Exploring Mathematical Thinking Obstacles through the Lens of Self-Efficacy

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ABSTRACT

This study investigates elementary students' mathematical thinking obstacles through the lens of self-efficacy in mathematics learning. Adopting a qualitative descriptive design, data were gathered through non-participant classroom observations, open-ended interviews, a Likert-scale self-efficacy questionnaire, and document analysis. Participants consisted of one fifth-grade teacher and six fifth-grade students selected purposively. Students' self-efficacy levels were categorized as high, moderate, or low through triangulation of questionnaire scores, classroom observations, and interview findings to ensure consistency between students' perceived beliefs and their actual learning behaviors. Data analysis followed the stages of data reduction, data display, and conclusion drawing. The findings indicate that students with high self-efficacy demonstrated persistence, confidence, learning autonomy, and effective emotional regulation when solving mathematical problems. Students with moderate self-efficacy tended to rely on previous learning experiences and familiar procedures, whereas students with low self-efficacy exhibited limited confidence, hesitation, and a tendency to disengage from challenging tasks. Mathematical thinking obstacles were identified as instrumental ontogenic, conceptual ontogenic, didactical, and epistemological. The ontogenic category was operationally divided into instrumental and conceptual dimensions to distinguish procedural difficulties from conceptual misunderstandings, enabling a more detailed analysis of students' cognitive obstacles. Among these categories, didactical obstacles emerged as the most dominant, particularly students' reliance on teacher-provided examples and difficulties in independently initiating problem-solving processes. Overall, the findings suggest an observed tendency that students with higher self-efficacy experience fewer and less complex mathematical thinking obstacles. The study highlights the importance of integrating self-efficacy-enhancing strategies into mathematics instruction to foster more autonomous, resilient, and effective mathematical thinking among elementary students.

ABSTRAK

Penelitian ini bertujuan untuk mengkaji hambatan berpikir matematis siswa sekolah dasar melalui perspektif self-efficacy dalam pembelajaran matematika. Penelitian ini menggunakan desain deskriptif kualitatif dengan teknik pengumpulan data berupa observasi kelas nonpartisipatif, wawancara terbuka, angket self-efficacy skala

Likert, dan analisis dokumen. Partisipan penelitian terdiri atas satu guru kelas V dan enam siswa kelas V yang dipilih secara purposive. Tingkat self-efficacy siswa dikategorikan ke dalam tingkat tinggi, sedang, dan rendah melalui triangulasi hasil angket, observasi kelas, dan temuan wawancara untuk memastikan kesesuaian antara keyakinan yang dilaporkan siswa dan perilaku belajar yang ditunjukkan selama pembelajaran. Analisis data dilakukan melalui tahapan reduksi data, penyajian data, dan penarikan kesimpulan. Hasil penelitian menunjukkan bahwa siswa dengan self-efficacy tinggi memperlihatkan ketekunan, kepercayaan diri, kemandirian belajar, serta regulasi emosi yang baik dalam menyelesaikan permasalahan matematika. Siswa dengan self-efficacy sedang cenderung mengandalkan pengalaman belajar sebelumnya dan prosedur yang telah dikenal, sedangkan siswa dengan self-efficacy rendah menunjukkan kepercayaan diri yang terbatas, keraguan, serta kecenderungan menghindari tugas yang menantang. Hambatan berpikir matematis diidentifikasi dalam empat kategori, yaitu hambatan ontogenik instrumental, hambatan ontogenik konseptual, hambatan didaktis, dan hambatan epistemologis. Kategori hambatan ontogenik dibedakan menjadi dimensi instrumental dan konseptual untuk membedakan kesulitan prosedural dari kesalahpahaman konseptual sehingga memungkinkan analisis yang lebih rinci terhadap hambatan kognitif siswa. Di antara keempat kategori tersebut, hambatan didaktis merupakan hambatan yang paling dominan, terutama berupa ketergantungan siswa terhadap contoh yang diberikan guru dan kesulitan memulai proses penyelesaian masalah secara mandiri. Secara keseluruhan, hasil penelitian menunjukkan adanya kecenderungan bahwa siswa dengan tingkat self-efficacy yang lebih tinggi mengalami hambatan berpikir matematis yang lebih sedikit dan tidak terlalu kompleks. Penelitian ini menegaskan pentingnya mengintegrasikan strategi untuk meningkatkan self-efficacy dalam pembelajaran matematika guna mengembangkan kemandirian, ketangguhan, dan kemampuan berpikir matematis siswa sekolah dasar secara lebih efektif.

INTRODUCTION

Mathematics learning at the elementary school level plays a strategic role in developing students' logical, critical, systematic, and reflective thinking abilities (Gusmarlia, 2025; Sardin et al., 2025; Asrulla et al., 2025). Ideally, mathematics learning outcomes should not be confined to computational proficiency but should also encompass conceptual understanding, problem-solving competence, and sound decision-making skills. Mathematics education is also expected to cultivate positive learning attitudes and strengthen students' confidence. This expectation aligns with educational policies issued by the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia, which emphasize the development of higher-order thinking skills and self-confidence as integral learning objectives (Sardin et al., 2025). Such educational aspirations require instructional practices that foster deep mathematical thinking while simultaneously addressing students' affective dimensions in learning.

(Zebua et al., 2024)(Wahyuni & Antoro, 2025)(Arvi et al., 2025) Mathematical thinking ability constitutes a central indicator of success in mathematics learning. This ability involves understanding problems, establishing conceptual connections, designing strategies, and evaluating solutions. Students who demonstrate strong mathematical thinking tend to exhibit flexibility in problem solving and the capacity to adapt strategies when encountering varied problem structures. Consequently, mathematics instruction at the elementary level should prioritize the early development of mathematical thinking as a foundational competence for subsequent learning stages. Achieving this objective requires learning environments that are active, meaningful, and contextually grounded.

Empirical evidence, however, indicates that Indonesian students' mathematical performance remains suboptimal. Findings from international assessments conducted by the Organisation for Economic Co-operation and Development through the Programme for International Student Assessment reveal that a substantial proportion of Indonesian students continue to perform at basic proficiency levels, particularly in reasoning and problem-solving domains (Muhtadin et al., 2024; Luthfiyah et al., 2024) . Students frequently succeed in solving routine tasks but encounter difficulties when presented with non-routine problems. This discrepancy reflects a persistent gap between intended curricular goals and classroom realities, suggesting that the development of mathematical thinking has not been fully optimized. Preliminary classroom observations conducted in a fifth-grade elementary setting further revealed various mathematical thinking obstacles. Students experienced difficulties in interpreting problem statements, particularly word problems requiring analytical reasoning. Many students engaged in procedural calculations without adequately comprehending the contextual meaning of problems. Misapplication of formulas and challenges in articulating solution strategies were also frequently observed. When confronted with unfamiliar problem contexts, students often exhibited confusion and a tendency to disengage. These patterns indicate that students' conceptual understanding and strategic thinking processes have not yet developed optimally.

Initial interviews with the classroom teacher highlighted the significant influence of affective factors on students' mathematical thinking processes. Many students demonstrated low confidence in mathematics learning, characterized by hesitation, fear of making errors, and reluctance to explore alternative strategies. Students with prior negative learning experiences were more likely to avoid challenging tasks. Emotional responses such as anxiety and tension were particularly evident during evaluative situations. In several instances, students preferred waiting for teacher assistance or replicating peers' solutions rather than engaging independently with problems. These observations underscore the critical role of self-belief in shaping students' learning behaviors and cognitive engagement.

