

Students' Numeracy Activities in Group Discussions: A Positioning Theory Perspective

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Abstract

Unequal participation in mathematics group discussions often restricts students' opportunities to engage in meaningful numeracy practices and develop conceptual understanding collaboratively. While previous studies have widely examined cooperative learning and classroom interaction, limited research has investigated numeracy activities through the lens of positioning theory. This study aimed to describe fifth-grade students' numeracy activities in group discussions based on their positioning as experts, facilitators, and novices. A qualitative descriptive approach was employed involving 25 fifth-grade students from a public elementary school in Malang, Indonesia. Data were collected through numeracy tests, classroom observations, and semi-structured interviews to explore students' interaction patterns and participation during mathematical discussions. The findings revealed that expert-positioned students tended to dominate calculation procedures, strategy selection, and answer validation, which often reduced opportunities for novice students to actively construct understanding. However, groups characterized by active facilitator roles demonstrated more balanced interaction patterns, as novice students were encouraged to explain reasoning, ask questions, and contribute ideas during discussions. These interaction dynamics created more inclusive learning environments and supported meaningful numeracy engagement among group members. The study highlights the importance of teachers designing structured collaborative discussions that distribute participation more equitably and encourage dialogic interaction to strengthen students' numeracy learning experiences.

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Introduction

Numeracy is a fundamental competence that enables students to understand, use, and interpret quantitative information in various contexts of daily life. Numeracy is not limited to arithmetic skills, but also includes the ability to use mathematical concepts, interpret data, choose problem-solving strategies, and communicate mathematical reasoning appropriately. Geiger et al. (2015) defined numeracy as the ability to respond critically and reflectively to mathematical demands in personal and social contexts, while OECD (2023) emphasized mathematical literacy as the capacity to formulate, use, and interpret mathematics in various situations. Despite its importance, many students still experience difficulties in participating actively in mathematics learning, particularly during collaborative classroom discussions.

The importance of numeracy has become increasingly significant in 21st-century learning because students are expected to think critically, solve problems, collaborate, and make decisions based on information. Numeracy learning therefore should not only focus on procedural calculation, but also on reasoning, representation, communication, and reflection. In elementary school classrooms, however, mathematics learning is often still dominated by answer-oriented activities in which only a few students actively contribute to discussion processes, while others remain passive participants.

This challenge is reflected in international assessment results. OECD (2023) reported that students' mathematics performance in PISA 2022 declined in several countries, particularly in reasoning, problem solving, and the application of mathematical concepts in real-life contexts. These findings indicate the need for classroom learning that provides broader opportunities for students to explain ideas, justify answers, and participate actively in mathematical thinking processes. Mahmud and Drus (2023) emphasized that reasoning skills should be developed from primary school because they support students in solving mathematical problems meaningfully.

At the primary school level, numeracy learning requires students to use symbols and numbers, interpret visual information, and communicate problem-solving strategies both orally and in writing. Students are increasingly expected to understand mathematical relationships presented in tables, diagrams, and other visual representations. Duval (2006) explained that mathematical understanding is closely related to the ability to coordinate multiple representations, while Ainsworth (2006) argued that external representations support learning when students are able to connect their meanings and functions. Similarly, Arcavi (2003) emphasized that visual representations play an important role in helping students construct mathematical understanding. Therefore, numeracy activities need to be understood not merely as calculation performance, but also as processes of reasoning, interpreting information, and constructing mathematical meaning through various forms of representation.

In collaborative numeracy activities, visual representations may also influence students' participation during classroom interaction. Tasks involving diagrams, tables, or geometric representations can create different levels of cognitive demand for students. Students who are more capable of interpreting visual representations may gain greater authority during discussions, while students who experience difficulties may become passive participants.

Consequently, numeracy participation is shaped not only by mathematical ability but also by how students interact with mathematical media and representations during collaborative learning.

In classroom discussions, however, students do not always participate equally in numeracy activities. Some students tend to dominate problem solving and answer validation because they are perceived as more capable, while other students become passive, hesitate to speak, or simply follow group decisions. These differences indicate that numeracy learning is influenced not only by individual ability but also by patterns of classroom interaction. Howe and Abedin (2013) showed that students' participation in classroom dialogue is strongly affected by communication structures and opportunities to contribute ideas. Similarly, Mercer et al. (2004) emphasized that classroom conversation can function as a tool for developing shared reasoning when students are encouraged to explain, question, and evaluate ideas collaboratively.

