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Mathematical Reasoning Confidence and Problem-Solving Engagement among Grade 6 Learners

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ABSTRACT

This study investigated the relationship between mathematical reasoning confidence and problem-solving engagement among Grade 6 learners at Carikkikan Elementary School, City of Ilagan, Isabela. It employed a cross-sectional relational-predictive survey design using validated scales on mathematical reasoning confidence and problem-solving engagement. All eligible Grade 6 learners were invited through census sampling. Data were analyzed using the median, interquartile range, Spearman's rank-order correlation with bias-corrected and accelerated bootstrap confidence intervals, and Theil-Sen robust regression. Results showed that learners generally demonstrated high mathematical reasoning confidence and problem-solving engagement. However, moderate levels were observed in explaining and justifying solutions, persisting during mathematical reasoning, communicating mathematical ideas, and continuing after an unsuccessful attempt. Mathematical reasoning confidence was significantly and positively related to problem-solving engagement, with persistence in reasoning showing the strongest association. Robust regression further indicated that mathematical reasoning confidence significantly predicted problem-solving engagement and accounted for a meaningful proportion of its variation. The findings suggest that learners who trusted their capacity to interpret problems, choose strategies, justify answers, and continue through difficulty were more likely to participate actively and persistently in mathematical tasks. Mathematics instruction should therefore provide sustained opportunities for explanation, strategy comparison, error analysis, solution revision, guided questioning, and collaborative problem solving. Strengthening both reasoning confidence and engagement may help Grade 6 learners approach challenging mathematical tasks with greater assurance, effort, and persistence.

Keywords: *Grade 6 learners, mathematical reasoning, mathematics confidence, problem-solving engagement, robust regression, self-efficacy*

INTRODUCTION

Mathematics at the elementary level involves more than performing calculations and arriving at correct answers. Learners are expected to recognize relationships, interpret information, choose appropriate methods, explain their thinking, and determine whether a solution is reasonable. These abilities become more demanding in Grade 6, when learners work with fractions, decimals, measurement, geometry, patterns, algebraic ideas, statistics, and probability. The Philippine K to 12 Mathematics Curriculum also expects Grade 6 learners to apply mathematical operations to problems and real-life situations, create problems with reasonable answers, and communicate solutions using sound mathematical ideas. Such expectations place reasoning and problem solving at the center of mathematics learning rather than treating them as secondary skills (Department of Education, 2016).

Meeting these expectations, however, depends not only on what learners know but also on how they respond when a mathematical task becomes unfamiliar or difficult. Some learners can recall procedures but hesitate when asked to explain why a solution works. Others begin a problem with interest but stop when the first strategy fails. There are also learners who remain silent during mathematical discussions even when they have useful ideas. These classroom experiences suggest that competence and participation do not always develop at the same pace. A learner's confidence in reasoning may affect whether that learner attempts a problem, presents an explanation, asks for clarification, checks an answer, or continues working after making an error.

The need to strengthen these abilities is evident in Philippine assessment results near the end of elementary education. The Southeast Asia Primary Learning Metrics 2019 reported that Filipino Grade 5 learners obtained a mean mathematics score of 288, below the regional reference mean of 300. About 41 percent did not meet the mathematics proficiency expected at the end of lower primary education, while only 17 percent reached the proficiency expected at the end of primary education. Learners who reached the end-of-primary standard could perform operations involving fractions, interpret tables and graphs, and solve measurement problems that required unit conversion. Since Grade 5 learners are preparing to enter the final year of elementary school, these results point to the importance of examining the personal and learning-related conditions that may support their progress in Grade 6 (Department of Education, 2021).

One condition worthy of attention is mathematical reasoning confidence. It refers to learners' belief that they can understand mathematical relationships, examine given information, select a possible strategy, justify a solution, and assess the reasonableness of an answer. Confidence of this kind is more specific than simply liking mathematics or believing that one is generally good at the subject. It concerns the learner's judgment of whether a particular mathematical activity can be handled successfully. A review of mathematics self-efficacy research found that such beliefs are closely associated with learning behavior, performance, and the choices learners make while studying mathematics. The review also warned that confidence should be measured in ways that closely match the task or learning outcome being examined (Street et al., 2024).

Confidence can shape a learner's response even before a solution is produced. Learners who believe that they can make sense of a problem may be more willing to explore relationships, compare strategies, and revise an incorrect method. Those who doubt their ability may avoid difficult items, wait for another person to provide the procedure, or give up before fully examining the problem. Zakariya (2022) explained that mathematics self-efficacy influences whether students engage with mathematical tasks or avoid activities they consider beyond their ability. The systematic review also showed that confidence is not fixed. It may be strengthened through carefully designed learning experiences, feedback, successful task completion, modeling, and instruction that helps learners recognize their own progress.

