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Investigating Mathematical Disposition within Elementary School Mathematics Teaching

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Abstract. This study aims to describe the mathematical dispositions of upper elementary school students within the context of mathematics learning. A qualitative approach with a case study method was employed to explore the characteristics of students' dispositions in a natural and contextual learning environment. The participants were 62 fifth- and sixth-grade students from SDN Babakan Jawa 1, Majalengka Regency, selected through purposive sampling. The primary instrument was a mathematical disposition questionnaire developed based on seven indicators: self-confidence, flexibility in thinking, perseverance, attentiveness and curiosity, self-monitoring and reflection, appreciation of mathematics in real-life applications, and valuing mathematics in daily life. Data were collected through questionnaires, semi-structured interviews, classroom observations, and documentation, and analyzed through data reduction, display, and conclusion drawing, supported by instrument triangulation. The findings revealed that students generally demonstrated a moderate level of mathematical disposition. The most prominent indicators were attentiveness, curiosity, and appreciation for the practical use of mathematics. In contrast, flexibility in thinking and reflective awareness were relatively weak. These results highlight the need for instructional strategies that foster idea exploration and develop students' metacognitive awareness. Students' mathematical dispositions were influenced by teaching styles, instructional models, peer support, and the contextual relevance of the material. The study recommends adopting holistic and contextual learning approaches to foster positive mathematical dispositions that support meaningful mathematical learning and problem-solving.

Introduction

Mathematics plays a fundamental role in elementary education as a core subject and a critical tool for developing students' reasoning and problem-solving skills. In Indonesia, the 2013 Curriculum structures learning thematically in lower grades to support interdisciplinary understanding. However, in upper elementary levels, mathematics is increasingly treated as a discrete subject, distinct from other learning areas such as Natural Sciences and the Indonesian Language (Isbir, 2014; Suprapto, 2016). Despite its thematic underpinnings, mathematics remains a compulsory subject with clear instructional objectives that demand students' cognitive, affective, and psychomotor involvement. The structured and high-stakes nature of mathematics teaching and assessment, particularly in the 2013 Curriculum context, affects how students experience and respond to mathematical learning (Daga, 2020; Amelia, Marini, & Nafiah, 2022).

In this context, mathematical disposition has emerged as a critical but often overlooked factor in supporting students' mathematical engagement and achievement. Defined as the affective domain encompassing students' attitudes, beliefs, interests, confidence, and persistence in mathematics, mathematical disposition is essential for shaping students' willingness to engage with mathematical challenges (Kusmaryono et al., 2019; Clark et al., 2014). Studies have highlighted its contribution to mathematical power: students' ability to reason, problem-solve, and think flexibly (AB, 2019;

Kusmaryono et al., 2019). Early learning experiences are particularly influential; positive dispositions developed in elementary school can support long-term mathematical engagement, while negative experiences may hinder future learning trajectories (An et al., 2015; Aizikovitsh-Udi & Cheng, 2015). Moreover, students' mathematical self-concept and self-efficacy are closely tied to their emotional responses and academic performance (Kaskens et al., 2020; Pitsia, Biggart, & Karakolidis, 2017). When these dispositions are underdeveloped, mathematics anxiety may arise, affecting working memory and reducing performance, especially among students influenced by gender stereotypes, parental expectations, or high-stakes assessment pressure (Ashcraft & Krause, 2007; del Carmen Pérez-Fuentes et al., 2020; Casad, Hale, & Wachs, 2015; Demirtaş & Uygun-Eryurt, 2022).

