

Enhancing mathematics teaching through sociocultural pedagogy: An analysis of teacher questioning using Vygotsky's framework

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ABSTRACT

This study investigates the impact of a pedagogical intervention aimed at enhancing teacher questioning strategies in a Grade 9 mathematics classroom. Grounded in Vygotsky's Sociocultural Theory, the research focuses on how changes in instructional practices influence learner engagement through the lens of the Zone of Proximal Development (ZPD), scaffolding, mediation, and social interaction. The primary goal was to examine how teacher questioning evolved from authoritative to more learner-centered forms of interaction that promote mathematical reasoning and collaboration. A qualitative case study design was adopted, involving pre-and post-intervention classroom observations and transcript analysis of a Grade 9 teacher. The intervention consisted of a professional development workshop centered on dialogic teaching, with a specific focus on questioning strategies aligned with sociocultural principles. Thematic analysis was used to identify shifts in pedagogical practice based on Vygotsky's key constructs. Findings revealed a clear transformation in the teacher's approach—from direct instruction and limited learner participation to more interactive, reflective, and scaffolded questioning. Learners were increasingly engaged in peer dialogue, supported within their ZPD, and encouraged to articulate and justify their thinking. It is recommended that teacher development programs prioritize training in dialogic pedagogy and provide opportunities for collaborative lesson planning and reflective practice. Embedding sociocultural principles into both pre-service and in-service training can foster more effective, inclusive teaching strategies. This study highlights the potential of sociocultural-based interventions to promote deeper learner engagement and autonomy in mathematics classrooms. It reinforces the value of shifting towards learner-centered approaches that support collaborative sense-making and conceptual understanding.

Keywords: mathematics teaching, sociocultural pedagogy, teacher questioning, Vygotsky's framework

INTRODUCTION

Effective teaching in mathematics hinges on more than the transmission of content; it involves fostering learner engagement, encouraging reasoning, and enabling collaborative knowledge construction. However, despite ongoing curriculum reforms advocating for learner-centered instruction, many mathematics classrooms continue to be dominated by teacher-led approaches (Denton, 2021; Stafford, 2023). In such environments, questioning is often reduced to eliciting brief factual responses rather than promoting conceptual understanding or dialogue. This limits opportunities for learners to articulate their thinking, challenge ideas, and co-construct knowledge through interaction with peers and teachers (Chen & Chan, 2022; Zwiers, 2022).

Vygotsky's Sociocultural Theory provides a compelling framework for rethinking these pedagogical practices. According to Vygotsky (1978), learning is a socially mediated process that occurs through interaction with more knowledgeable others within the learner's Zone of Proximal Development (ZPD). Within this framework, scaffolding, mediation, and social interaction are central to cognitive development. Effective questioning plays a vital role in activating the ZPD by prompting learners to reflect, explain, and engage with new ideas (Yildirim & Uzun, 2021). When teachers use open-ended, dialogic questioning techniques, they support learners in constructing deeper mathematical understanding and encourage meaningful collaboration (Khoza & Msimanga, 2022).

Despite policy and theoretical support for dialogic teaching, many mathematics teachers continue to rely on authoritative questioning strategies that limit learner autonomy and peer interaction (Krist, 2024). This creates a disjuncture between recommended practices and what happens in everyday classrooms. Without targeted support, teachers may find it challenging to transform their questioning techniques in ways that foster reasoning, scaffolding, and collaborative learning.

This study investigates the impact of a professional development intervention on teacher questioning strategies in a Grade 10 mathematics classroom. Specifically, it examines how the teacher's practices evolved before and after the intervention, and how these changes supported learner autonomy, reasoning, and social interaction, using Vygotsky's constructs as an analytical lens.

The study is significant in demonstrating how sociocultural theory can inform practical classroom strategies. It contributes to the discourse on mathematics pedagogy and provides insights for designing professional development that promotes learner-centered teaching and dialogic engagement. The paper proceeds with a review of relevant literature, followed by the research methodology, findings and discussion, and concludes with recommendations and implications for classroom practice and teacher education.