One learning strategy that can support students' numeracy development is group discussion. Through collaborative discussion, students have opportunities to exchange strategies, explain reasoning, evaluate answers, and build shared understanding. Nevertheless, group discussions do not always produce balanced participation. In some groups, certain students become dominant in directing solutions, whereas others contribute minimally. This condition suggests that mathematics discussions should be examined not only in terms of final answers but also in terms of how students gain access to mathematical ideas and participate in problem-solving processes.

Several previous studies have examined mathematics discussions using perspectives such as social constructivism, classroom dialogue, and commognitive approaches. These studies mainly focused on shared meaning-making, discourse patterns, and collaborative reasoning processes. However, these perspectives provide limited explanation regarding how students gain, negotiate, or lose authority during interaction, particularly in numeracy activities involving visual representations and collaborative problem solving. Positioning theory offers a more specific lens because it explains how students occupy and negotiate social positions that shape their rights and responsibilities during interaction. Campbell and Hodges (2020) explained that positioning theory can reveal how students gain authority to explain, question, and validate mathematical ideas in group work.

Previous studies have discussed cooperative learning, classroom dialogue, and positioning in mathematics discussions. However, limited studies have specifically examined how elementary students' numeracy activities emerge through expert, facilitator, and novice positioning during group discussions, particularly in relation to students' interaction with mathematical representations and visual media. In fact, numeracy activities involve specific processes such as using symbols and numbers, interpreting visual representations, and making mathematical predictions or conclusions. Therefore, this study aims to describe fifth-grade students' numeracy activities in group discussions viewed from their positioning as experts, facilitators, and novices. This study is expected to contribute theoretically by extending the application of positioning theory in elementary numeracy research and practically by providing

insights for teachers in designing more equitable, representation-based, and participatory mathematics discussions.

Method

This study employed a qualitative descriptive approach to explore fifth-grade students' numeracy activities during group discussions based on their positioning as experts, facilitators, and novices. The study involved 25 fifth-grade students from a public elementary school in Malang, Indonesia, who were divided into five heterogeneous discussion groups formed by the classroom teacher based on academic achievement and classroom participation to ensure variation in mathematical ability and interaction patterns. Prior to the main study, two preliminary classroom observations were conducted to identify students' tendencies in explaining mathematical ideas, solving problems, responding to peers, and managing discussion flow. Three groups demonstrating the clearest variation in interaction patterns and role distribution were selected for in-depth analysis. The numeracy tasks focused on interpreting tables, diagrams, and geometric representations related to triangle concepts and angle measurements to encourage students to use symbols and numbers, interpret visual information, explain mathematical reasoning, and collaboratively determine conclusions. Data were collected through numeracy tests, classroom observations, and semi-structured interviews conducted over four meetings within one month. Classroom discussions were audio-recorded and supported by field notes to capture students' verbal interactions, participation patterns, and responses to mathematical representations. Semi-structured interviews were conducted with selected students to clarify their reasoning processes and experiences during group discussions. Students' positioning was categorized into three operational roles: expert, facilitator, and novice, identified through repeated interaction patterns observed across the four meetings. Expert students frequently explained solution strategies, validated answers, and dominated mathematical decision-making; facilitators encouraged peer participation and managed discussion flow; while novices rarely initiated ideas and contributed minimally to mathematical explanations. Data were analyzed using thematic analysis following Braun and Clarke, including coding, categorization, data display, and conclusion drawing. The analysis focused on three numeracy indicators: using symbols and numbers, interpreting visual representations, and making mathematical interpretations and predictions. Trustworthiness was ensured through methodological triangulation and peer debriefing with another mathematics education researcher. Ethical procedures included obtaining consent from students, parents, and the school, while participant anonymity was maintained through the use of pseudonyms in all research records and reports.

Results and Discussion

Results

The results showed that students' numeracy activities differed according to their positioning during group discussions. Across the three observed groups, different interaction patterns emerged in relation to the use of symbols and numbers, interpretation of visual

representations, and mathematical reasoning. Group 1 and Group 3 demonstrated expert-dominant interaction patterns, whereas Group 2 showed more balanced participation due to the active role of the facilitator.

Table 1. Dominant Positioning and Participation Patterns

Group	Dominant Positioning	Characteristics of Numeracy Participation
Group 1	Expert-dominant	Expert students controlled calculations and answer validation, while novice students contributed minimally
Group 2	Facilitator-supported collaborative interaction	Facilitator encouraged all members to explain ideas and validate answers together
Group 3	Expert-dominant	Expert students dominated interpretation of diagrams and mathematical conclusions

All groups were generally able to calculate angle measures correctly and determine whether figures could be classified as triangles. However, the participation patterns differed substantially across groups.