Longitudinal evidence also indicates that learners' confidence and achievement can develop together. Grigg et al. (2018) found that mathematics self-efficacy positively predicted changes in mathematics achievement, while earlier interest in mathematics contributed to later self-efficacy. This finding suggests that confidence is not merely a reaction to high scores. It can also contribute to the effort and learning behavior through which stronger achievement develops. For Grade 6 learners, this relationship may be especially meaningful because their mathematical work often requires several connected steps. Learners must understand what is being asked, retrieve relevant knowledge, choose operations, organize a solution, and check whether the answer fits the conditions of the problem. Confidence may help them remain involved throughout this process rather than treating difficulty as a signal to stop.

Problem-solving engagement describes how actively and persistently learners take part in this process. It can be seen when learners read problems carefully, identify important information, represent mathematical relationships, test possible strategies, explain their ideas, listen to alternative solutions, and continue working after an unsuccessful attempt. Engagement therefore includes observable participation as well as the mental effort invested in understanding and solving a task. In a study involving fifth- and sixth-grade learners, Hidayatullah et al. (2024) found that mathematics self-efficacy was linked with behavioral engagement and helped explain how motivation was associated with participation in mathematics learning. Although the study was conducted outside the Philippines, its focus on learners from the same grade range supports the value of examining confidence and engagement together during the later elementary years.

Learners' participation may also be weakened by worry and fear of failure. When mathematical tasks are viewed as threatening, attention may shift from understanding the problem to avoiding embarrassment or anticipating an incorrect answer. Barroso et al. (2021) synthesized 223 studies and found a consistent negative relationship between mathematics anxiety and achievement across different age groups. The association was already present during childhood, showing that negative mathematical experiences should not be dismissed as concerns that appear only in secondary school. A Grade 6 learner who repeatedly experiences uncertainty, public correction, or unsuccessful problem solving may gradually become less willing to attempt demanding tasks. Examining reasoning confidence can therefore help identify whether learners approach mathematical challenges with assurance, hesitation, or avoidance.

The quality of classroom learning experiences may influence both confidence and engagement. The Organisation for Economic Co-operation and Development reported that teaching practices involving cognitive activation were strongly associated with students' confidence in mathematical reasoning and other mathematics tasks. These practices included encouraging students to consider different ways of solving problems and asking them to explain their reasoning. Such activities allow learners to see that mathematical thinking is not limited to recalling one prescribed procedure. They also give teachers opportunities to respond to partial understanding, recognize sound reasoning, and guide learners toward clearer explanations. Although the OECD findings were drawn from older students, they support a teaching principle that is also suitable for Grade 6 classrooms: learners build confidence when they are given regular opportunities to reason, explain, compare, and reflect (Organisation for Economic Co-operation and Development [OECD], 2024).

The available literature establishes that mathematics confidence is associated with achievement, motivation, participation, and persistence. Nevertheless, broad international and regional findings cannot fully explain how these qualities are expressed among Grade 6 learners in a particular elementary school. Learners may differ in their willingness to explain solutions, attempt unfamiliar tasks, seek assistance, work with classmates, and continue after encountering errors. These differences may not be captured by achievement scores alone. A learner may earn acceptable marks through memorized procedures while remaining uncertain when asked to justify an answer. Another learner may participate actively but struggle to organize a complete solution. Studying confidence and engagement together can provide a fuller account of how learners approach mathematical problem solving.

This study examine the extent to which learners believe in their capacity to reason mathematically and the degree to which they participate, persist, and invest effort in solving mathematical problems. It determine whether mathematical reasoning confidence is significantly related to problem-solving engagement. Conducted among Grade 6 learners of Carikkikan Elementary School in Carikkikan Norte, City of Ilagan, Isabela, the study provide school-based evidence for planning learning activities, feedback practices, and instructional support that respond to both the cognitive and personal sides of mathematics learning. Its findings may help teachers create opportunities in which learners are not only taught how to solve problems but are also encouraged to trust their reasoning, communicate their ideas, and remain involved when solutions require patience and revision.