Mathematical disposition has received limited attention in classroom instruction and curriculum implementation despite its importance. The 2013 Curriculum places significant emphasis on academic outcomes and national assessments, which can lead to instructional practices focused primarily on procedural fluency and rote learning (Amelia et al., 2022). However, recent research underscores the need for a more balanced approach—one that integrates affective development through the use of real-world problems, authentic tasks, and student-centred learning environments (Gresham, 2008; Cady & Rearden, 2007; Verschaffel et al., 2020; Kaiser & Schwarz, 2010). Teachers' beliefs and pedagogical choices play a central role in fostering or hindering these dispositions (Clark et al., 2014; Cooke, 2015). Furthermore, the shift to digital learning during the COVID-19 pandemic has intensified the need for valid and reliable assessment tools that can account for both cognitive and affective aspects of learning (Andika & Hendri, 2021; Azzahro & Subekti, 2022; Proborini, 2021).

Given these considerations, this study investigates how mathematical disposition is cultivated within elementary school mathematics teaching. By examining how students' affective engagement is supported—or neglected—within the curricular, instructional, and assessment practices of the 2013 Curriculum, this study contributes to a deeper understanding of the non-cognitive dimensions of mathematics learning. In doing so, it highlights the need for instructional models that promote procedural and conceptual competence, confidence, autonomy, and positive attitudes toward mathematics (Gainsburg, 2008). Ultimately, the study seeks to inform policy, curriculum design, and teaching practices that support the holistic development of mathematical competence at the foundational level.

Methods

This study employed a qualitative approach with a case study method to investigate students' mathematical dispositions within the context of elementary school mathematics teaching. A qualitative approach enables researchers to describe events, behaviours, or situations in a detailed narrative (Moleong, 2014). The case study design was chosen to explore the students' natural and contextualized learning environment in depth. This research specifically aimed to describe the state of mathematical dispositions among upper-grade students at SDN Babakan Jawa 1, Kabupaten Majalengka, using a descriptive qualitative research design.

Several stages were carried out throughout the research process. It began with an empirical study to determine the relevance and urgency of the research problem, followed by an in-depth theoretical review to construct the conceptual foundation. Valid data collection instruments were then prepared to obtain rich and accurate data aligned with the research focus. The main instrument used was a mathematical disposition questionnaire, developed based on key disposition indicators. Table 1 presents the instrument grid showing the indicators and corresponding positive and negative items.

Table 1. Grid of Mathematical Disposition Questionnaire Instrument

Indicator	Positive Item(s)	Negative Item(s)
Self-confidence	1, 3, 5	2, 4
Idea exploration and flexibility	6	7
Perseverance in solving problems	8, 9	10
Attention, curiosity, and interest in learning	11, 13, 15	12, 14
Monitoring and reflection	16, 17, 18	19
Respect for mathematical applications	20, 21	23
Appreciation of mathematics in daily life	22, 24	25

In addition to the questionnaire, researchers employed supporting instruments such as semi-structured interview guides and documentation guidelines, both of which were developed based on the same indicators of mathematical disposition. Each indicator was represented by several items to support and triangulate the information obtained from the questionnaire.

Participants were selected using a purposive sampling technique, based on specific criteria that allowed the researcher to identify subjects most likely to provide relevant and insightful data (Sugiyono, 2013). This study's total number of participants was 62 upper-grade students from SDN Babakan Jawa 1. The research was conducted over seven months.

Data collection techniques included observation, interviews, questionnaires, and documentation. To ensure data validity, the study applied a triangulation technique, which involves comparing results from different data collection methods applied to the same subjects. Triangulation is an essential strategy for enhancing credibility in qualitative research. The research procedure followed several key stages: pre-field preparation, fieldwork, data analysis, and report writing. Data analysis was carried out through data reduction, data display, and conclusion drawing, which was conducted iteratively throughout and after fieldwork.

Results And Discussion

Result

The results of this study are presented based on a qualitative data analysis process consisting of data reduction, data display, and conclusion drawing, supported by data triangulation through a mathematical disposition questionnaire, semi-structured interviews, observations, and documentation. The study involved 62 upper-grade students from SDN Babakan Jawa 1, Majalengka. The research was conducted in four main stages: (1) preparation before data collection, (2) field implementation, (3) data analysis, and (4) reporting. Initially, a literature review and preliminary empirical study were conducted to establish the urgency of investigating mathematical disposition in elementary mathematics learning. This foundation guided the development of valid and relevant research instruments: a mathematical disposition questionnaire, interview guidelines, and observation protocols. These instruments were designed based on seven key indicators of mathematical disposition: (1) self-confidence, (2) flexibility of ideas, (3) perseverance in problem-solving, (4) attention and curiosity, (5) monitoring and reflection, (6) appreciation of mathematics applications, and (7) appreciation of mathematics in daily life. Each indicator was operationalised through positive and negative questionnaire items and integrated into interview and observation items for data triangulation.