Self-efficacy, defined as individuals' beliefs in their capabilities to organize and execute actions required to manage prospective situations, provides a relevant theoretical lens for understanding these phenomena (Bandura, 1994) . According to Albert Bandura, self-efficacy is developed through four primary sources: mastery experiences, vicarious experiences, verbal persuasion, and physiological and emotional states. These four sources served as the conceptual foundation for the self-efficacy questionnaire employed in this study. The mastery experiences dimension measured students' confidence derived from previous success in solving mathematical tasks. The vicarious experiences dimension assessed students' confidence gained by observing classmates successfully complete similar tasks. The verbal persuasion dimension examined the influence of encouragement and feedback from teachers and peers on students' confidence in mathematics learning. The physiological and emotional states dimension evaluated students' ability to regulate anxiety, nervousness, and emotional responses when facing challenging mathematical problems. Collectively, these dimensions were used to identify variations in students' self-efficacy levels and explore how differences in self-beliefs were reflected in their mathematical thinking obstacles.

(Ananda & Wandini, 2022) Within mathematics learning, self-efficacy influences students' willingness to apply new strategies, persist when encountering difficulties, and engage in complex problem-solving activities (Hikmah & Mufqi, 2025). Previous studies have consistently reported that students with stronger self-efficacy tend to achieve better mathematics performance, demonstrate greater persistence, employ more diverse problem-solving strategies, and exhibit stronger higher-order thinking skills than students with lower self-efficacy. These findings provide the theoretical rationale for examining mathematical thinking obstacles from the perspective of self-efficacy in the present study (Rumiati, 2024).

Mathematical thinking obstacles were analyzed using Guy Brousseau's Theory of Didactical Situations (TDS) because this framework provides a comprehensive perspective for identifying the sources of students' learning difficulties beyond cognitive errors alone. Rather than attributing students' difficulties solely to inadequate conceptual understanding, Brousseau's framework distinguishes learning obstacles according to their origins, namely ontogenic, didactical, and epistemological obstacles. This classification enables researchers to examine whether students' mathematical thinking difficulties arise from cognitive readiness, instructional practices, or limitations in applying mathematical knowledge across different contexts (Hidayat, 2025). Consequently, the framework is particularly suitable for the present study, which aims to explore mathematical thinking obstacles from both cognitive and instructional perspectives while considering students' self-efficacy.

In this study, ontogenic obstacles were operationally divided into instrumental and conceptual dimensions to obtain a more detailed analysis of students' cognitive difficulties. Instrumental ontogenic obstacles refer to students' difficulties in using mathematical symbols, notations, algorithms, formulas, and procedures accurately, reflecting weaknesses in procedural competence. Conceptual ontogenic obstacles, by contrast, refer to students' limited understanding of mathematical concepts, misconceptions, and inability to explain or connect mathematical ideas meaningfully. Although Brousseau conceptualizes ontogenic obstacles as a single category related to learners' developmental readiness, this subdivision was adopted as an analytical refinement to distinguish procedural difficulties from conceptual misunderstandings more clearly. Such differentiation allows a more nuanced interpretation of how different aspects of cognitive readiness are associated with students' self-efficacy and mathematical thinking obstacles. Analyzing mathematical thinking obstacles through this framework therefore enables a more comprehensive identification of the sources of students' learning difficulties and provides a stronger basis for designing targeted instructional interventions (Tarmizi et al., 2025).

Based on these considerations, this study aims to explore elementary students' mathematical thinking obstacles from the perspective of self-efficacy within a qualitative descriptive framework. The research addresses the following questions: (1) What are students' self-efficacy levels in mathematics learning? (2) What types of mathematical thinking obstacles are experienced by elementary students? (3) How do mathematical thinking obstacles vary across different self-efficacy levels? As an exploratory study involving a small, purposively selected qualitative sample, the findings are intended to provide an in-depth understanding of participants' learning experiences rather than statistical generalizations to a broader population. Nevertheless, the study is expected to contribute to mathematics education by offering insights into the interplay between cognitive and affective dimensions of learning. The findings may serve as contextual empirical evidence to assist teachers in designing instructional strategies that strengthen students' self-efficacy while reducing mathematical thinking obstacles.

METHOD

This study employed a qualitative descriptive design aimed at providing an in-depth portrayal of elementary students' mathematical thinking obstacles in relation to their self-efficacy levels when solving contextual mathematical problems (Wahyuni et al., 2025). A qualitative descriptive approach was considered appropriate because the study sought to develop a comprehensive, contextual, and meaningful understanding of students' cognitive experiences, learning behaviors, and psychological dispositions within authentic classroom settings. Although the study used a Likert-scale self-efficacy questionnaire and numerical observation ratings, these quantitative measures were not intended for statistical hypothesis testing or inferential analysis. Instead, they served as descriptive tools to profile students' self-efficacy levels and the frequency of observed mathematical thinking obstacles, thereby supporting participant selection and facilitating systematic comparison across cases. The primary analysis remained qualitative, emphasizing the interpretation of classroom observations, interview findings, students' written work, and document analysis through data triangulation. This approach enabled the numerical data to complement, rather than replace, the qualitative interpretation, resulting in a richer and more comprehensive understanding of how self-efficacy relates to mathematical thinking obstacles in authentic classroom contexts (Sandelowski, 2000; Kim et al., 2017).

The participants consisted of one fifth-grade teacher and six fifth-grade students selected through purposive sampling. The sampling process was guided by three criteria. First, students represented variations in academic ability based on the teacher's records of mathematics achievement. Second, students were initially screened using a self-efficacy questionnaire to identify variations in self-efficacy levels. Third, the classroom teacher recommended students who consistently demonstrated different levels of confidence, participation, persistence, and problem-solving behaviors during mathematics learning. The integration of these criteria enabled the selection of participants representing high, moderate, and low self-efficacy, thereby supporting an in-depth exploration of mathematical thinking obstacles across different learner characteristics (Palinkas et al., 2015).

The study was conducted at SD Negeri 1 Wajak Lor, located on Jalan Raya Karanggayam, Wajak Lor Village, Boyolangu District, Tulungagung Regency. Data collection techniques included non-participant classroom observations, open-ended interviews, self-efficacy questionnaires, and documentation. Classroom observations were conducted during two mathematics lessons, each lasting 2 × 35 minutes, on the topic of data presentation. The observations focused on identifying students' mathematical thinking obstacles while they interpreted, represented, and solved contextual problems related to data presentation. Students' learning engagement, problem-solving strategies, persistence, emotional responses, and interactions during instructional activities were systematically documented using an observation instrument. The observational findings were subsequently triangulated with open-ended interviews involving both the teacher and the selected students to obtain deeper insights into students' cognitive difficulties, learning experiences, and self-efficacy beliefs when confronting challenging mathematical problems.