Literature Review

Mathematical Reasoning Confidence

Mathematical reasoning confidence reflects learners' belief that they can interpret mathematical information, recognize relationships, select suitable procedures, and explain why a solution is valid. It differs from general academic confidence because it concerns judgments about handling specific mathematical demands. Learners with stronger confidence are more likely to approach unfamiliar tasks with a sense that the problem can be understood, although confidence alone does not guarantee successful performance. Kaskens et al. (2020)

examined 610 Grade 4 learners and found that mathematical self-concept was positively associated with arithmetic fluency, while growth in mathematical problem-solving was more strongly predicted by teachers' mathematical knowledge than by learners' self-efficacy, self-concept, or anxiety. The findings suggest that confidence should not be treated as a substitute for mathematical knowledge and sound instruction. Instead, it may be viewed as a personal resource that can encourage learners to use what they know, test possible strategies, and communicate their reasoning without becoming overly discouraged by uncertainty.

Problem-Solving Engagement

Problem-solving engagement refers to the attention, effort, participation, and persistence learners display while working through mathematical tasks. It is evident when learners examine the conditions of a problem, organize relevant information, try more than one strategy, use feedback, and remain involved when an immediate answer is not available. Reinhold et al. (2021) studied a sixth-grade class completing a four-week unit on fractions and found substantial differences in how learners participated emotionally and behaviorally despite receiving the same instruction. Positive mathematical orientations, particularly enjoyment and self-concept, were associated with greater intrinsic motivation, situational interest, and feelings of competence during learning. Emotional engagement also contributed to learning outcomes, while behavioral engagement was shaped partly by learners' prior knowledge. These results show that engagement is not adequately measured by task completion alone because two learners may finish the same activity while differing greatly in interest, concentration, strategic effort, and willingness to use available support.

Relationship Between Confidence and Engagement

Confidence and engagement are closely connected because learners' beliefs about their mathematical capability may influence how willingly they participate in challenging work. A learner who believes that mathematical ideas can be understood may be more prepared to explain an answer, contribute during discussions, and persist after an unsuccessful attempt. In contrast, repeated doubt may lead to silence, dependence on worked examples, or withdrawal from tasks requiring extended reasoning. Liu et al. (2018), in their study of 869 elementary learners, found that academic self-efficacy helped explain the relationship between teacher support and cognitive, behavioral, and emotional engagement in mathematics. Enjoyment also served as an important pathway through which supportive classroom experiences encouraged participation. Their findings indicate that confidence can support engagement by helping learners view mathematical activity as manageable, while positive emotions make sustained participation more likely. For Grade 6 learners, this connection may be particularly important when problems require several steps, careful explanation, and revision of an initial strategy.

Classroom Practices Supporting Confidence and Engagement

Classroom practices influence whether learners experience mathematics as an opportunity to reason or as a subject centered mainly on obtaining correct answers. Tasks that invite explanation, comparison of strategies, discussion of errors, and reflection on solutions can allow learners to participate meaningfully while developing trust in their own thinking. Murphy and Ingram (2023) reviewed 250 papers concerning mathematics classroom practices, affect, and learning outcomes, but found that only 26 studies clearly examined all three areas together. Their review showed that classroom practice, learner emotions, motivation, and engagement should not be studied as separate concerns because the way mathematics is taught can shape how learners feel and act during mathematical work. The limited number of well-integrated studies also supports the need for school-based research that examines learners' confidence and engagement together. Such evidence may help teachers identify whether Grade 6 learners need more opportunities for guided reasoning, productive discussion, supportive feedback, or sustained work on nonroutine problems.

METHODS

Research Design

The study employed a cross-sectional relational-predictive survey design with robust statistical estimation. This design was selected because the investigation examined mathematical reasoning confidence and problem-solving engagement as naturally occurring learner characteristics without introducing an instructional intervention or manipulating classroom conditions. The relational component determined whether changes in mathematical reasoning confidence corresponded with changes in problem-solving engagement, while the predictive component estimated the extent to which reasoning confidence accounted for variation in learners' engagement during mathematical problem solving. Robust procedures were incorporated to reduce the influence of non-normal scores, unequal variability, and unusual observations that could affect conventional parametric estimates. Data were gathered at one period during the school year, allowing the study to describe the prevailing conditions experienced by Grade 6 learners.

Research Locale

The study was conducted at Carikkikan Elementary School in Carikkikan Norte, City of Ilagan, Isabela. The school operated under the Schools Division Office of the City of Ilagan and provided basic education to learners from the community and nearby areas. It was selected as the research locale because the study addressed mathematical learning experiences among Grade 6 learners enrolled in the school. The locale also provided an appropriate setting for examining how learners approached mathematical reasoning and participated in problem-solving activities within their regular educational environment. Permission to conduct the investigation was secured from the concerned school and education authorities before the administration of the research instrument.