The questionnaire was administered to all fifth and sixth-grade students during the field stage. Based on the questionnaire results, six students representing high, moderate, and low disposition levels were purposively selected for semi-structured interviews to gain deeper insights into their mathematical dispositions. Observations of mathematics classes were conducted over four sessions to capture behaviours reflecting the disposition indicators, such as perseverance, curiosity, and reflective abilities. Supporting documentation, including photos of learning activities, student work, and relevant

teacher notes, was also collected to understand students' mathematical disposition characteristics comprehensively.

The data analysis process began with reducing quantitative data from the mathematical disposition questionnaire administered to all fifth and sixth-grade students at SDN Babakan Jawa 1, Majalengka. The collected data were then categorised based on the scores for each mathematical disposition indicator. The disposition levels were classified using the following percentage score thresholds: high category for scores above 80%, moderate category for scores between 60% and 80%, and low category for scores below 60%. Data presentation was conducted by summarising the main findings for each indicator, which were further corroborated through triangulation with interview and observation data.

1. **Self-Confidence in Mathematics**
   68% of students scored in the moderate category, indicating that most students exhibit adequate confidence in solving routine mathematics problems. However, interview data revealed a decline in confidence when students faced challenging or contextual problems. Observations supported this finding, showing that students tended to remain silent and wait for teacher guidance when presented with non-routine tasks.
2. **Flexibility of Ideas in Problem Solving**
   This indicator was categorised as low, with 54% of students demonstrating rigid thinking patterns. Analysis of the questionnaire and interviews indicated that most students relied on a single method taught by the teacher and showed limited ability to explore alternative strategies. Classroom observations confirmed that students rarely attempted different approaches despite opportunities to do so.
3. **Perseverance in Completing Tasks**
   72% of students fell into the moderate category. Questionnaire results suggested that students generally attempted to complete tasks but tended to give up when facing difficulties. Interviews revealed that some students experienced frustration after repeated failures. Observations showed that only a small number of students persisted despite encountering obstacles.
4. **Attention and Curiosity toward Mathematics**
   This indicator was rated high, with 81% of students demonstrating interest and active engagement in learning. Interviews and observations confirmed that many students actively asked questions, took notes of important information, and showed enthusiasm for material connected to real-life contexts.
5. **Monitoring and Reflection on the Thinking Process**
   With 59% of students scoring in the low category, the questionnaire results indicated that students seldom reviewed their work or recognised their errors. Interviews further suggested that self-reflection was not yet habitual. Observations revealed that students focused more on the final answers than on the thinking process or strategies.
6. **Appreciation of Mathematical Applications**
   85% of students were in the high category, indicating strong appreciation when mathematical concepts were linked to real-life applications. Interviews showed that students were more motivated when measurement and money management were contextualized. This motivation was also evident in students' expressions of interest during thematic learning sessions.
7. **Appreciation of Mathematics in Daily Life**
   This indicator fell into the moderate category, with 74% of students recognising the importance of mathematics but not yet fully able to independently connect mathematical concepts to everyday activities. Interviews revealed that students still depended on teacher examples to understand the relevance of the material. At the same time, observations indicated a low level of student initiative in relating the content to their personal experiences.

Table 1 systematically presents the findings from the quantitative questionnaire and qualitative interview data. It highlights the triangulation results by matching each mathematical disposition indicator's survey scores with representative excerpts from student interviews. This table clearly connects students' self-reported attitudes and verbal expressions, allowing for a nuanced understanding of the data.