The self-efficacy questionnaire consisted of 17 items measured using a four-point Likert scale with response options of Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1). The instrument was developed based on Bandura's four sources of self-efficacy, namely mastery experiences, vicarious experiences, verbal persuasion, and physiological and emotional states. Individual item scores were summed to obtain a total self-efficacy score ranging from 17 to 68. For descriptive purposes, the total score range was divided into three equal intervals representing low (17–33), moderate (34–50), and high (51–68) self-efficacy. However, these score intervals were used only to provide an initial descriptive profile of students' self-efficacy and to support participant screening. The final classification of students into high, moderate, and low self-efficacy was determined through triangulation of questionnaire scores, classroom observations, and interview findings to ensure consistency between students' reported beliefs and their actual learning behaviors. Students were categorized as having high self-efficacy when they consistently demonstrated confidence, persistence, learning autonomy, and effective emotional regulation across all three data sources. Students were categorized as having moderate self-efficacy when their confidence depended primarily on familiar tasks, previous learning experiences, and teacher support. Students were categorized as having low self-efficacy when questionnaire responses, classroom observations, and interviews consistently indicated limited confidence, hesitation, avoidance of challenging tasks, and dependence on external assistance (Boateng et al., 2018).

Documentation was employed to complement the data, including students' written work, lesson plans, and other relevant instructional artifacts. Data analysis followed the stages of data reduction, data display, and conclusion drawing. Observation notes, interview transcripts, and students' written work were first coded into meaningful analytical units before being classified according to Brousseau's learning obstacle framework. The coded data were subsequently categorized into instrumental ontogenic obstacles, referring to difficulties in applying mathematical procedures, algorithms, formulas, and symbols accurately; conceptual ontogenic obstacles, referring to misconceptions and inadequate understanding of mathematical concepts and relationships; didactical obstacles, referring to learning difficulties associated with instructional practices, teacher explanations, or students' dependence on worked examples; and epistemological obstacles, referring to difficulties in transferring mathematical knowledge to unfamiliar or contextual problem situations.

To enhance the trustworthiness of the findings, methodological and source triangulation were employed by systematically comparing evidence obtained from classroom observations, interviews, questionnaires, and students' written work (Azka et al., 2024). For example, when a student obtained a moderate self-efficacy score on the questionnaire, classroom observations were examined to determine whether the student relied on teacher guidance or familiar solution procedures during mathematics learning. These findings were then compared with interview responses concerning the student's confidence in solving mathematical problems and with the student's written solutions to identify whether procedural errors or conceptual misunderstandings consistently appeared. A mathematical thinking obstacle was confirmed only when the same pattern was consistently supported across multiple sources of evidence. This triangulation process enhanced the credibility, dependability, and validity of the findings while providing a comprehensive understanding of students' mathematical thinking obstacles and the role of self-efficacy in mathematical problem solving (Fusch et al., 2018).

Table 1 and Table 2 present the observation instrument framework used to identify students' mathematical thinking obstacles during mathematics learning. The framework was structured based on categories of thinking obstacles, corresponding indicators, and observable descriptors. The observation instrument extended beyond cognitive obstacles to encompass students' classroom behaviors, including engagement, persistence in facing difficulties, learning autonomy, emotional responses, and social interactions. Such multidimensional observations were considered essential for capturing the complexity of students' learning experiences within mathematics instruction. Furthermore, this comprehensive observational framework enabled the researchers to obtain a more holistic understanding of how students' cognitive processes interacted with their behavioral and affective responses during learning activities.

Table 1. Student Behavior Observation Instrument Grid

No	Observed Aspect	Behavioral Indicators	Observation Descriptors
1	Learning Engagement	Participation in learning activities	Ask and answer questions and participate in discussions.
		Response to teacher instructions	Complete assignments according to the instructions.
2	Resilience in Facing Difficulties	Not giving up easily when faced with difficult tasks	Keep trying even after making mistakes.
		Problem-solving strategies	Try other methods when answers are incorrect.
3	Learning Independence	Working independently on tasks	Do not rely entirely on peers.
		Initiative to learn	Start assignments without being prompted.
4	Emotional State	Emotional control while learning	Do not show excessive anxiety.
		Attitude toward failure	Remain calm when answers are incorrect.
5	Social Interaction	Peer collaboration	Actively discuss and help peers.

Student behavior was recorded using a structured observation sheet based on the behavioral indicators presented in Table 1. Each behavioral indicator in Table 1 was rated from 1 (Not Observable) to 4 (Highly Observable). Scores were interpreted descriptively and triangulated with interviews, questionnaire profiles, and written work; they were not used for inferential analysis.

Table 2. Observation Instrument Grid for Student Thinking Obstacles

No	Type of Thinking Obstacle	Indicator	Observation Descriptor
1	Instrumental Ontogenic	Difficulty using tools/symbols	Students misuse symbols, notation, or formulas.
		Procedural errors	Students make mistakes even after being given guidance.
2	Conceptual Ontogeny	Misunderstanding of concepts	Students misinterpret basic concepts.
		Inability to explain concepts	Students are unable to explain concepts.
3	Didactical	Reliance on teacher examples	Students can only solve problems similar to examples.

No	Type of Thinking Obstacle	Indicator	Observation Descriptor
		Confusion due to presentation of material	Students are confused by instructions or explanations.
4	Epistemological	Limited context of application	Students fail to apply concepts in new contexts.
		Low knowledge transfer	Students are unable to generalize concepts.

The observation instrument presented in Table 2 was developed based on Brousseau's Theory of Didactical Situations, which classifies learning obstacles as ontogenic, didactical, and epistemological. This framework was used to identify whether students' mathematical difficulties originated from cognitive readiness, instructional practices, or limitations in applying knowledge across contexts. For more detailed analysis, ontogenic obstacles were divided into instrumental and conceptual dimensions. Instrumental obstacles refer to difficulties in using procedures, algorithms, symbols, and formulas, whereas conceptual obstacles involve misconceptions and limited understanding of mathematical concepts. This distinction served as an analytical refinement without altering Brousseau's original classification.

Didactical obstacles refer to difficulties arising from teaching strategies, learning materials, or dependence on teacher-provided examples, while epistemological obstacles involve difficulties transferring knowledge to unfamiliar situations. These categories guided the analysis of observation data, interview transcripts, and students' written work. Table 3 and Table 4 present the open-ended interview frameworks for the teacher and students, which complemented the observational data by exploring participants' experiences, mathematical thinking obstacles, and factors influencing their self-efficacy.

Table 3. Grid for Grade V Teacher Interview Instrument

No	Variable	Indicators Explored	Operational Sub-Indicators
1	Mathematics Learning in the Classroom	Contextual teaching strategies	How teachers explain word problems, use examples, and model solution steps
2	Students' Thinking Obstacles	Students' points of confusion	Parts of problems that often leave students unsure of where to start
3	Student Self-Efficacy	Confidence in tackling difficult questions	Students' responses when encountering difficulties and their persistence in trying again
4	Supporting and Inhibiting Factors	Environment and teacher intervention	Learning support, remediation, motivation, and assistance strategies

The interview with the teacher provided contextual information regarding instructional practices, students' mathematical thinking obstacles, self-efficacy, and classroom factors influencing mathematics learning. Building on these findings, a separate interview instrument was developed for students to explore their personal experiences, perceptions, and learning behaviors in greater depth. The student interview instrument is presented in Table 4.

Table 4. Interview Instrument Grid for Fifth Grade Students

No	**Variable**	**Aspect Explored**	**Student Behavior Indicators**
1	Thinking Obstacles	Obstacles in Understanding Problems	Students experience confusion when understanding the meaning of questions.
		Obstacles in Problem Solving	Students hesitate or stop when working on questions.
2	*Self-Efficacy*	Confidence in Facing Difficult Problems	Students have confidence or doubts when working on difficult questions.
		Perseverance and Strategy	Students try again or give up when they make mistakes.
		The Influence of Experience and Environment	Students are influenced by previous experiences, friends, teachers, or parents.