Participants and Sampling Technique

The participants consisted of Grade 6 learners who were officially enrolled at Carikkikan Elementary School during the period of data collection. Learners who were present during the scheduled administration, had obtained written parental or guardian consent, and had provided personal assent were included in the study. Learners who did not satisfy the consent requirements or were unavailable during data gathering were not compelled to participate. A census sampling technique was applied because all eligible Grade 6 learners in the identified locale were invited to take part. This technique allowed the investigation to represent the target group within the school without selecting only a smaller portion of the eligible learners.

Research Instrument

Data were obtained through a structured questionnaire composed of two major scales. The Mathematical Reasoning Confidence Scale contained 15 statements that measured learners' perceived ability to interpret mathematical information, identify relationships, select appropriate strategies, explain and justify solutions, evaluate the reasonableness of answers, and continue reasoning when a task became difficult. The Problem-Solving Engagement Scale also consisted of 15 statements that assessed learners' attention to mathematical tasks, effort, strategic participation, persistence, willingness to communicate solutions, use of feedback, and involvement in completing multistep problems. Responses were recorded using a four-point Likert-type scale with verbal descriptions suited to Grade 6 learners. The statements were written using direct and age-appropriate language to reduce misunderstanding and unnecessary reading difficulty.

The initial instrument underwent content validation by specialists in mathematics education, educational research, measurement and evaluation, and elementary instruction. The validators examined the relevance, clarity, developmental suitability, and alignment of each statement with the constructs being measured. Items judged to be repetitive, ambiguous, overly complex, or unrelated to the operational definitions were revised or removed. The Mathematical Reasoning Confidence Scale obtained a scale-level content validity index of S-CVI/Ave = .95, while the Problem-Solving Engagement Scale obtained S-CVI/Ave = .93. The complete questionnaire yielded an overall content validity index of S-CVI/Ave = .94, indicating strong agreement among the validators regarding the relevance and suitability of the items. These coefficients exceeded the minimum acceptable value of .80. The revised instrument was also reviewed for grammar, reading level, clarity of instructions, and appropriateness for elementary learners.

A pilot test was conducted among Grade 6 learners from another public elementary school who possessed learning characteristics comparable to those of the intended participants but were not included in the final data collection. The pilot administration assessed the clarity of the directions, adequacy of the response options, completion time, and internal consistency of the scales. Corrected item-total correlations were inspected, and statements with weak correlations or confusing wording were revised before the final administration. Cronbach's alpha was used to determine the reliability of the pilot-tested instrument. The Mathematical Reasoning Confidence Scale obtained an alpha coefficient of $\alpha = .87$, while the Problem-Solving Engagement Scale obtained $\alpha = .90$. The complete 30-item questionnaire produced an overall reliability coefficient of $\alpha = .92$. These findings demonstrated good to excellent internal consistency and indicated that the statements within each scale measured their intended constructs consistently.

Data Gathering

The researcher first prepared a formal request addressed to the appropriate school authorities seeking permission to undertake the study. After approval had been granted, the schedule of questionnaire administration was coordinated with the school head and the Grade 6 class adviser to prevent disruption of regular lessons and required school activities. Parental or guardian consent forms were distributed before data collection, and learner assent was obtained from those who agreed to participate.

Before the questionnaire was answered, the researcher explained the purpose of the study, the voluntary nature of participation, and the procedures for protecting the learners' identities. The directions and response options were discussed using language appropriate to the participants' level of understanding. Learners were informed that the activity was not an examination and that their responses would not affect their mathematics grades, classroom standing, or access to school services. The questionnaires were administered in a quiet classroom setting under the supervision of the researcher and the designated school personnel. Questions concerning the directions were clarified without suggesting particular responses.

Completed questionnaires were checked for missing pages and unanswered sections while preserving the participants' freedom to leave any item unanswered. No learner was required to complete a response against personal preference. The accomplished instruments were coded using identification numbers rather than names. The responses were then encoded in a password-protected data file, examined for encoding errors, and prepared for statistical analysis. Paper copies were kept in a secured location accessible only to the researcher.

Data Analysis

The data were analyzed using descriptive and robust inferential procedures appropriate for Likert-type composite scores. Frequency counts and percentages were used to summarize the distribution of responses for each questionnaire statement. The median and interquartile range were computed to describe the central response and variability because these statistics were less affected by skewed distributions and unusually high or low scores. Composite scores were calculated for mathematical reasoning confidence and problem-solving engagement after negatively worded statements, when applicable, had been reverse-coded.

McDonald's omega was computed as a supplementary reliability estimate for the final dataset because it did not require the strict assumption that all questionnaire items contributed equally to the construct. Cronbach's alpha was retained to permit comparison with the pilot-test findings. Corrected item-total correlations were also reviewed to determine whether each statement contributed adequately to its assigned scale.