Theoretical Framework

This study is anchored in Vygotsky's Sociocultural Theory of learning, which emphasizes that cognitive development is fundamentally a social process mediated by language, tools, and interaction with more knowledgeable others (Vygotsky, 1978). Unlike individualistic or behaviorist models of learning, the sociocultural perspective asserts that learning does not occur in isolation but through meaningful engagement with others in culturally and historically situated contexts (Azadi, 2024). Within this framework, three interrelated constructs—Zone of Proximal Development (ZPD), scaffolding, and mediation—are especially pertinent to understanding the role of teacher questioning in the mathematics classroom.

The Zone of Proximal Development (ZPD) is defined as the distance between what a learner can achieve independently and what they can accomplish with appropriate guidance and support (Vygotsky, 1978). In a mathematics context, the ZPD highlights the importance of instructional interactions that extend learners' thinking beyond their current capabilities. When teachers pose well-sequenced and thought-provoking questions, they create opportunities for learners to access concepts within their ZPD, thereby promoting conceptual growth (Twiner et al., 2021).

Closely linked to the ZPD is the concept of scaffolding, which refers to the temporary and adaptive support provided by teachers or peers to assist learners in mastering tasks they cannot yet perform unaided (Puntambekar, 2022). Scaffolding can take various forms, including guided questioning, prompts, modelling, and feedback, and it must be adjusted to match the learner's evolving competence. In this study, teacher questioning is viewed as a central scaffolding tool that helps learners navigate mathematical problem-solving processes by encouraging reflection, justification, and multiple solution strategies.

Mediation, another foundational aspect of Vygotsky's theory, involves the use of cultural tools—particularly language—as a means through which learning and higher-order thinking are facilitated (Salinas, 2022). Teachers act as mediators when they strategically use questions and discourse to shape learners' understanding and promote internalization of mathematical concepts. Through sustained interaction and dialogic engagement, learners are not merely recipients of knowledge but active participants in co-constructing meaning.

Underlying all three constructs is the principle that social interaction is the primary mechanism through which learning occurs. In dialogic mathematics classrooms, learners engage in collaborative discourse that allows them to articulate, defend, and refine their ideas. Such interactions enable learners to appropriate new ways of thinking and reasoning, fostering deeper understanding and cognitive development (Heron et al., 2023). Therefore, teacher questioning serves not only as a means of assessment but as a critical pedagogical strategy for mediating learning and encouraging active learner participation.

In this study, Vygotsky's Sociocultural Theory offers a robust lens through which to examine the shift in questioning practices before and after a pedagogical intervention. It provides the conceptual grounding for analyzing how scaffolding, mediation, and ZPD are operationalized through teacher-student interactions and how these interactions support learner autonomy and engagement in the mathematics classroom.

LITERATURE REVIEW

Teacher Questioning in Mathematics Education

Teacher questioning plays a central role in shaping classroom discourse and facilitating mathematical understanding. It serves as a primary tool for guiding learners' attention, assessing understanding, and promoting critical thinking. However, research has consistently shown that in many mathematics classrooms, questioning is often limited to lower-order, recall-based questions that do not engage learners in meaningful reasoning (Kater, 2024). Such questioning tends to maintain teacher authority and results in closed interactions, thereby constraining opportunities for learners to explore concepts collaboratively or articulate their thinking (Alhayyan, 2023).

Effective questioning, in contrast, involves open-ended, higher-order questions that invite explanation, justification, and the consideration of alternative perspectives (Yildizli & Günaydin, 2022). When teachers employ follow-up prompts and probing questions, learners are more likely to engage in elaborated responses and develop metacognitive awareness (DeJarnette & Hord, 2022). Therefore, transforming questioning practices is seen as key to enhancing student participation and conceptual understanding in mathematics.

Dialogic Teaching and Classroom Interaction

Dialogic teaching refers to a pedagogical approach that promotes dialogue between teachers and learners, encouraging reciprocal communication rather than unidirectional transmission of knowledge (Chmarkh, 2021). Central to dialogic teaching is

the idea that learning occurs through structured talk, where teachers and learners jointly construct meaning through questions, elaborations, clarifications, and counterarguments (Shongwe, 2021).

In mathematics classrooms, dialogic interactions allow learners to verbalize and reflect on their reasoning, which helps in developing a deeper conceptual understanding (Bishop et al., 2022). However, implementing dialogic teaching remains a challenge, as many teachers are unfamiliar with questioning techniques that facilitate such interactions. Professional development programs that focus on dialogic strategies have shown promise in shifting classroom discourse toward more participatory and inquiry-based learning (Shongwe, 2021).