Table 5 presents the framework of the students' self-efficacy questionnaire employed to assess students' beliefs in their capabilities to perform and complete mathematical tasks, particularly when engaging with challenging problems. The instrument was developed based on Albert Bandura's self-efficacy theory as the primary conceptual foundation. Responses were measured using a Likert scale comprising four categories: strongly agree, agree, disagree, and strongly disagree. This instrument was designed to systematically capture students' confidence levels, perceived competence, and psychological dispositions in mathematics learning contexts.

Table 5. Self-Efficacy Questionnaire Instrument Grid

No	Self-Efficacy Aspect	Indicator
1	Mastery Experiences	Confidence in completing tasks based on previous experience
		Confidence in facing difficulties based on past successes
2	Vicarious Experiences	Self-confidence after seeing the success of friends
		Confidence in being able to imitate the strategies used by others
3	Verbal Persuasion	Self-confidence after receiving encouragement from teachers
		Self-confidence after receiving support from friends
4	Physiological and Emotional Conditions	Ability to control anxiety while learning
		Emotional resilience when facing difficult tasks

The self-efficacy questionnaire was developed by the researcher based on Bandura's theory of self-efficacy, encompassing four dimensions: mastery experiences, vicarious experiences, verbal persuasion, and physiological and emotional states. The instrument consisted of 17 items measured using a four-point Likert scale. Before data collection, the questionnaire underwent content validation through expert judgment conducted by a lecturer from the Graduate School of Universitas Bhinneka PGRI. The expert evaluated the relevance, clarity, language appropriateness, and alignment of each item with Bandura's theoretical framework and the characteristics of elementary school students. Revisions were made based on the expert's recommendations before the questionnaire was administered. Because the questionnaire was employed as a supporting instrument to profile students' self-efficacy within a qualitative descriptive study, rather than as a standalone psychometric instrument for statistical inference, the credibility and trustworthiness of the data were established primarily through methodological and source triangulation by comparing questionnaire findings with classroom observations, interviews, and students' written work.

RESULTS AND DISCUSSION

The presentation of findings began with documentation of the data collection process, which encompassed the administration of the self-efficacy questionnaire, classroom observations, and open-ended interviews with the fifth-grade teacher and students (Bella et al., 2025; Nurmala et al., 2025) . The documentation indicated that students completed the self-efficacy questionnaire independently within a structured and conducive classroom environment under the supervision of both the teacher and the researcher. This procedure was intended to ensure that students' responses accurately reflected their authentic learning experiences and perceptions. Classroom observations were conducted during mathematics instruction to systematically examine students' learning behaviors, cognitive strategies, and the emergence of mathematical thinking obstacles while they solved contextual problems. These observations were further supported by visual documentation capturing students' interactions, discussion activities, and behavioral responses when they encountered learning difficulties. Such documentation provided a richer contextual understanding of students' cognitive engagement and affective reactions throughout the instructional process. Subsequently, in-depth interviews were conducted with students representing high, moderate, and low self-efficacy categories, as well as with the fifth-grade teacher. The interviews aimed to elicit comprehensive insights into students' learning experiences, perceived difficulties, and factors influencing their self-efficacy in mathematics learning. The integration of observational, interview, and documentary evidence strengthened the validity of the data collection process, demonstrating that the findings were derived systematically, naturally, and in alignment with authentic classroom conditions.

(a) (b)

Figure 1. The researchers explained the questionnaire instructions to the students and observed them.

Once the researchers had explained the questionnaire instructions and confirmed that the students understood the procedures, the questionnaire was administered. The students subsequently completed the questionnaire independently under the supervision of the researchers.

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(a) (b)

Figure 2. Students completed the questionnaire.

Upon completion of the questionnaire, the researchers conducted open-ended interviews with selected students to gain deeper insights and validate the findings obtained from the questionnaire.

(a) (b)

Figure 3. The researchers conducted open-ended interviews with students.

Based on Figure 1, Figure 2, and Figure 3, the data collection stage involved explaining the questionnaire instructions to the students while observing them, guiding them as they completed the questionnaire, and conducting open-ended interviews. (Mustofa & Danuri, 2025) The discussion of this study was grounded in participants selected purposively based on preliminary observations and recommendations from the fifth-grade teacher. Participant selection was guided by variations in students' self-efficacy levels and the characteristics of mathematical thinking obstacles observed during mathematics learning. The fifth-grade teacher was positioned as a key informant, providing pedagogical insights into instructional strategies, students' learning difficulties, and contextual classroom factors influencing students' self-beliefs. Meanwhile, the fifth-grade students were included to capture their lived learning experiences, emotional responses, and cognitive processes when engaging with challenging mathematical tasks. Gender variation was also considered to enhance the representativeness and contextual richness of the data.

Findings derived from classroom observations, self-efficacy questionnaires, and interviews consistently indicated that differences in self-efficacy levels were associated with variations in students' persistence and problem-solving behaviors. Students demonstrating higher self-efficacy tended to engage more actively in exploring multiple strategies and exhibited greater resilience when confronted with difficulties. In contrast, students with lower self-efficacy tended to avoid complex tasks, often accompanied by more pronounced and multifaceted mathematical thinking obstacles. These patterns were further substantiated through methodological triangulation, which integrated evidence from classroom observations, self-efficacy assessments, and in-depth interviews with both the teacher and students (Honicke & Broadbent, 2016; Talsma et al., 2018).

Table 6. Research Subjects

No	Subject Initials	Role in Research	Gender	Self-Efficacy Category	Selection Rationale
1	E.S.	Fifth-grade teacher	Female	–	Homeroom teacher who provided information regarding students' learning characteristics and mathematical thinking obstacles.
2	N.Z.D.	Fifth-grade student	Male	High	Selected because the student consistently demonstrated high self-efficacy across questionnaire, observation, and interview data.
3	H.A.F.	Fifth-grade student	Male	High	Selected to represent students with high self-efficacy and minimal mathematical thinking obstacles.
4	A.R.W.A.	Fifth-grade student	Male	High	Selected to represent students who consistently showed confidence, persistence, and independent problem-solving.
5	S.N.P.	Fifth-grade student	Female	Moderate	Selected to represent students with moderate self-efficacy who relied on previous learning experiences and teacher guidance.
6	A.R.A.	Fifth-grade student	Male	Moderate	Selected to represent students with moderate self-efficacy who displayed confidence only in familiar mathematical tasks.
7	I.L.P.	Fifth-grade student	Male	Low	Selected to represent students with low self-efficacy who frequently hesitated and avoided challenging mathematical tasks.

Based on Table 6, the six student participants were selected using purposive sampling to represent variations in high, moderate, and low self-efficacy identified through the initial questionnaire results and subsequently confirmed through classroom observations and interviews. This variation enabled an in-depth exploration of how mathematical thinking obstacles differed across self-efficacy levels. The classroom teacher was included as a key informant to provide contextual information regarding students' learning characteristics, classroom participation, and mathematics learning experiences, thereby strengthening data triangulation.