Spearman's rank-order correlation coefficient was used to determine the direction and strength of the association between mathematical reasoning confidence and problem-solving engagement. This treatment was selected because it was suitable for ordered and potentially non-normal composite scores. A bias-corrected and accelerated bootstrap procedure with 5,000 resamples was applied to generate a 95 percent confidence interval for the correlation coefficient. The relationship was considered statistically significant when the confidence interval did not include zero and the probability value was below the .05 level.

The Theil-Sen robust regression estimator was used to examine whether mathematical reasoning confidence significantly predicted problem-solving engagement. This method estimated the typical rate of change in engagement associated with a one-unit increase in reasoning confidence and was less sensitive to extreme observations than ordinary least squares regression. The unstandardized slope, bootstrap confidence interval, probability value, and pseudo coefficient of determination were reported. Statistical conclusions were interpreted together with effect sizes and confidence intervals rather than being based solely on probability values.

Ethical Consideration

The study observed the ethical principles of voluntary participation, informed consent, learner assent, confidentiality, privacy, fairness, and protection from harm. Approval was obtained from the concerned educational authorities before any participant was approached. Since the participants were minors, written permission from their parents or legal guardians was secured, and each learner was given a clear explanation of the study before assent was requested.

Participation remained voluntary throughout the investigation. Learners were informed that they could decline participation, omit a question, or withdraw without punishment or disadvantage. No academic reward, grade, or classroom privilege was offered in exchange for participation. The questionnaire avoided statements that could embarrass, label, or psychologically distress the learners. Administration procedures were arranged to minimize pressure from teachers, classmates, and school personnel.

Names and other direct personal identifiers were not written on the research instruments or included in the statistical file. Codes were used during encoding, analysis, and reporting. Findings were presented only in summarized form so that individual responses could not be traced to particular learners. Digital records were stored in a password-protected file, while printed documents were placed in a secured storage area. The data were used solely for the stated research purpose and were managed in accordance with the principles of the Data Privacy Act of 2012. After the required retention period, electronic files and paper records were scheduled for secure deletion and disposal.

RESULTS AND DISCUSSION

Table 1. *Validity and Reliability Results of the Research Instrument*

Scale	Number of Items	S-CVI/Ave	Pilot Cronbach's Alpha	Final Cronbach's Alpha	McDonald's Omega	Interpretation
Mathematical Reasoning Confidence	15	.95	.87	.89	.90	Good reliability
Problem-Solving Engagement	15	.93	.90	.91	.92	Excellent reliability
Entire Instrument	30	.94	.92	.93	.94	Excellent reliability

Note. S-CVI/Ave referred to the scale-level content validity index using the average method. Coefficients of .70 or higher were considered acceptable.

Table 1 presents the validity and reliability evidence for the questionnaire. The scale-level content validity indices ranged from .93 to .95, indicating that the validators found the items relevant, understandable, and appropriate for Grade 6 learners. The entire instrument obtained an S-CVI/Ave of .94, which exceeded the minimum acceptable value of .80. This result indicated strong agreement among the validators regarding the alignment of the statements with mathematical reasoning confidence and problem-solving engagement.

The pilot-test Cronbach's alpha coefficients were .87 for mathematical reasoning confidence and .90 for problem-solving engagement. These values showed that the items within each scale consistently measured the same general construct. Reliability remained strong during the final administration, with alpha coefficients of .89 and .91. McDonald's omega values of .90 and .92 further confirmed that the items contributed adequately to their respective scales even when equal item contribution was not assumed.

The reliability findings showed that the questionnaire produced sufficiently stable scores for the relational and predictive analyses. The slightly higher coefficients for problem-solving engagement indicated that learners responded more consistently to statements concerning attention, effort, participation, feedback use, and persistence. Mathematical reasoning confidence also showed good internal consistency, although learners appeared to distinguish among confidence in interpreting problems, selecting strategies, explaining solutions, and continuing after an unsuccessful attempt.

Table 2. *Mathematical Reasoning Confidence of Grade 6 Learners*

Indicator	Median	Interquartile Range	Learners at Moderate or Low Level (%)	Interpretation
Understanding and representing mathematical information	3.14	0.50	23.5	High
Selecting an appropriate strategy	3.02	0.58	31.4	High
Explaining and justifying a solution	2.42	0.67	52.9	Moderate
Checking the reasonableness of an answer	2.76	0.63	37.3	High
Persisting during mathematical reasoning	2.47	0.75	56.9	Moderate
Overall mathematical reasoning confidence	2.79	0.54	39.2	High

Note. The interpretation followed these intervals: 3.26 to 4.00, very high; 2.51 to 3.25, high; 1.76 to 2.50, moderate; and 1.00 to 1.75, low.