Vygotsky's Sociocultural Theory and Mathematics Teaching

Vygotsky's Sociocultural Theory emphasizes that learning is fundamentally a social process, mediated by tools, language, and interaction with more knowledgeable others (Vygotsky, 1978). Within this framework, the Zone of Proximal Development (ZPD) is a critical concept, defined as the gap between what a learner can do independently and what they can achieve with support. Effective teaching involves identifying learners' ZPD and providing appropriate scaffolding to bridge that gap (Rahman, 2024). In mathematics education, this translates into carefully crafted questions and prompts that guide learners from their current level of understanding to more advanced conceptualizations.

Puntambekar (2022) refers to Scaffolding as the support provided by the teacher or peers to help learners perform tasks, they cannot yet complete independently. Scaffolding can take the form of questioning, modelling, hints, or collaborative problem-solving, and it must be adjusted as learners gain competence. Rather than giving answers, effective scaffolding involves guiding learners to discover or construct understanding on their own (Rahman, 2024).

Mediation in Vygotskian theory involves the use of cultural tools—particularly language—as a means of transforming thought processes. Teachers serve as mediators when they help learners use language to make sense of mathematical ideas, communicate reasoning, and internalize strategies (Cunningham, 2023). As learners become more competent, this mediation can also come from peers, especially in settings that promote group work and shared tasks.

Finally, social interaction is the context in which learning is most effectively realized. When learners engage in dialogue, they co-construct knowledge by explaining, questioning, and refining each other's ideas (Hennessy, 2024). In mathematics classrooms, promoting peer discussion and collaborative problem-solving can enhance understanding and foster a sense of mathematical agency.

Implications for Teacher Development

While the theoretical value of sociocultural approaches to teaching is widely acknowledged, research highlights a persistent gap between theory and classroom practice. In their work Rashidi and Majdeddin (2023) found that teachers often lack the training or resources to implement questioning strategies that activate learners' ZPD and promote dialogic interaction. Reza Adel and Azari Noughabi (2023) argue that effective professional development should focus not only on content knowledge but also on pedagogical content knowledge—specifically, how to pose productive questions, scaffold learning, and mediate understanding in real-time classroom interactions.

Studies show that teacher reflection, collaborative lesson planning, and transcript analysis can help teachers become more aware of their discourse patterns and make intentional shifts toward dialogic and learner-centered teaching (Denton, 2021). Therefore, professional learning communities and coaching models that incorporate these elements are crucial for sustainable change in teaching practice.

METHODOLOGY

This study employs a qualitative case study approach to explore the impact of a pedagogical intervention on teacher questioning practices in a Grade 10 mathematics classroom. The focus is on how teacher questioning evolves to better support learner autonomy, collaboration, and engagement in mathematical reasoning, guided by Vygotsky's Sociocultural Theory. The study compares pre- and post-intervention lesson transcripts to assess changes in the utilization of Vygotsky's core concepts: The Zone of Proximal Development (ZPD), scaffolding, mediation, and social interaction.

Research Design

A single case study design was chosen to allow for an in-depth examination of the intervention's effects in one classroom setting. This approach enables a focused exploration of the teacher's instructional strategies and how they shift as a result of the professional development intervention. The case study method is particularly suited to understanding complex educational processes and capturing nuanced changes in teaching practice over time (Hetherington, 2013).

Participants

The study centers on one Grade 10 mathematics teacher at a secondary school. The teacher participated in a targeted professional development program, which aimed to enhance their questioning strategies and promote learner-centered dialogue. The classroom context, including the students' backgrounds, was considered, though the main focus was on the teacher's instructional shifts. The study does not aim to generalize the findings but rather to provide rich, contextual insights into how one teacher's questioning techniques evolve.

Data Collection

Data were collected through detailed observations of classroom lessons conducted before and after the intervention. These observations were supplemented by lesson transcripts, which were verbatim recordings of teacher-student interactions. The pre-intervention transcripts captured the teacher's questioning techniques and interactions with students before the professional development session. Similarly, the post-intervention transcripts provided data on how questioning strategies had evolved following professional development.