(Maharani et al., 2022) The table above indicates that this study involved one teacher and six students as the primary participants. This participant composition was considered sufficient to provide a comprehensive and contextually grounded understanding of students' mathematical thinking obstacles and self-efficacy within elementary mathematics learning. The analysis of observational findings revealed that students' mathematical thinking obstacles manifested across multiple dimensions, including instrumental, conceptual, didactical, and epistemological obstacles. Instrumental ontogenic obstacles were evident when students experienced difficulties in accurately applying mathematical symbols, notations, and procedures despite prior exposure to foundational concepts. Conceptual ontogenic obstacles were reflected in students' misinterpretations of conceptual meanings and their limited ability to articulate mathematical ideas using their own reasoning frameworks. Didactical obstacles emerged primarily from instructional processes, particularly when students demonstrated confusion about teacher explanations or exhibited excessive reliance on provided examples. Epistemological obstacles were identified when students were able to solve problems only within familiar contexts but encountered challenges in transferring conceptual understanding to novel situations. These findings suggest that mathematical thinking obstacles are shaped by a complex interplay of conceptual understanding, prior learning experiences, and students' self-beliefs when confronting mathematical tasks. The observed variations align with previous studies emphasizing that learning obstacles are not solely cognitive in nature but are also influenced by affective and experiential factors.

Table 7. Results of Student Thinking Obstacles Observation

Type of Obstacle	Observed Behavioral Indicator	N.Z.D	H.A.F	A.R.W.A	S.N.P	A.R.A	I.L.P
Instrumental Ontogenic	Difficulty using mathematical symbols or notation	1	1	2	2	2	3
	Incorrect use of formulas or procedures	1	1	3	4	4	4
Conceptual Ontogenic	Misunderstanding mathematical concepts	3	1	2	2	1	2
	Inability to explain mathematical concepts	2	2	2	3	4	4
Didactical	Confusion caused by teacher explanations	1	1	3	2	2	2

Type of Obstacle	Observed Behavioral Indicator	N.Z.D	H.A.F	A.R.W.A	S.N.P	A.R.A	I.L.P
	Dependence on teacher-provided examples	4	4	4	4	4	4
Epistemological	Able to solve problems only in familiar contexts	2	2	2	2	3	3
	Difficulty applying concepts in new situations	2	2	2	3	3	3
Total Score		16	14	20	22	23	25
Mean Score		2.00	1.75	2.50	2.75	2.88	3.13

Score explanation:
4 = Obstacles appear very often
3 = Obstacles appear often
2 = Obstacles rarely appear
1 = Obstacles do not appear

Table 7 shows that the most consistently observed indicator was students' dependence on teacher-provided examples, with all six students receiving the maximum score of 4. This finding indicates that the behavior appeared very frequently regardless of students' self-efficacy level. During classroom observations, students generally waited for the teacher to demonstrate solution procedures before attempting similar tasks. When mathematical problems differed from the examples presented in class, many students hesitated to begin solving them independently and frequently sought additional guidance from the teacher.

This pattern constitutes strong evidence of didactical obstacles because the observed difficulty originated primarily from the instructional process rather than from students' cognitive readiness alone. According to Brousseau's learning obstacle framework, didactical obstacles emerge when instructional practices unintentionally restrict students' opportunities to construct mathematical understanding independently. In the present study, the predominance of teacher-centered explanations and worked examples appeared to encourage procedural imitation rather than conceptual exploration. Consequently, students became accustomed to reproducing familiar solution patterns but experienced difficulties when confronted with contextual problems requiring flexible reasoning or alternative solution strategies (Atkinson et al., 2000; Renkl, 2014).

The consistency of this finding across students with high, moderate, and low self-efficacy further suggests that didactical obstacles were experienced by all participants, although their responses differed according to their self-efficacy levels. Students with high self-efficacy generally continued attempting different solution strategies despite relying on examples, whereas students with moderate and low self-efficacy were more likely to stop working or wait for additional teacher assistance when the examples could not be directly applied. Therefore, the uniformly high score on this indicator provides strong evidence that instructional practices played a substantial role in shaping students' mathematical thinking obstacles in this study.

Table 8. Category Criteria

Value	Category
1,00-1,75	Rarely Appears
1,76-2,50	Appears
2,51-3,25	Appears Frequently
3,26-4,00	Appears very frequently

The category criteria presented in Table 8 were established using the equal-interval method. Because the observation instrument employed a four-point rating scale ranging from 1 to 4, the interval width was calculated by dividing the score range by the number of categories, namely $(4 - 1) \div 4 = 0.75$. Accordingly, the mean observation scores were classified into four categories: 1.00–1.75 (Rarely Appears), 1.76–2.50 (Appears), 2.51–3.25 (Appears Frequently), and 3.26–4.00 (Appears Very Frequently). These categories were used descriptively to facilitate the interpretation of the frequency with which each type of mathematical thinking obstacle was observed during classroom learning. The categories served solely as descriptive guidelines and were not intended for statistical inference.

Based on the findings, I.L.P. exhibited the highest level of mathematical thinking obstacles, with a mean score of 3.13, which falls within the Appears Frequently category. Students S.N.P. and A.R.A. were also classified in the Appears Frequently category, while N.Z.D. and A.R.W.A. were categorized as Appears, and H.A.F. was categorized as Rarely Appears. These findings indicate that mathematical thinking obstacles were experienced to varying degrees across participants, with didactical obstacles emerging as the most consistently observed type. The variation in obstacle levels suggests that students' mathematical difficulties were influenced not only by their conceptual understanding but also by differences in self-efficacy when confronting mathematical challenges. This interpretation was further supported by interview findings, which revealed distinct differences in students' confidence, persistence, and problem-solving strategies when they encountered contextual mathematical tasks.

Observational data demonstrated that each student exhibited unique patterns of mathematical thinking obstacles. Student N.Z.D. predominantly experienced conceptual ontogenic and didactical obstacles. The student encountered challenges in developing a deep understanding of mathematical concepts and articulating mathematical ideas independently, while also demonstrating a tendency to rely on teacher-provided examples. Instrumental obstacles were minimally observed, indicating adequate proficiency in applying mathematical symbols and procedures. Epistemological obstacles appeared less frequently, suggesting a relatively stronger ability to transfer mathematical knowledge to different contexts.

This pattern was further supported by interview findings. When asked about the strategy used when encountering difficulties, N.Z.D. stated, "I take a deep breath and try to reread the problem step by step until I understand its meaning." This response reflects the physiological and emotional states dimension of self-efficacy, as the student was able to regulate anxiety and maintain emotional control when facing challenging mathematical tasks. The student's decision to reread the problem systematically also demonstrates confidence in personal effort to achieve understanding, which is consistent with the mastery experiences dimension of self-efficacy. Although N.Z.D. still experienced conceptual ontogenic obstacles in interpreting mathematical concepts and didactical obstacles through reliance on teacher examples, the interview indicates that these obstacles did not lead the student to abandon the task. Instead, the student employed self-regulation and persistence to overcome difficulties, explaining why the observed mathematical thinking obstacles were less pronounced than those exhibited by students with lower self-efficacy.

For student H.A.F., didactical obstacles emerged as the most prominent type of mathematical thinking obstacle, particularly in the form of dependence on teacher guidance and worked examples. Instrumental obstacles were not observed, indicating strong procedural competence in applying mathematical symbols and algorithms accurately. Conceptual and epistemological obstacles appeared only at low levels, suggesting that the student possessed an adequate conceptual understanding and was generally able to apply mathematical knowledge across different situations. Overall, these findings indicate that H.A.F. experienced relatively few mathematical thinking obstacles compared with the other participants.