In Group 1 and Group 3, expert students dominated procedural calculations and solution strategies. Novice students tended to follow answers without actively contributing explanations or alternative reasoning. During one discussion in Group 1, the expert student immediately determined the angle value and validated the answer before other members responded.

Expert student: "The total angle is 180° , so this angle must be 70° ."

Novice student: "Yes, I just follow that answer."

This interaction illustrates how expert students occupied stronger authority positions in mathematical decision-making, while novice students relied on the expert's reasoning without independently explaining their understanding.

In contrast, Group 2 demonstrated more balanced participation. The facilitator encouraged novice students to contribute to calculations and explain reasoning before the group agreed on the final answer.

Facilitator : "What do you think, Rina? Can you explain how you got the answer?"

Novice student: "Because the two angles are the same, we subtract them from 180° first."

Facilitator : "Okay, let's check together if the calculation is correct."

This interaction indicates that the facilitator created opportunities for novice students to participate actively in mathematical reasoning rather than simply accepting answers from expert students.

Differences among groups were also visible in visual data analysis activities. Students generally found it easier to interpret information presented in tables than in diagrams or geometric representations. Tasks involving diagrams required students to coordinate angle

relationships and identify triangle characteristics simultaneously, creating greater difficulty for several students.

Group 2 showed more collaborative interpretation of visual information because students discussed triangle classifications together and responded to one another's explanations. Students negotiated meaning collectively before deciding on conclusions.

Facilitator : "Look at the diagram carefully. Which angle shows that this is an obtuse triangle?"

Student : "This one is more than 90° ."

Facilitator : "So, can we still call it an acute triangle?"

Students : "No."

The dialogue demonstrates how the facilitator supported students in connecting visual representations with mathematical concepts through questioning and collaborative reasoning.

In contrast, Group 3 experienced difficulties in interpreting diagrams accurately. Expert students often interpreted the visual information independently without involving novice students in the reasoning process.

Expert student: "This diagram is confusing, but the answer should be this."

Novice student: "I don't really understand the picture."

This finding suggests that difficulties in interpreting visual representations may strengthen expert dominance because students who better understand diagrams tend to gain greater authority during discussion.

In the indicator of interpretation and prediction, expert students in Group 1 and Group 3 again played dominant roles in predicting angle measures and determining conclusions. Facilitators in these groups mainly maintained discussion continuity but did not significantly encourage novice participation.

Meanwhile, Group 2 demonstrated more balanced interpretation activities because the facilitator actively invited novice students to explain reasoning and confirm answers collectively. This interaction allowed more students to participate in mathematical decision-making processes.

For example, during one activity involving prediction of unknown angles, the facilitator encouraged students to justify their reasoning before agreeing on a conclusion.

Facilitator : "Why do you think the angle is 110° ?"

Student : "Because the other angle is 70° , and together they make 180° ."

Facilitator : "Does everyone agree with that explanation?"

Other students: "Yes."

This interaction shows that mathematical conclusions in Group 2 were constructed collaboratively rather than dominated by a single student.

Overall, the findings indicate that all groups were able to complete most numeracy tasks accurately, particularly in procedural calculations. However, the quality of participation differed

across groups. Group 2 demonstrated the most balanced numeracy activities because expert, facilitator, and novice students all contributed to using symbols, interpreting visual information, and validating conclusions collaboratively.

In contrast, Group 1 and Group 3 showed expert-dominant interaction patterns in which numeracy activities were concentrated mainly on high-achieving students. Although these groups achieved correct answers, novice students participated minimally in reasoning and interpretation processes. These findings suggest that students' positioning during group discussions influences not only participation patterns but also the quality of numeracy engagement and access to mathematical reasoning among group members.

Discussion

The findings of this study indicate that students' numeracy activities in group discussions are closely related to their social positioning during classroom interaction. Students positioned as experts tended to dominate the process of selecting strategies, performing calculations, interpreting diagrams, and validating answers. This finding supports the view that positioning in mathematics discussions influences students' access to mathematical reasoning and participation in decision-making processes. Campbell and Hodges (2020) explained that students who occupy dominant positions in collaborative discussions generally gain greater authority in explaining and validating mathematical ideas. Similarly, Drageset and Ell (2024) emphasized that classroom interaction shapes students' rights and responsibilities in contributing mathematical understanding.