The professional development intervention, lasting for several weeks, focused on dialogic teaching practices and effective questioning techniques. The goal was to shift the teacher's questioning style from authoritative, teacher-centered interactions to a more interactive, learner-centered approach. The training included strategies for scaffolding student responses, encouraging peer collaboration, and fostering deep thinking through open-ended, follow-up questions.

Data Analysis

Thematic analysis was used to analyse the lesson transcripts, with a coding framework derived from Vygotsky's Sociocultural Theory. The four core constructs—ZPD, scaffolding, mediation, and social interaction—formed the basis of the coding scheme. Each transcript was carefully analysed to identify instances where these constructs were either present or absent in teacher-student interactions.

ZPD (Zone of Proximal Development)

The analysis focused on how the teacher's questioning facilitated the learners' movement from tasks they could perform independently to those that required guidance and support.

Scaffolding

Instances of the teacher providing temporary support, such as prompting, questioning, or offering hints, were identified and categorized to assess the level of scaffolding employed.

Mediation

The role of the teacher as a mediator, particularly in using language and tools to guide students' thinking, was analysed by examining how the teacher engaged with students to promote understanding.

Social interaction

The level of student collaboration and peer interaction was analysed, noting whether learners were encouraged to discuss ideas, collaborate, and construct knowledge together.

Each transcript was coded iteratively to ensure that all relevant interactions were captured. Codes were refined throughout the analysis process, with initial categories being adjusted as new themes emerged.

Ethical Considerations

Ethical approval for the study was obtained prior to data collection. Permission to conduct the research in the school was granted by the relevant Department of Basic Education structures, and informed consent was obtained from the school, the participating teacher, and learners (including parental consent where required). To ensure anonymity and confidentiality, all identifying information was removed from the lesson transcripts. The teacher and students were informed that participation was voluntary and that they could withdraw from the study at any time without consequence.

Limitations

While this study provides in-depth insights into a single classroom, it is limited by its small sample size. The findings may not be generalizable to other classrooms or educational contexts. However, the study offers valuable implications for professional development programs and teaching practices in mathematics classrooms.

FINDINGS

Analysis of the Transcript Using Vygotsky's Sociocultural Theory

Vygotsky's Sociocultural Theory emphasizes that learning occurs through social interaction, scaffolding, and mediation within the Zone of Proximal Development (ZPD). This analysis examines pre- and post-intervention lessons through the lens of Vygotsky's key concepts.

Pre-Intervention Analysis

Before the intervention, teacher questioning was largely authoritative, with minimal scaffolding, learner autonomy, or social interaction.

Zone of proximal development (ZPD) - Weakly utilized

Before the intervention, the teacher's approach to the Zone of Proximal Development (ZPD) was weakly utilized as seen in the following example the teacher posed questions in reference to two parallel lines shown in **Figure 1**.



Figure 1. Parallel lines without transversal line (Source: Field study)

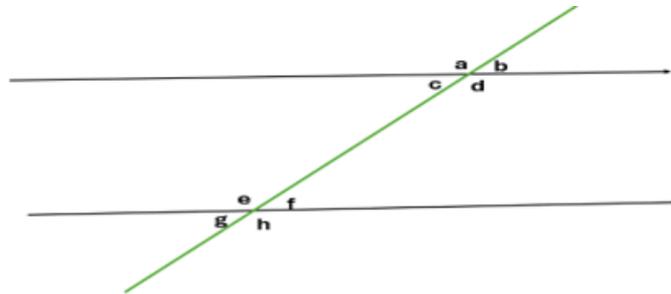


Figure 2. Parallel lines with transversal lines (Source: Field study)

Tr: Relate to what you did before. Are there any angles there on the diagram?

Ls: Yes, No. (some agree, some disagree).

Tr: You don't just say yes, or no. Give a reason for your yes or no.

L: I say yes, angle is there on a straight line.

This exchange highlights that the teacher's approach did not effectively facilitate learners' engagement within their Zone of Proximal Development (ZPD). Instead of prompting students to explore the content further, the teacher's questioning remained authoritative and focused on recall, limiting opportunities for independent thinking and deeper exploration. It is evident that learners faced challenges in engaging independently with the content. The teacher did not effectively bridge the gap between known and new material, instead opting to move forward with explanations without facilitating deeper exploration. Peer collaboration was absent, as responses were individual and remained teacher centered. The teacher's questioning primarily focused on assessing recall rather than extending learners' understanding. For example, when the teacher asked students to relate a diagram to prior learning, the responses were fragmented and lacked depth. Instead of guiding the learners through a process of exploration, the teacher provided direct answers, missing an opportunity to prompt further thinking and engage students in a more interactive and reflective learning experience.