The observation findings were supported by the interview data. When asked how he felt when working on difficult mathematical problems, H.A.F. stated, “I consider a long problem like an adventure that must be completed step by step.” This response reflects the physiological and emotional states dimension of Bandura's self-efficacy theory, as the student perceived challenging tasks positively rather than experiencing anxiety or avoidance. The response also demonstrates the mastery experiences dimension because H.A.F. expressed confidence that difficult problems could be solved progressively through personal effort. These characteristics explain why only limited mathematical thinking obstacles were identified. Although H.A.F. occasionally relied on teacher-provided examples, the student remained confident, persistent, and emotionally resilient when solving mathematical problems, thereby reducing the impact of didactical and conceptual obstacles on overall mathematical performance.

Similarly, student A.R.W.A. exhibited predominantly didactical obstacles, accompanied by instrumental difficulties in procedural application. Conceptual and epistemological obstacles were comparatively minimal, indicating adequate conceptual understanding but limited flexibility in selecting alternative solution strategies. This interpretation was supported by the interview response, “I look back at my notes to find a similar example problem.” The response demonstrates an active effort to solve mathematical problems by reviewing previous learning experiences, reflecting the mastery experiences dimension of self-efficacy. However, it also indicates a tendency to depend on familiar examples rather than independently constructing alternative solution strategies. Therefore, although reviewing notes represents a constructive learning strategy, the student's continued reliance on worked examples provides further evidence of didactical obstacles, particularly the tendency to reproduce procedures demonstrated by the teacher instead of adapting mathematical concepts to unfamiliar problem situations.

Student S.N.P. demonstrated a more complex profile of mathematical thinking obstacles. Frequently observed obstacles included instrumental ontogenic obstacles related to procedural execution, didactical obstacles, and epistemological obstacles, together with difficulties in explaining mathematical concepts. Problems associated with the use of mathematical symbols and basic conceptual understanding appeared less frequently. Overall, didactical and instrumental ontogenic obstacles were the most dominant, indicating that the student still required structured instructional support to strengthen conceptual understanding and develop greater independence in mathematical problem solving.

Student A.R.A. exhibited prominent didactical and epistemological obstacles. The student showed considerable dependence on teacher-provided examples and experienced difficulty transferring mathematical concepts to unfamiliar problem situations. Instrumental obstacles were also observed, whereas conceptual obstacles appeared less dominant but remained insufficient to support effective problem solving. This interpretation was reinforced by the interview response. When asked what he usually did after encountering difficulties in solving mathematical problems, A.R.A. replied, “I stop working until someone helps me.” This statement provides direct evidence of low learning autonomy, as the student chose to discontinue the problem-solving process rather than attempting alternative strategies independently. The response also demonstrates a strong dependence on external assistance, indicating that the student relied primarily on teachers or peers instead of personal effort to overcome learning difficulties. From Bandura's perspective, this behavior reflects weaknesses in the mastery experiences dimension because the student lacked confidence in solving problems through individual effort and persistence. Consequently, the student's reliance on external support contributed to the persistence of didactical obstacles, as independent mathematical reasoning was replaced by dependence on guidance from others.

In contrast, student I.L.P. demonstrated the highest level of mathematical thinking obstacles among all participants. Instrumental ontogenic obstacles were particularly dominant, especially in procedural execution and organizing appropriate solution steps. Conceptual ontogenic obstacles were also evident, accompanied by didactical obstacles characterized by dependence on teacher-provided examples and epistemological obstacles reflected in difficulties applying mathematical concepts to unfamiliar problem situations. Collectively, these findings indicate that I.L.P. experienced obstacles across multiple dimensions of mathematical thinking.

The observation findings were reinforced by the interview data. When asked about the initial response to mathematical problems, I.L.P. stated, “When I first read a mathematical problem, I read it slowly, but sometimes I still do not understand it even after reading it many times. I often get confused. Usually, I only look at the numbers, but I do not know what to do next. When I see a long and complicated problem, I feel afraid and just want the lesson to end quickly because it makes my head hurt.” This response provides strong evidence of conceptual ontogenic obstacles, as the student experienced persistent difficulty in understanding the meaning of the problem despite repeated reading. The statement “I only look at the numbers, but I do not know what to do next” also reflects instrumental ontogenic obstacles, indicating uncertainty in selecting and organizing appropriate mathematical procedures. Furthermore, the student's fear of lengthy and complex problems demonstrates weakness in the physiological and emotional states dimension of Bandura's self-efficacy theory, as negative emotional reactions reduced confidence and persistence when facing challenging tasks. The tendency to avoid difficult problems rather than continue exploring possible solution strategies further illustrates low learning autonomy, which may reinforce didactical obstacles because the student becomes increasingly dependent on external guidance instead of developing independent mathematical reasoning (Namkung et al., 2019; Barroso et al., 2021).

These findings are consistent with self-efficacy theory, which emphasizes the pivotal role of self-belief in shaping individuals’ persistence, learning strategies, and responses to challenges. Students demonstrating higher self-efficacy exhibited stronger self-regulation, strategic engagement, and resilience, as reflected in N.Z.D. and H.A.F. Conversely, students with lower self-efficacy displayed tendencies toward disengagement and reliance on external assistance, as observed in A.R.A. and I.L.P. These patterns suggest that enhancing students’ self-efficacy represents a critical pathway for mitigating mathematical thinking obstacles. Accordingly, instructional practices should prioritize the development of mastery experiences, constructive feedback, and opportunities for strategic exploration. Such efforts are expected to foster more adaptive mathematical thinking while improving overall learning effectiveness (Schunk & DiBenedetto, 2020).

Table 9. Observation Results of Students' Self-Efficacy-Related Behaviors During Mathematics Learning

No.	Observed Aspect	Behavioral Indicator	N.Z.D	H.A.F	A.R.W.A	S.N.P	A.R.A	I.L.P
1	Learning Engagement	Students ask or answer questions	4	4	4	3	2	2
		Students follow the teacher's instructions	4	4	3	3	2	3
2	Resilience in Facing Difficulties	Students persist when encountering difficulties	4	4	4	3	2	2
		Students try alternative strategies when their answers are incorrect	4	4	3	3	2	2
3	Learning Independence	Students complete assignments independently	3	3	3	3	2	2
		Students show initiative in starting assignments	4	3	3	3	3	2
4	Emotional Regulation	Students do not show excessive anxiety	4	4	3	2	1	2
		Students remain calm after making mistakes	4	4	4	3	2	2
5	Social Interaction	Students actively collaborate with peers	4	4	4	3	3	4
	Total Score		35	34	31	25	19	21
	Percentage (%)		97.2	94.4	86.1	69.4	52.8	58.3

The observation results in Table 9 indicate that the overall level of students' observed behavior was positive. Three students (N.Z.D., H.A.F., and A.R.W.A.) were classified as Very Good, demonstrating consistently high levels of behavior in accordance with the established observational indicators throughout the learning process. Two students (S.N.P. and A.R.A.) achieved a Good rating, indicating that they exhibited most of the expected behavioral indicators, although there was still room for further improvement. Meanwhile, one student (I.L.P.) was categorized as Fair, suggesting that the expected behaviors were demonstrated only to a moderate extent and required additional guidance and reinforcement. Overall, the findings suggest that the majority of participants displayed good to very good behavioral performance during the implementation of the learning activities.