Table 1. Data Triangulation Results: Questionnaires and Interviews

Indicator	Questionnaire Result	Interview Excerpt
Self-Confidence	68% Moderate category	"I am confident when solving problems I am familiar with. However, I often doubt myself when dealing with difficult problems."
Flexibility of Ideas	54% Low category	"I only use the method taught by the teacher because I fear making mistakes if I try other ways."
Perseverance	72% Moderate category	"I try several times, but if I still cannot solve it, I give up and ask for help."
Attention and Curiosity	81% High category	"I like to ask questions and always take notes so I do not forget."
Monitoring and Reflection	59% Low category	"I rarely review my answers unless the teacher asks me to."
Appreciation of Mathematical Applications	85% High category	"Mathematics is important for counting money or managing time."
Appreciation of Mathematics in Daily Life	74% Moderate category	"Sometimes I know it is important, but I do not yet see a direct connection to daily activities."

Table 2 summarizes the observational findings related to each indicator to complement the questionnaire and interview data. This table captures students' behaviors and interactions during mathematics lessons, offering direct evidence that supports and enriches the insights obtained from the self-reported measures.

Table 2. Data Triangulation Results: Observations

Indicator	**Observation Findings**
Self-Confidence	Students wait for instructions when faced with complex problems and rarely attempt solutions independently without guidance.
Flexibility of Ideas	Students only use a single method and show limited attempts to explore alternative strategies.
Perseverance	Students make efforts but give up after several failed attempts and seek help from the teacher or peers.
Attention and Curiosity	Students actively ask questions and take notes throughout the learning process.
Monitoring and Reflection	Students submit their work directly without rechecking or reflecting on possible errors.
Appreciation of Mathematical Applications	Students show greater enthusiasm and engagement when the material is related to real-life contexts.

Appreciation of Mathematics in Daily Life	Students tend to be passive during discussions about the application of mathematics and rely heavily on teacher examples.

Several key conclusions can be drawn based on triangulation and thorough data analysis. First, students' mathematical dispositions predominantly fall within the moderate category, indicating a considerable potential for development if appropriately facilitated. Second, the strongest indicators identified are students' curiosity and appreciation for mathematics's practical applications, highlighting these aspects as valuable entry points for instructional enhancement. Conversely, particular attention is warranted for indicators of cognitive flexibility and self-reflection abilities, as these were comparatively weak and may hinder deeper mathematical engagement. Furthermore, the analysis reveals that multiple factors influence students' mathematical disposition, including teaching styles, the instructional models applied, peer support mechanisms, and the relevance of learning materials to real-life contexts. These findings underscore the importance of a holistic approach in fostering positive mathematical dispositions to support students' learning and problem-solving capabilities.

Discussion

The findings of this study reveal that most upper-grade elementary students demonstrated moderate levels of mathematical disposition. Specifically, they exhibited strong attentiveness during lessons and a high appreciation for the practical applications of mathematics. These indicators suggest that students are generally engaged and motivated, particularly when mathematics is contextualised in real-life situations—an observation aligned with previous research that emphasises the motivational power of authentic contexts (Bottge, 1999; Heckman & Weissglass, 1994; Reyes et al., 2019). However, despite these affective strengths, students showed significant weaknesses in cognitive flexibility and metacognitive self-regulation. Many were unable to consider alternative strategies or to effectively monitor and reflect on their problem-solving processes, suggesting underdeveloped executive function and reflective capacity (Vitiello et al., 2016; Celik & Ozdemir, 2020). This duality supports the initial hypothesis: while students express genuine interest in mathematics, this affective engagement does not necessarily lead to deep cognitive involvement without proper scaffolding.