Scaffolding – Minimal

Before the intervention, the teacher's approach to scaffolding was minimal, as seen in the following example in relation to **Figure 2**.

Tr: Corresponding angles are also called F-angles. Do you know the reason why?

L: (Silence).

Tr: It is because the lines forming corresponding angles produce the shape of letter F.2

It is clear that the teacher did not effectively scaffold the learning process, opting instead to provide direct answers when students struggled. This approach led to missed opportunities for deeper engagement, as the teacher dominated the discussion rather than guiding students through leading questions. Scaffolding, a crucial aspect of effective teaching, was virtually absent. For instance, when learners were unable to respond, the teacher immediately supplied the information, such as explaining that corresponding angles form an "F," without encouraging students to explore the concept either visually or cognitively. This lack of scaffolding limited the students' ability to actively construct their understanding and instead positioned them as passive recipients of information.

Mediation – Teacher-driven

Before the intervention, mediation in the classroom was largely teacher-driven, as illustrated in the following example where co-interior angles x and 40 were discussed.

Tr: If the angles are added, do they give 180 degrees?

L: (Silence).

Tr: Yes. Angle x and angle 40 are co-interior angles.

In this exchange, there is little to no peer mediation. The teacher quickly supplies the answer rather than allowing learners the opportunity to co-construct knowledge. This dynamic leads to learners being passive recipients, not actively engaged in mathematical reasoning. The learning process was largely teacher-driven, with the teacher taking on a central role in providing

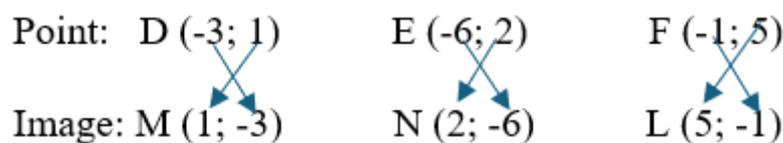


Figure 3. Learner demonstrates the “cross multiplication” on the board (Source: Field study)

explanations. When learners hesitated or struggled, the teacher immediately filled the silence with direct answers, missing valuable opportunities for student reasoning or peer contributions. By not allowing for peer mediation, the teacher limited the potential for collaborative problem-solving, which could have deepened learners’ understanding. This lack of interaction and active engagement further reinforced a teacher-centered environment rather than fostering a space where students could actively negotiate meaning and co-construct their knowledge.

Social Interaction – Limited

Before the intervention, social interaction in the classroom was limited, as demonstrated in the following example:

Tr: Do you agree with the answer given?

Ls: Yes.

In this instance, learners respond in unison, showing limited individual engagement. The lesson remains highly teacher-centered, with few opportunities for meaningful discussion. The interaction was restricted to brief choral responses, with little opportunity for learners to express their own thoughts or engage in critical dialogue. There was little evidence of learner-learner discourse or collective problem-solving, which are crucial for fostering collaborative learning. The teacher’s questioning did not encourage peer-to-peer exchange or deeper exploration of ideas. Instead, the focus remained on the teacher’s validation of responses, rather than promoting student-driven discussion. This lack of meaningful social interaction limited the opportunity for learners to develop their understanding through collaborative engagement, hindering the potential for more dynamic and interactive learning experiences.

Post-Intervention Analysis

After the intervention, teacher questioning became more interactive, learner-centered, and scaffolded, aligning more closely with Vygotsky’s principles.

Zone of proximal development (ZPD) – Actively utilized

After the intervention, the teacher made a concerted effort to actively utilize the Zone of Proximal Development (ZPD), as seen in the following example involving the results obtained when reflecting a point along the y-axis.

Tr: What is the relationship between a point and its image?

L: x-value comes negative, same y.

Tr: Let’s check again. Are we sure about this for all points?