Note. Each behavioral indicator was rated on a four-point scale (1 = behavior not observed; 2 = behavior rarely observed; 3 = behavior frequently observed; 4 = behavior consistently observed). The percentages were calculated using the formula: (Obtained Score ÷ 36) × 100%, where 36 represents the maximum possible score. The categories Very Good, Good, and Fair describe the quality of observed self-efficacy-related behaviors and were not used to classify students' self-efficacy levels. Students' self-efficacy categories (high, moderate, and low) were determined from the self-efficacy questionnaire and subsequently confirmed through interviews and classroom observations.

Based on the classroom observations, students demonstrated varying manifestations of self-efficacy-related behaviors during mathematics learning. These behaviors were assessed across five dimensions: learning engagement, resilience in facing difficulties, learning independence, emotional regulation, and social interaction. The observation findings were used to complement and verify the self-efficacy classifications obtained from the questionnaire through methodological triangulation. Overall, the results indicate that while some students consistently demonstrated confidence, persistence, and emotional stability during mathematics learning, others exhibited greater hesitation and dependence on external support, particularly when encountering unfamiliar or challenging tasks.

Students N.Z.D. and H.A.F. obtained the highest observation scores, namely 35 (97.2%) and 34 (94.4%), respectively. These findings indicate that both students consistently displayed positive self-efficacy-related behaviors, including active participation in classroom discussions, persistence when facing difficulties, independence in completing learning tasks, and effective emotional regulation. The observation results are consistent with the questionnaire findings, which classified both students as having high self-efficacy. This interpretation was further supported by the interview with H.A.F., who stated, "Yes, Ma'am, I believe that if I work carefully and avoid rushing, I can solve it properly." This response reflects strong confidence in personal capability (mastery experiences) and positive emotional regulation (physiological and emotional states), both of which represent important dimensions of Bandura's self-efficacy theory. These characteristics explain why H.A.F. demonstrated only limited mathematical thinking obstacles throughout the learning process.

Student A.R.W.A. obtained an observation score of 31 (86.1%), indicating consistently positive self-efficacy-related behaviors. This finding supports the questionnaire result, which also classified the student as having high self-efficacy. Nevertheless, classroom observations and interview data revealed that the student frequently relied on previously learned examples when solving unfamiliar mathematical problems. As expressed during the interview, "I look back at my notes to find a similar example problem." This response demonstrates confidence in using prior learning experiences (mastery experiences) while simultaneously indicating a tendency to depend on familiar examples. Consequently, although A.R.W.A. exhibited strong self-efficacy-related behaviors, the student continued to experience didactical obstacles, particularly when mathematical problems required flexible reasoning beyond procedures previously demonstrated by the teacher.

Student S.N.P. obtained an observation score of 25 (69.4%), indicating generally positive self-efficacy-related behaviors during classroom learning. The observation findings supported the questionnaire classification of moderate self-efficacy, showing adequate participation and cooperation but occasional hesitation when confronted with unfamiliar mathematical tasks. This interpretation was reinforced by the interview response, "If the problems are similar to the exercises, I feel confident. But if the problems are new and unusual, I become less confident." The statement illustrates that the student's confidence depended largely on mastery experiences, suggesting that self-efficacy remained situational and was influenced by familiarity with the task.

Students A.R.A. and I.L.P. obtained observation scores of 19 (52.8%) and 21 (58.3%), respectively, indicating fair self-efficacy-related behaviors during classroom learning. These observation results were used as supporting evidence and were interpreted together with the questionnaire and interview findings. Both students demonstrated greater difficulty in emotional regulation, persistence, and learning independence than the other participants. Student A.R.A. stated, “I stop working until someone helps me,” providing direct evidence of limited learning autonomy and dependence on external assistance. Similarly, I.L.P. explained, “I am not very confident, Ma’am. I feel that my classmates understand the material much better than I do.” This response reflects negative social comparison and weakness in the physiological and emotional states dimension of self-efficacy, as feelings of anxiety and low confidence reduced the student’s willingness to persist when facing difficult mathematical problems.

Overall, the observation findings indicate that students who demonstrated stronger self-efficacy-related behaviors also tended to show greater persistence, more effective emotional regulation, and higher learning independence during mathematics learning. Conversely, students who displayed lower levels of these behaviors were more likely to hesitate, rely on teacher or peer assistance, and experience greater mathematical thinking obstacles. When interpreted alongside the questionnaire and interview data, these findings suggest an observed tendency that stronger self-efficacy is associated with fewer mathematical thinking obstacles. Therefore, mathematics instruction should provide rich mastery experiences, constructive feedback, and learning environments that encourage students to explore multiple solution strategies independently without fear of making mistakes.

Table 10 presents both the frequency (n) and percentage (%) of students' responses to each questionnaire item. Because the study involved only six participants, reporting frequencies alongside percentages provides a clearer representation of the response distribution and prevents percentages from being interpreted without reference to the actual number of respondents.

Table 10. Results of the Student Self-Efficacy Questionnaire

No	**Statement**	**Strongly Agree n (%)**	**Agree n (%)**	**Disagree n (%)**	**Strongly Disagree n (%)**
1	I am confident that I can solve problems if I have done similar ones before.	3 (50.0%)	0 (0.0%)	2 (33.3%)	1 (16.7%)
2	My previous successes have made me more confident in learning mathematics.	3 (50.0%)	2 (33.3%)	1 (16.7%)	0 (0.0%)
3	I feel capable of completing mathematics assignments because of my past experiences.	2 (33.3%)	3(50.0%)	1 (16.7%)	0 (0.0%)
4	I keep trying even though the problems are quite difficult.	2 (33.3%)	2 (33.3%)	2 (33.3%)	0 (0.0%)
5	My previous successes help me tackle difficult problems.	2 (33.3%)	3 (50.0%)	1 (16.7%)	0 (0.0%)

No	Statement	Strongly Agree n (%)	Agree n (%)	Disagree n (%)	Strongly Disagree n (%)
6	I feel confident that I can solve the problem when I see my friends succeed.	3 (50.0%)	0 (0.0%)	3 (50.0%)	0 (0.0%)
7	Seeing how my friends solve problems makes me more confident.	2 (33.3%)	2 (33.3%)	1 (16.7%)	1 (16.7%)
8	I can imitate my friends' strategies for solving mathematical problems.	2 (33.3%)	0 (0.0%)	4 (66.7%)	0 (0.0%)
9	My friends' success makes me believe that I can also succeed.	2 (33.3%)	2 (33.3%)	2 (33.3%)	0 (0.0%)
10	I feel more confident when my teacher says that I am capable of doing the problem.	2 (33.3%)	3 (50.0%)	1 (16.7%)	0 (0.0%)
11	Encouragement from my teacher makes me dare to try difficult problems.	2 (33.3%)	3 (50.0%)	1 (16.7%)	0 (0.0%)
12	Support from my friends makes me more enthusiastic about learning mathematics.	2 (33.3%)	2 (33.3%)	2 (33.3%)	0 (0.0%)
13	Praise from my friends makes me more enthusiastic about learning.	2 (33.3%)	3 (50.0%)	1 (16.7%)	0 (0.0%)
14	I remain calm when working on difficult mathematical problems.	2 (33.3%)	1 (16.7%)	2 (33.3%)	1 (16.7%)
15	I do not become anxious easily when working on mathematical problems in class.	1 (16.7%)	1 (16.7%)	3 (50.0%)	1 (16.7%)
16	I am able to control my nervousness when working on problems.	2 (33.3%)	1 (16.7%)	0 (0.0%)	1 (16.7%)
17	I remain enthusiastic even when I encounter difficulties in working on problems.	1 (16.7%)	4 (66.7%)	1 (16.7%)	0 (0.0%)