Table 2 shows that the Grade 6 learners had a high overall level of mathematical reasoning confidence, with a median of 2.79 and an interquartile range of 0.54. The result indicated that most learners generally believed that they could understand mathematical problems, identify useful information, choose possible strategies, and determine whether an answer was reasonable. However, 39.2 percent of the learners remained within the moderate or low categories. The overall interpretation therefore did not mean that confidence was uniformly strong across the group.

Understanding and representing mathematical information received the highest median of 3.14. This finding indicated that learners were generally comfortable identifying known information, recognizing what a problem required, and translating written conditions into mathematical expressions or representations. Their confidence in strategy selection was also high, with a median of 3.02. Many learners believed that they could choose a suitable operation or method when the structure of the problem was familiar.

The result changed when learners were required to explain and justify their solutions. This indicator obtained a median of 2.42, interpreted as moderate, while 52.9 percent of the learners were classified within the moderate or low levels. Learners appeared more confident in producing an answer than in providing a complete mathematical explanation. They may have known which operation to perform but were less certain about describing why the operation was appropriate, defending each step, or responding when asked to present another method.

Confidence in persisting during mathematical reasoning also remained moderate, with a median of 2.47. More than half of the learners fell within the moderate or low categories for this indicator. The result revealed a practical concern because Grade 6 mathematical problems often required several connected procedures. Learners who encountered an incorrect first attempt may have waited for assistance, copied another solution, or stopped working rather than reconsidering the information and testing a different method.

The difference between understanding a problem and explaining or persisting through it showed that confidence was strongest during the opening stages of problem solving but weakened when sustained reasoning was required. The finding agreed with Herset et al. (2023), who found that learners' efficacy judgments could change according to how difficult a mathematical task appeared. When tasks were perceived as difficult, confidence declined even when the mathematical content remained the same. This condition may explain why learners expressed confidence in familiar problem structures but became uncertain when tasks demanded justification, several steps, or alternative strategies.

The result also supported the findings of Koponen et al. (2021), who established that mathematical self-efficacy among elementary learners could be strengthened through a combination of strategy instruction and direct efficacy support. Successful experiences, specific encouragement, observation of manageable solution processes, and attention to learners' emotional responses contributed to improved confidence. The moderate results for explanation and persistence therefore represented areas that could be improved rather than fixed learner limitations.

Table 3. *Problem-Solving Engagement of Grade 6 Learners*

Indicator	Median	Interquartile Range	Learners at Moderate or Low Level (%)	Interpretation
Attending to and beginning a problem-solving task	3.09	0.50	27.5	High
Applying strategic effort	2.78	0.63	39.2	High
Communicating mathematical ideas and solutions	2.46	0.75	54.9	Moderate
Using feedback to improve a solution	2.66	0.67	43.1	High
Persisting after an unsuccessful attempt	2.38	0.83	60.8	Moderate
Overall problem-solving engagement	2.69	0.58	45.1	High

Table 3 reveals that the Grade 6 learners had a high overall level of problem-solving engagement, with a median of 2.69 and an interquartile range of 0.58. Learners generally attended to assigned mathematical activities, began working on problems, applied effort, and responded to teacher feedback. Nevertheless, 45.1 percent remained within the moderate or low levels. The result showed that almost half of the group did not consistently demonstrate strong engagement across all stages of problem solving.

Attending to and beginning a task obtained the highest median of 3.09. Most learners were able to focus on the initial directions and start an assigned problem. This result may have reflected their familiarity with teacher-led classroom routines and structured mathematical exercises. Strategic effort also received a high interpretation, although its median of 2.78 was lower. Learners appeared willing to apply known procedures, but their effort may have decreased when a task did not closely resemble a worked example.

Mathematical communication obtained a moderate median of 2.46. More than half of the learners were within the moderate or low categories. They did not consistently volunteer explanations, compare their answers with classmates, ask questions about unclear steps, or present alternative approaches. Some learners may have participated through written computation but remained hesitant during oral discussion. Others may have viewed mathematical communication as a task reserved for learners who were certain that their answers were correct.

The lowest result was recorded for persistence after an unsuccessful attempt, with a median of 2.38. A considerable 60.8 percent of the learners demonstrated moderate or low engagement in this area. This finding identified the most serious concern in the results. Learners could begin a problem with reasonable attention, but many had difficulty remaining engaged when their first procedure failed, when the answer did not match the expected result, or when several operations had to be coordinated.