The dominance of expert students found in Group 1 and Group 3 suggests that procedural accuracy does not necessarily reflect equal conceptual participation among all group members. Although expert students successfully solved most tasks, novice students often contributed minimally to explanation, interpretation, and justification processes. This condition occurred because expert students frequently controlled mathematical reasoning before other students had opportunities to articulate their ideas. As a result, novice students tended to rely on expert explanations rather than constructing independent understanding. This finding supports Mata-Pereira and Ponte (2017), who argued that mathematical reasoning develops when students are encouraged to explain, justify, and defend their strategies during collaborative learning activities.

The findings also indicate that students' positioning was influenced not only by mathematical ability but also by the nature of the tasks and representations used during discussion. Tasks involving diagrams and geometric representations appeared to strengthen expert dominance because they required students to coordinate multiple visual and conceptual relationships simultaneously. Students who were able to interpret diagrams more quickly gained greater authority during discussion, while students who experienced difficulty understanding the representations tended to become passive participants. In contrast, tasks presented in table form provided more accessible entry points for novice students because the information was more explicit and easier to organize collaboratively.

This finding is consistent with Duval (2006), who explained that mathematical understanding depends on students' ability to coordinate multiple forms of representation. Similarly, Ainsworth (2006) stated that visual representations support learning only when

students are able to connect representations with underlying mathematical meanings. In this study, several novice students struggled not because they lacked procedural calculation skills, but because they experienced difficulty interpreting spatial and visual relationships in diagrams. Consequently, expert students became more dominant in guiding conclusions and validating answers.

In contrast to Group 1 and Group 3, Group 2 demonstrated more balanced numeracy participation because the facilitator actively managed interaction and encouraged collaborative reasoning. The facilitator frequently invited novice students to explain ideas, respond to questions, and confirm mathematical conclusions before the group agreed on final answers. This interaction pattern reduced expert domination and created broader opportunities for participation. The success of the facilitator in Group 2 appeared to be influenced by both communication practices and task structure. Rather than allowing one student to complete the problem independently, the discussion process required students to collectively interpret visual representations and justify their reasoning together.

This finding supports Webb (2009), who emphasized that productive collaborative dialogue requires students to explain, question, and evaluate ideas collectively rather than merely exchange answers. The facilitator's questioning strategies in Group 2 functioned as scaffolding that helped novice students participate more confidently in numeracy activities. Therefore, balanced participation was not solely determined by students' academic ability, but also by how classroom interaction was structured during collaborative learning.

The findings of this study suggest the importance of designing mathematical tasks and learning media that support equitable participation during group discussions. Visual representations should not only function as tools for delivering information, but also as media that encourage collaborative interpretation and discussion among students. Tasks involving multiple representations, such as tables, diagrams, and symbolic expressions, may provide opportunities for different students to contribute according to their understanding.

Based on these findings, this study proposes a media-based positioning perspective in numeracy learning, in which mathematical representations influence how students gain authority and participate during collaborative discussions. Diagram-based tasks may unintentionally strengthen expert positioning because they demand higher levels of visual interpretation and conceptual coordination. Therefore, teachers need to design scaffolding strategies that support novice students in interpreting visual information before group discussion begins. For example, teachers may assign structured discussion roles, provide guiding questions, or divide representation analysis tasks among group members to prevent expert dominance.

This study extends previous research on positioning theory by specifically examining elementary students' numeracy activities in relation to visual representations and collaborative interaction. The findings demonstrate that positioning influences not only classroom participation patterns but also students' opportunities to engage in reasoning, interpretation, and mathematical communication. Practically, these findings highlight the importance of structured collaborative discussions in which facilitators actively involve all students and mathematical media are designed to support equitable participation and meaningful numeracy learning experiences.

Conclusion

This study demonstrates that fifth-grade students' numeracy activities in group discussions are closely related to their social positioning as experts, facilitators, and novices. Expert students contributed to procedural accuracy and answer validation, but expert dominance often limited equal participation and conceptual engagement among other group members. In contrast, groups with active facilitators showed more balanced numeracy participation because novice students were encouraged to explain ideas, interpret visual information, and contribute to mathematical decision-making. These findings extend the application of positioning theory in elementary numeracy learning by showing how interaction patterns influence students' opportunities to engage in mathematical reasoning. Practically, the study highlights the importance of structured collaborative discussions in which teachers assign clear roles, encourage equitable participation, and support all students in developing meaningful numeracy understanding.

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Authors' Note

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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