclusive and equitable mathematics classrooms, it is recommended that educators integrate dialogic pedagogies that position students as active participants in the learning process. This includes creating space for student-generated questions, encouraging multiple problem-solving strategies, and valuing mistakes as part of the learning journey. Shifting from a transmission-based model to one that promotes inquiry, reasoning, and dialogue can enhance both conceptual understanding and student motivation.

Additionally, embedding inquiry-based tasks and encouraging collaborative exploration of mathematical ideas can help balance the need for procedural fluency with the development of higher-order thinking skills. Teachers can still provide structure and scaffolding while gradually releasing responsibility to students, thereby fostering greater autonomy and engagement.

Ultimately, mathematics education should not be confined to procedural correctness alone. When classrooms are designed to promote interaction, reflection, and conceptual depth, they become spaces where all students—not just those already proficient—can participate meaningfully, develop confidence in their abilities, and experience mathematics as a dynamic and empowering discipline.

AI ACKNOWLEDGEMENT

The authors acknowledge the use of Grammarly. The prompts used include editing text for spelling and grammar errors. The output from these prompts was used to make the text easy to read. While the authors

ISSN: 2178-7727

acknowledge the usage of AI, they maintain that they are the sole authors of this article and take full responsibility for the content therein, as outlined in COPE recommendations.

INFORMED CONSENT

The authors have obtained informed consent from all participants.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

LIMITATIONS OF THE STUDY

While Critical Discourse Analysis (CDA) offers in-depth insights into classroom discourse, it does not account for non-verbal elements such as gestures and facial expressions, which also play a role in communication. Furthermore, the study's focus on a single classroom limits the scope for broader generalisation. Future studies could address this by including multiple classrooms and incorporating interviews with teachers and students to achieve a more holistic perspective.
This section has outlined the research framework, data collection strategies, and analytical approach used to investigate discourse in mathematics teaching. By applying CDA, the study critically explores how language, power, and ideology influence classroom interactions, contributing to ongoing discussions on inclusive and equitable mathematics education.

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