The wider interquartile range of 0.83 for persistence also indicated substantial differences among learners. Some remained actively involved despite difficulty, while others withdrew quickly. A classroom could therefore appear generally engaged even though a considerable group depended heavily on immediate teacher assistance or direct procedural guidance. The overall high rating should be interpreted beside this variation rather than taken as evidence that all learners were consistently persistent.

Middleton et al. (2023) described mathematical engagement as a combination of learners' judgments of control, the value they assigned to the task, emotional reactions, and support available from teachers and peers. Their findings showed that engagement changed according to the demands of a task and the classroom experiences surrounding it. The present result followed this pattern because learners participated more readily at task initiation but became less involved when they had to communicate uncertain ideas or recover from an unsuccessful solution.

The moderate communication result also indicated that classroom participation may have been associated with learners' fear of error. Wang et al. (2024) found that stronger mathematical self-efficacy was connected with lower mathematics anxiety among elementary learners. When learners doubted their capability, they were more likely to experience worry and become reluctant to participate. Supportive teacher relationships helped, but confidence remained an important personal condition. Learners may therefore require a classroom atmosphere where incomplete reasoning can be discussed without embarrassment and where errors are treated as information for improving a solution.

Table 4. *Relationship Between Mathematical Reasoning Confidence and Problem-Solving Engagement*

Mathematical Reasoning Confidence Indicator	Spearman's rho with Overall Engagement	BCa 95% Confidence Interval	Probability Value	Interpretation	Decision
Understanding and representing mathematical information	.39	[.18, .56]	.004	Moderate positive	Significant
Selecting an appropriate strategy	.47	[.27, .62]	.002	Moderate positive	Significant
Explaining and justifying a solution	.53	[.34, .67]	.001	Moderate positive	Significant
Checking the reasonableness of an answer	.44	[.24, .60]	.003	Moderate positive	Significant
Persisting during mathematical reasoning	.62	[.46, .74]	.001	Strong positive	Significant
Overall mathematical reasoning confidence	.57	[.39, .70]	.001	Moderate positive	Significant

Note. BCa referred to the bias-corrected and accelerated bootstrap confidence interval based on 5,000 resamples. The null hypothesis was rejected at the .05 significance level.

Table 4 presents a statistically significant positive relationship between mathematical reasoning confidence and problem-solving engagement. The overall Spearman correlation coefficient was .57, with a BCa 95 percent confidence interval ranging from .39 to .70 and a probability value of .001. Since the confidence interval did not include zero and the probability value was below .05, the null hypothesis of no significant relationship was rejected.

The coefficient represented a moderate positive relationship. Learners who reported stronger confidence in interpreting mathematical information, selecting strategies, explaining solutions, checking answers, and continuing through difficulty also tended to report stronger attention, effort, participation, feedback use, and persistence during problem solving. Confidence and engagement were not identical constructs, but they moved in the same direction.

Persistence during mathematical reasoning had the strongest relationship with overall engagement, with a coefficient of .62. This result meant that learners who believed they could continue reasoning after difficulty were also more likely to remain actively involved in problem-solving tasks. The strength of this relationship was important because persistence received one of the lowest descriptive ratings. The area that represented the greatest difficulty for learners was also the confidence component most strongly connected with their engagement.

Explaining and justifying a solution produced the second highest relationship, with a coefficient of .53. Learners who believed they could defend their answers were more likely to discuss strategies, use feedback, and remain involved in completing mathematical tasks. Confidence in explanation may have supported participation because learners who trusted their reasoning were less likely to remain silent or depend entirely on the teacher's method.

Understanding and representing information had the weakest relationship with engagement, although it remained statistically significant. Its coefficient of .39 indicated that understanding the initial conditions of a problem was helpful but did not ensure continued participation. A learner could identify relevant information and still discontinue work when the solution became difficult. Sustained engagement appeared to depend more heavily on confidence in persistence and explanation than on confidence in reading the problem alone.

The findings were consistent with the synthesis of Granello et al. (2025), which showed that mathematical self-competence beliefs were associated with interest, perseverance, emotional responses, and learning behavior. Their review also emphasized that confidence and mathematics performance could strengthen one another over time. Learners who experienced manageable success developed stronger beliefs, while stronger beliefs encouraged greater effort and continued participation.

The relationship did not establish that confidence alone caused engagement. Classroom instruction, prior mathematical knowledge, task difficulty, peer interaction, emotional responses, and teacher support may also have contributed to the learners' participation. However, the moderate relationship showed that reasoning confidence was a meaningful part of the engagement pattern and should not be overlooked when planning Grade 6 mathematics instruction.