An analysis of indicator-specific findings provides further insight into this issue. Students reported high levels of self-confidence when dealing with routine problems, but this confidence diminished when confronted with unfamiliar or complex tasks, indicating a strong dependence on task familiarity—consistent with the literature on context-dependent confidence (Gabriel et al., 2018). Their reliance on single, teacher-modeled strategies points to an instructional emphasis on procedural fluency at the expense of exploratory thinking (Leader & Middleton, 2004; Olivares, Lupiáñez, & Segovia, 2021). Furthermore, although students initially attempted to complete given tasks, perseverance declined in the face of challenges, highlighting the need to develop growth mindsets and emotional regulation. Encouragingly, students displayed high levels of curiosity and attentiveness, particularly when mathematics was framed in everyday contexts. However, their ability to engage in metacognitive monitoring was minimal, possibly due to a lack of explicit instruction in such strategies. The strong appreciation for mathematics in practical domains (e.g., money, measurement) further confirms the motivating role of contextual utility (Reyes et al., 2019). Nevertheless, the moderate ability to independently connect mathematics to daily life suggests a missed opportunity for instructional approaches to foster authentic, student-generated links to mathematical ideas.

Contrary to studies that report high adaptability among learners (e.g., Andreescu et al., 2008), this study found a general rigidity in students' mathematical thinking. This discrepancy may reflect variations in curricular emphases and cultural-educational practices (Berry, 1985; Andreescu et al., 2008). The observed limitations in flexibility and self-monitoring may stem not only from instructional

approaches but also from broader sociocultural influences on mathematical cognition. These findings imply the necessity for instructional frameworks that promote both procedural mastery and strategic reasoning. As suggested by Chew, Shahrill, and Li (2019), integrating contextualised problem-solving approaches within the curriculum can foster cognitive resilience and mathematical reasoning. Similarly, Shinn and Hubbard (1992) argue for the alignment of assessment and instruction through problem-solving tasks that target deeper learning processes.

The broader implication is that mathematics instruction should strive for a balanced design that supports both affective engagement and cognitive-metacognitive development. Although students' interest and curiosity were notably strong, this alone was insufficient to sustain independent and reflective thinking. This suggests that instructional practices must go beyond merely engaging students emotionally. They should also incorporate diverse strategies, student-led exploration, and explicit metacognitive scaffolding. Designing tasks that are thematically rich, cross-disciplinary, and grounded in students' lived experiences may further enhance relevance and support the transfer of learning. Ultimately, fostering mathematical disposition requires more than cultivating enthusiasm; it demands intentional pedagogical design to develop students' capacity for flexible reasoning and autonomous mathematical thought.

Conclusion

This study set out to explore the characteristics of mathematical disposition among upper-grade elementary students at SDN Babakan Jawa 1, Majalengka. The findings from questionnaire data, interviews, observations, and documentation reveal that students' overall mathematical dispositions are in the moderate category. This indicates a foundational level of development that holds promise for further enhancement. One of the most significant findings to emerge from this study is that students show high levels of attention and curiosity, as well as a strong appreciation for mathematical applications in real-life contexts. These strengths suggest potential entry points for the design of more engaging and meaningful mathematics instruction. However, the study also found that students demonstrated low levels of flexibility in problem-solving and limited abilities in monitoring and reflecting on their thinking processes. This finding is consistent with prior studies highlighting challenges in developing metacognitive and adaptive thinking skills at the elementary level. These findings suggest several practical implications. Teachers should consider incorporating more open-ended, contextualised tasks that encourage multiple solution strategies and promote student reflection. In addition, classroom practices that foster autonomy, peer collaboration, and real-life relevance may serve to improve students' self-confidence and initiative in mathematics learning. In conclusion, this study has shown that while students already exhibit some positive dispositions toward mathematics, more comprehensive and reflective instructional strategies are needed to support their holistic development. Future research should explore the effectiveness of targeted interventions designed to strengthen students' cognitive flexibility and reflective thinking in mathematics.

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Declarations

Author Contribution : **NI** was responsible for the conceptualization, research design, data collection, data analysis, and manuscript drafting. **MS** contributed to substantial revisions and interpretation of findings. All authors have read and approved the final version of the manuscript.

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