In this exchange, the teacher guides learners through discovery instead of providing direct answers. The teacher’s questioning prompts learners to reflect on their initial responses and evaluate the validity of their understanding across multiple data points. By doing so, the teacher fosters an environment where learners operate within their ZPD, with both the teacher and peers offering supportive questioning. Post-intervention, learners engage more deeply with the content, as they are encouraged to think critically and collaboratively. The teacher’s prompts, which guide learners through a process of exploration and reasoning, allow them to stretch their cognitive abilities within their ZPD. This approach not only encourages independent thinking but also supports learners in constructing knowledge through guided inquiry and collaborative dialogue.

Scaffolding – Stronger and more effective

After the intervention, scaffolding was notably stronger and more effective, as demonstrated in the following example:

Tr: How did you get that?

L: The coordinates cross each other.

Tr: What do you mean by ‘cross each other’?

L: Like cross multiplication.

Tr: Come forward and explain it to us using points on the board (**Figure 3**).

In this exchange, the teacher fosters self-explanation by prompting the learner to articulate their reasoning. The teacher’s questions encourage deeper reflection, allowing the student to clarify their thought process. This interactive approach to scaffolding ensures that the learner is not simply receiving answers but instead is actively engaging in a process of reasoning and reflection. Instead of providing direct answers, the teacher prompts the learner to explain further, thereby creating opportunities for metacognitive engagement. By inviting the learner to come to the board and explain their reasoning, the teacher provides a space for self-explanation, which is a hallmark of effective scaffolding. This approach supports the development of independent problem-solving skills, as learners are encouraged to think through their understanding and share it with others, reinforcing both their own learning and that of their peers.

Mediation – More learner-led

After the intervention, mediation became more learner-led, as illustrated in the following example:

Tr: Anyone with a different answer?

L: (Learner explains a different method).

Tr: That's interesting! Can someone else add to this explanation?

In this exchange, learners mediate each other's understanding, signalling a shift from teacher-driven instruction to a more collaborative learning environment. The teacher fosters an atmosphere where multiple solutions and viewpoints are encouraged, allowing learners to explore different methods and reasoning. By prompting learners to share alternative solutions, the teacher promotes peer-to-peer interaction and encourages a collective approach to problem-solving. This transition from a teacher-centered approach, where knowledge is directly transmitted, to a more learner-led model highlights the increased focus on dialogue and collaborative learning. The teacher's role shifted from that of a knowledge dispenser to a facilitator, supporting the co-construction of knowledge through guided discussions. This change in mediation reflects a key shift in pedagogical practice, where learners are given more responsibility for their own learning, while still receiving support from their peers and teacher.

Social interaction – Peer collaboration encouraged

After the intervention, peer collaboration was significantly encouraged, as seen in the following example:

Tr: Discuss with your partner—what happens to x and y values when reflected along the y -axis?

Ls: (Learners discuss before responding).

L: x becomes negative, but y stays the same.

In this instance, pair and group work emerged as a prominent feature of the classroom. Learners worked together to discuss the concept, which allowed for collaborative problem-solving and deeper understanding. This shift towards collaboration marked a reduction in choral responses, as learners engaged in more individual and collective interactions. The transition from teacher-centered questioning to peer-driven dialogue encouraged learners to take ownership of their learning while supporting each other's understanding. As learners discussed the concepts with their peers before responding, they had the opportunity to reflect on their reasoning and receive feedback, fostering a more interactive and reflective learning environment. This shift not only increased individual accountability but also facilitated the development of a more nuanced and in-depth understanding of the content. The table below shows a summary of the changes in teaching practices based on Vygotsky's Sociocultural Theory, comparing pre- and post-intervention lessons. It highlights the shifts in the utilization of the Zone of Proximal Development (ZPD), scaffolding, mediation, and social interaction, reflecting the transformation in teacher questioning and classroom dynamics following the intervention.

DISCUSSION

This study analysed the shifts in teaching practices in a Grade 10 mathematics classroom before and after an intervention, using Vygotsky's Sociocultural Theory as the analytical framework. The key concepts of Vygotsky's theory—Zone of Proximal Development (ZPD), scaffolding, mediation, and social interaction—were employed to explore how teacher questioning, and classroom dynamics evolved throughout the intervention. The findings indicate that post-intervention, teaching practices became more learner-centered, emphasizing active engagement, peer collaboration, and guided discovery.