Table 5. *Theil-Sen Robust Regression Predicting Problem-Solving Engagement*

Predictor	Theil-Sen Estimate	BCa 95% Confidence Interval	Probability Value	Decision
Constant	1.08	[.62, 1.49]	.003	Significant
Mathematical reasoning confidence	.58	[.39, .77]	.001	Significant

Model Fit Measure	Value
Pseudo R^2	.32
Median absolute prediction error	.27
Bootstrap resamples	5,000

Table 5 shows that mathematical reasoning confidence significantly predicted problem-solving engagement. The Theil-Sen slope estimate was .58, with a BCa 95 percent confidence interval from .39 to .77 and a probability value of .001. The interval remained entirely above zero, showing that the positive predictive relationship was stable across the bootstrap resamples.

The slope indicated that every one-unit increase in mathematical reasoning confidence corresponded with an estimated 0.58-unit increase in problem-solving engagement. The result was based on a robust estimator that reduced the influence of unusual scores. It therefore provided evidence that the finding was not produced only by a small number of learners who reported extremely high or low levels.

The model obtained a pseudo-R^2 of .32. Mathematical reasoning confidence accounted for a meaningful portion of the variation in engagement, but most of the variation remained unexplained by confidence alone. This result was realistic because learners' engagement could also have been affected by mathematical knowledge, reading comprehension, the difficulty of assigned problems, classroom relationships, instructional support, and prior experiences with success or failure.

The median absolute prediction error of .27 indicated that the model produced reasonably close estimates of engagement, although individual differences remained. Two learners with similar confidence scores could still differ in their participation because one might receive stronger peer support, understand the lesson more clearly, or possess better-developed mathematical procedures. The result supported the usefulness of confidence as a predictor while showing that it should not be treated as the sole basis for understanding engagement.

The predictive result corresponded with Koponen et al. (2021), who showed that strengthening self-efficacy alongside mathematical strategy instruction benefited elementary learners with low initial confidence and weak calculation performance. Their findings supported an integrated approach. Learners needed both the skills required to solve mathematical problems and learning experiences that helped them believe those skills could be used successfully.

Granello et al. (2025) likewise found that interventions involving collaboration and technology showed promise in improving mathematical competence beliefs, while self-regulation and instructional interventions were often more effective for improving mathematical outcomes. These findings indicated that the learners in the present study would not benefit from encouragement alone. Support should combine guided strategy instruction, manageable mathematical challenges, structured peer explanation, feedback on reasoning, and opportunities to revise unsuccessful solutions.

Summary of the Major Findings

The instrument demonstrated strong content validity and internal consistency. Grade 6 learners showed high overall mathematical reasoning confidence and problem-solving engagement, but the results revealed important weaknesses beneath these general ratings. Confidence in explaining solutions and persisting during reasoning remained moderate. Engagement in mathematical communication and persistence after an unsuccessful attempt was also moderate.

A significant moderate positive relationship was found between mathematical reasoning confidence and problem-solving engagement. Persistence confidence produced the strongest association with engagement. Mathematical reasoning confidence also significantly predicted problem-solving engagement through the Theil-Sen robust regression model, with a pseudo-R^2 of .32.

The findings indicated that the central concern was not the learners' willingness to begin mathematical tasks. The more serious difficulty appeared when learners had to explain their reasoning, handle an incorrect attempt, and continue working without immediate confirmation. Instructional support should therefore move beyond providing more exercises. Grade 6 learners would benefit from activities that require them to explain strategies, compare approaches, examine errors, revise solutions, and experience progress through appropriately challenging mathematical work.

CONCLUSION

The Grade 6 learners generally demonstrated high mathematical reasoning confidence and problem-solving engagement, although notable weaknesses remained in explaining solutions, sustaining effort after an unsuccessful attempt, and communicating mathematical ideas. Mathematical reasoning confidence was significantly and positively related to problem-solving engagement, with persistence in reasoning showing the strongest association. It also significantly predicted learners' engagement, indicating that those who trusted their ability to interpret problems, select strategies, justify answers, and continue working through difficulty were more likely to participate actively and persistently in mathematical tasks. Based on these findings, mathematics teachers should provide regular opportunities for learners to explain their reasoning, compare solution methods, analyze errors, revise incomplete answers, and solve appropriately challenging problems. Structured peer discussion, guided questioning, specific feedback, and scaffolded problem-solving activities should also be used to strengthen both confidence and engagement. The school may further support teachers through learning sessions focused on reasoning-centered instruction and classroom strategies that encourage productive struggle. Future researchers may examine additional factors such as mathematics anxiety, prior achievement, teacher support, and classroom climate to develop a broader explanation of learners' problem-solving participation.

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