The self-efficacy questionnaire results reveal that the majority of students exhibited a relatively adequate level of confidence in mathematics learning, particularly within the dimension of mastery experience (Zamhariroh & Muhid, 2025) . This pattern was evidenced by the predominance of “agree” and “strongly agree” responses to items associated with prior success. Several students indicated that experiences such as solving similar problems, achieving previous academic success, and engaging in earlier learning activities contributed positively to their confidence in completing mathematical tasks. These findings suggest that mastery experience functions as the primary factor in the development of students' self-efficacy. Moreover, within the dimension of social persuasion, most students acknowledged that teacher encouragement and peer support played a significant role in enhancing their motivation and willingness to confront challenging mathematical problems.

In contrast, variability was observed in the dimensions of vicarious experience and emotional states. Not all students reported increased confidence solely through observing their peers' success, particularly with respect to adopting problem-solving strategies. Additionally, some students demonstrated indications of anxiety when dealing with mathematical tasks, as reflected in the proportion of "disagree" responses to statements related to calmness and the regulation of nervousness. These findings highlight that emotional factors remain a critical challenge in strengthening students' self-efficacy. Nevertheless, most students demonstrated a reasonably positive degree of persistence, as indicated by their continued efforts and reluctance to give up when encountering difficulties.

Based on the data analysis, students H.A.F., N.Z.D., and A.R.W.A. were classified within the high self-efficacy category. Students S.N.P. and A.R.A. were categorized as moderate, while I.L.P. was identified as possessing low self-efficacy. These results are consistent with the theoretical framework proposed by Albert Bandura, which posits that self-efficacy beliefs are shaped by mastery experience, vicarious experience, social persuasion, and physiological and affective states. Students with higher levels of self-efficacy tend to demonstrate greater persistence, stronger learning autonomy, and increased flexibility in applying diverse problem-solving strategies. Consequently, instructional practices that systematically provide opportunities for mastery experiences, reinforce social support, and cultivate a supportive learning environment are essential. Such approaches are expected to enhance students' self-efficacy while simultaneously mitigating cognitive obstacles in mathematics learning.

The interviews with the fifth-grade teacher showed that mathematics learning was carried out contextually and oriented toward numeracy literacy. The teacher related the material to students' real experiences so that learning became more meaningful and relevant. The teacher stated, "I usually start by relating the material to everyday events so that students feel it is relevant." This strategy was followed by practicing reading questions thoroughly, identifying known and unknown information, and constructing mathematical models before performing calculations. This approach aimed to develop systematic thinking and reduce procedural errors that often occur among elementary school students.

The teacher also emphasized the importance of using visual representations as thinking aids. Students were encouraged to use tables, pictures, or sketches according to the characteristics of the material. The teacher explained, "For comparison or statistics questions, tables are very helpful, while for geometry I ask them to make sketches." This practice helped students understand relationships between concepts and clarified the solution process. This finding indicates that learning activities emphasizing visualization can strengthen conceptual understanding while improving mathematical thinking skills. This effort is also in line with the needs of elementary school students, who are still transitioning from concrete to abstract thinking (Fyfe et al., 2014).

The interviews revealed that the main obstacles faced by students were related to interpreting questions and determining the first step. The teacher stated that students were "often confused about where to start," especially when the questions differed from the examples given. This difficulty was even more apparent in mixed calculations and contextual questions that required reasoning. Student responses varied, with most students tending to remain passive and wait for instructions, while others asked questions such as "Ma'am, what does this mean?" Some students also gave up before trying because they felt incapable.

These conditions reinforced the observation that didactical and conceptual obstacles remained dominant, especially among students with low self-confidence (Rittle-Johnson et al., 2015).

(Safitri et al., 2025) In addition, the interviews showed that self-efficacy played an important role in students' persistence and learning strategies. The teacher stated that "if the questions are similar to the examples, their confidence is quite high, but they find higher-order thinking skills (HOTS) questions too difficult." Only about 20–30% of students had the persistence to try other strategies after making mistakes. Factors that influenced students' abilities included internal aspects, such as logical ability, interest in learning, and self-confidence, as well as external factors, such as parental support, learning methods, and peer environment. To overcome these obstacles, the teacher applied scaffolding, asked probing questions, and provided peer tutoring. The teacher emphasized, "I do not give them the answers right away, but help them find the patterns themselves," with the aim of continuously improving students' independence, confidence, and mathematical thinking skills. These findings align with the self-efficacy framework proposed by Albert Bandura, which emphasizes that individuals' beliefs about their capabilities significantly influence their perseverance, strategic behavior, and willingness to engage with challenging situations. Consequently, the development of a supportive learning environment, the application of varied instructional strategies, and the provision of meaningful mastery experiences should be continuously strengthened to mitigate mathematical thinking obstacles (van de Pol et al., 2010).

CONCLUSION

The findings indicate considerable variation in elementary students' self-efficacy in mathematics learning. H.A.F., N.Z.D., and A.R.W.A. demonstrated high self-efficacy through confidence, persistence, and effective emotional regulation when solving challenging problems. S.N.P. and A.R.A. showed moderate self-efficacy, as their confidence depended largely on the similarity between new tasks and previous exercises. In contrast, I.L.P. exhibited low self-efficacy, reflected in limited confidence, negative social comparison, and a strong perception of inability. These findings highlight the importance of mastery experiences, teacher support, and a supportive learning environment in shaping students' beliefs about their mathematical capabilities.

Students' mathematical thinking obstacles were identified across instrumental, conceptual, didactical, and epistemological dimensions. Didactical obstacles were the most dominant, particularly students' dependence on teacher-provided examples and difficulties initiating problem-solving independently. Conceptual obstacles involved limited understanding and difficulty explaining mathematical ideas, instrumental obstacles were reflected in procedural inaccuracies, and epistemological obstacles appeared when students struggled to apply knowledge in unfamiliar contexts. Students with high self-efficacy generally experienced fewer and less complex obstacles and showed greater flexibility in exploring alternative strategies, whereas students with moderate self-efficacy relied more on familiar procedures. Students with low self-efficacy experienced more varied obstacles, especially in the instrumental, conceptual, and epistemological dimensions. However, because the study used an exploratory qualitative design with a small sample, these patterns should be interpreted as context-specific tendencies rather than confirmed relationships.

The findings suggest that mathematics instruction should emphasize conceptual understanding, strategic flexibility, knowledge transfer, and learning autonomy. Teachers are encouraged to use varied, contextualized, and student-centered strategies supported by mastery experiences, constructive feedback, scaffolding, and collaborative learning. Future research should design and evaluate instructional interventions grounded in self-efficacy theory and involve larger samples across strategies supported by mastery experiences, constructive feedback, scaffolding, and collaborative learning. Future research should design and evaluate instructional interventions grounded in self-efficacy theory and involve larger samples across different educational levels to produce broader evidence for educational practice and policy.

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