Zone of Proximal Development (ZPD) – A Shift Toward Active Engagement

Before the intervention, the teacher's use of the Zone of Proximal Development (ZPD) was minimal. The teacher's questioning was largely directive, offering direct answers rather than scaffolding students' thinking. This limited the learners' ability to engage with content independently, and the responses remained superficial, highlighting the lack of exploration within their ZPD. However, after the intervention, the teacher actively utilized the ZPD by posing exploratory questions that prompted learners to critically evaluate their understanding. For example, the teacher's prompt, "Let's check again. Are we sure about this for all points?" encouraged learners to reflect on their answers and assess the validity of their understanding across multiple data points. This approach shifted the teacher's role from providing answers to fostering an environment where learners actively participated in the discovery process. Learners were guided through their ZPD, with both the teacher and peers offering supportive questioning that enhanced cognitive engagement and deeper learning (McLeod, 2024; Vygotsky, 1978; Wood et al., 1976).

Scaffolding – A More Interactive and Effective Approach

The pre-intervention analysis revealed that scaffolding was minimal, as the teacher tended to provide direct answers when students struggled. This approach bypassed opportunities for cognitive engagement and limited learners' ability to construct knowledge independently. The lack of scaffolding also meant that learners remained passive recipients of information, rather than active participants in their own learning process (Mamun, 2022). Post-intervention, the teacher's scaffolding approach became significantly more interactive. Instead of offering direct answers, the teacher prompted learners to explain their reasoning and reflect on their thought processes. The example where the teacher asked a student to explain their method at the board demonstrated a stronger approach to scaffolding. This allowed learners to engage in metacognitive activities, articulating their reasoning and constructing their understanding more effectively. By inviting the learner to come to the board and explain their reasoning, the teacher provided a space for self-explanation, which is a hallmark of effective scaffolding (Wood et al., 1976). This

approach supports the development of independent problem-solving skills, as learners are encouraged to think through their understanding and share it with others, reinforcing both their own learning and that of their peers (Rogoff, 1990).

Mediation – From Teacher-Driven to Learner-Led

Before the intervention, the mediation in the classroom was predominantly teacher-driven. The teacher frequently supplied answers when learners hesitated, thereby limiting the potential for peer mediation and collaborative problem-solving. This type of teacher-dominant interaction restricted the learners' opportunity to engage in peer-to-peer dialogue, which is central to Vygotsky's theory of cognitive development. After the intervention, mediation became more learner led. The teacher shifted from being the sole knowledge dispenser to a facilitator of discussions (Mansour, 2024). In the post-intervention example, when a learner offered a different answer, the teacher encouraged peers to add to the explanation, fostering collaborative dialogue. This transition allowed students to share alternative methods and viewpoints and encouraged collective problem-solving. By shifting the focus from teacher-centered instruction to peer-driven learning, the teacher created a more dynamic, interactive classroom environment that promoted co-construction of knowledge. Learners became active participants in the learning process, contributing to each other's understanding (Mercer, 2000; Vygotsky, 1978).

Social Interaction – Encouraging Peer Collaboration

Social interaction in the classroom was minimal before the intervention, as learners responded in unison to the teacher's questions, limiting opportunities for peer-to-peer engagement. There was little collaborative discussion, and the teacher-maintained control of the discourse, which inhibited the development of critical thinking and collective problem-solving skills (Fielding & Makar, 2022). However, after the intervention, peer collaboration was significantly encouraged. In one instance, the teacher prompted learners to discuss a concept with their partner before providing a response. This shift from choral responses to collaborative discussion not only increased individual accountability but also allowed learners to engage more deeply with the material. Learners were encouraged to reflect on their reasoning, exchange ideas with their peers, and provide feedback to one another, thereby enriching their understanding. This shift in social interaction fostered a more dynamic learning environment where learners took ownership of their learning and actively contributed to the collective construction of knowledge. These findings align with Vygotsky's notion that social interaction plays a pivotal role in cognitive development (Mercer & Littleton, 2007; Vygotsky, 1978).

The analysis of the pre- and post-intervention lessons through Vygotsky's Sociocultural Theory reveals significant shifts in the classroom dynamics. Before the intervention, teacher questioning was primarily authoritative, with minimal scaffolding, limited peer collaboration, and little engagement with the ZPD. Post-intervention, however, teaching practices became more learner-centered, with a strong emphasis on scaffolding, peer mediation, and social interaction. These changes align with Vygotsky's principles, highlighting the importance of social interaction, guided discovery, and collaborative learning in fostering deeper understanding. The intervention proved effective in shifting the classroom environment toward a more interactive, collaborative, and student-centered approach, which not only enhanced learners' understanding but also encouraged the development of critical thinking and problem-solving skills.

CONCLUSION

This study explored the transformation in teaching practices following an intervention that incorporated Vygotsky's Sociocultural Theory, specifically focusing on the concepts of the Zone of Proximal Development (ZPD), scaffolding, mediation, and social interaction. The findings indicate that post-intervention, the classroom environment shifted from a teacher-centered model to one that emphasized active learner participation, peer collaboration, and guided discovery. The teacher's role transitioned from being a knowledge dispenser to a facilitator who encouraged learners to engage in critical thinking and problem-solving through scaffolding, peer mediation, and social interaction. These changes aligned with Vygotsky's theoretical framework, which emphasizes the importance of social interaction and guided learning in fostering deeper cognitive development.

Before the intervention, the teacher's approach to questioning was largely authoritative, with minimal opportunities for learners to engage in independent thought or peer collaboration. However, post-intervention, learners were encouraged to co-construct knowledge through dialogue, critical reflection, and peer-mediated problem-solving. The increased focus on the ZPD allowed learners to explore their understanding within a supportive framework, which contributed to deeper engagement with the content and enhanced cognitive development. This study demonstrates that adopting a more learner-centered approach, as guided by Vygotsky's principles, can lead to a more interactive, collaborative, and cognitively enriching classroom environment.

RECOMMENDATIONS

Based on the findings of this study, it is recommended that educators incorporate more learner-centered practices into their teaching, drawing from Vygotsky's Sociocultural Theory. Teachers should aim to foster an environment where learners are actively involved in constructing knowledge, particularly through peer-mediated activities and collaborative problem-solving. The use of questioning should be more exploratory, encouraging learners to reflect on their reasoning and evaluate their understanding. Scaffolding should move beyond direct answers to guiding learners through the process of discovery, allowing them to develop problem-solving skills and independent thinking. Additionally, fostering social interaction among learners through pair and group

work can enhance collaborative learning and deepen understanding, allowing students to negotiate meaning and share diverse perspectives.

Furthermore, professional development programs for teachers should focus on equipping educators with strategies to effectively implement Vygotsky's concepts in the classroom. Teachers should be trained in using scaffolding techniques that promote metacognitive engagement and encourage peer mediation. This will enable them to shift from a teacher-driven approach to one that values and nurtures learner autonomy and collaborative learning.

IMPLICATIONS

The findings of this study have several implications for teaching practices and educational policy. First, the shift from teacher-centered to learner-centered practices aligns with current trends in education that emphasize the importance of student engagement, critical thinking, and collaborative learning. By adopting a more interactive teaching approach that emphasizes peer collaboration and social interaction, educators can support the development of higher-order thinking skills in students. This shift also aligns with the increasing recognition of the importance of social and emotional learning, as collaborative environments foster communication, teamwork, and problem-solving skills.

On a broader scale, the implications of this study suggest that educational systems should move towards more flexible and dynamic teaching methods that allow for individualized learning within a collaborative context. By emphasizing the Zone of Proximal Development and scaffolding, students can be better supported in reaching their full cognitive potential. The study also suggests that educational practices should be continually evaluated and refined, particularly in relation to how teaching strategies facilitate deeper cognitive engagement and peer collaboration.

Finally, the shift to a more learner-centered classroom has implications for assessment practices. As students engage more deeply in collaborative problem-solving and co-construction of knowledge, assessment strategies should also evolve to capture not only individual achievement but also collaborative efforts and the development of critical thinking skills. This may involve incorporating more formative assessments that focus on student reasoning and peer interactions, allowing for a more holistic view of student progress and learning.

In conclusion, this study provides valuable insights into how adopting Vygotsky's Sociocultural Theory can enhance teaching practices by promoting active learner engagement, collaboration, and critical thinking. The implications and recommendations put forth are crucial for fostering an educational environment that supports the cognitive and social development of students, ultimately contributing to more effective learning experiences.

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