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Students' Self-Efficacy in Mathematical Problem Solving and the Problem-Solving Processes of Learners with Low Self-Efficacy

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ABSTRACT

This study investigated (1) the level of students' self-efficacy in mathematical problem-solving and (2) the problem-solving processes of students with low self-efficacy. A validated self-efficacy scale was given to secondary mathematics students to classify their self-efficacy levels. Classroom observations and semi-structured interviews were then conducted with selected students with low self-efficacy to examine their problem-solving behaviors. Descriptive statistics were used to determine self-efficacy levels, while qualitative case analysis examined students' strategies, persistence, emotional responses, and reliance on support during problem-solving. Findings showed that most students had moderate self-efficacy, whereas a small group had low self-efficacy, characterized by hesitation, avoidance, and dependence on external guidance. These students displayed fragmented problem-solving processes and behavioral tendencies when faced with mathematical challenges. The study underscores the need to identify learners with low self-efficacy early and highlights that understanding their problem-solving behaviors is essential for developing targeted interventions. By informing the creation of instructional scaffolds that foster both confidence and active engagement, the results suggest practical ways to enhance the mathematical learning outcomes of those who struggle with self-efficacy.

Key Words: Case Analysis, Problem-Solving Processes, Low Self-Efficacy Learners, Mathematics Education, Self-Efficacy.

1. INTRODUCTION

Problem-solving is central to mathematics education, enabling learners to apply conceptual understanding, procedural knowledge, and reasoning skills to unfamiliar situations. Despite its importance, many students struggle with mathematical problem-solving because of both cognitive demands and affective factors that influence their engagement and persistence. One such factor is self-efficacy, which refers to individuals' beliefs in their capability to organize and execute actions required to achieve specific outcomes (Bandura, 1997).

Self-efficacy plays a significant role in shaping how students approach mathematical tasks. Learners with high self-efficacy are more likely to persist when confronted with challenging problems, employ flexible strategies, and view difficulties as opportunities for learning. In contrast, students with low self-efficacy tend to avoid complex tasks, hesitate to initiate problem-solving, and experience anxiety when faced with mathematical challenges (Pajares & Miller, 1994; Zimmerman & Schunk, 2013). These beliefs influence not only students' motivation but also the quality of their problem-solving processes.

Research has consistently demonstrated a positive relationship between self-efficacy and academic performance in mathematics. Students who believe in their capabilities are more likely to engage deeply with tasks and achieve higher levels, while those with low self-efficacy often disengage and rely heavily on external assistance (Bandura, 1997;

Schunk & DiBenedetto, 2020). However, while the relationship between self-efficacy and performance is well established, fewer studies have closely examined how students with low self-efficacy actually engage in problem-solving within classroom contexts.

Understanding students' problem-solving processes is essential, particularly for learners who struggle with confidence. Problem-solving involves more than arriving at a correct answer; it includes how students interpret problems, select strategies, regulate their emotions, and persist when difficulties arise. Students with low self-efficacy often employ fragmented strategies, experience self-doubt, and exhibit emotional responses such as anxiety and frustration, which can hinder their ability to complete tasks effectively (Linnenbrink & Pintrich, 2003; Morales-Rodriguez et al., 2019).

Identifying students with low self-efficacy and examining their problem-solving behaviors can provide valuable insights into the challenges they face and the types of instructional support they may need. By describing both students' self-efficacy levels and the problem-solving processes of those with low self-efficacy, educators can better understand how affective factors influence mathematical learning and inform the design of instructional practices that support student engagement and persistence.

In this context, the present study focuses on two primary objectives: (1) identifying the level of students' self-efficacy in mathematical problem-solving and (2) observing and describing the problem-solving processes of students with low self-efficacy. By situating the investigation in authentic classroom settings, this study aims to deepen understanding of the role of self-efficacy in shaping students' engagement in mathematical problem-solving.

2. METHODOLOGY

2.1 Research Design

The study used a descriptive design with qualitative support to examine students' self-efficacy in mathematical problem-solving and the problem-solving processes of low self-efficacy students. Quantitative data determined students' self-efficacy levels, while qualitative data provided in-depth descriptions of the problem-solving processes of students with low self-efficacy. Prior to data collection, informed consent was obtained from all participants, and the study ensured confidentiality and voluntary participation in accordance with ethical guidelines.

2.2 Participants and Setting

The participants were secondary school students enrolled in a mathematics class at a laboratory secondary school in Lanao del Norte, Philippines. A total of 31 students participated in the self-efficacy survey administered at the beginning of the study.

The intended number of participants for the qualitative phase of the study was five to ten (5–10) students identified as having low self-efficacy in mathematical problem-solving. However, survey results indicated that only four (4) students met the criteria for low self-efficacy. Of these, one (1) student declined to participate in the observation and interview phase of the study.

To ensure sufficient qualitative data and maintain alignment with the study's focus, the researcher included students with moderate self-efficacy whose scores were close to those of the low self-efficacy group. These students showed confidence levels and behavioral indicators similar to the identified low self-efficacy learners.

In total, six (6) students agreed to participate in the qualitative phase of the study and were included in classroom observations and interviews. This selection process aligns with purposive sampling in qualitative research, in which participants are chosen based on their relevance to the research objectives and the depth of information they can provide.

2.3 Research Instruments

A General Self-Efficacy Scale adapted for mathematical problem-solving was used to determine students' self-efficacy levels. Classroom observation guides and semi-structured interview protocols were employed to examine students' problem-solving behaviors, strategies, emotional responses, and help-seeking tendencies.

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2.4 Data Collection Procedure

The self-efficacy survey was administered to classify students into high, moderate, and low self-efficacy levels. Selected students with low self-efficacy were then observed while solving mathematical problems during regular class sessions. Post-task interviews were conducted to further explore their thought processes and experiences during problem-solving.

2.5 Data Analysis

Quantitative data from the questionnaire were analyzed using descriptive statistics to determine the frequency and percentage distribution of self-efficacy levels. Qualitative data from observations, interviews, and video recordings were analyzed through case-based analysis and triangulation. Patterns of behavior related to task initiation, strategy use, help-seeking, and behavioral mannerisms were identified to describe students' problem-solving processes with low self-efficacy.

3. RESULTS AND DISCUSSIONS

3.1 Level of Students' Self-Efficacy In Mathematical Problem Solving

Table 1 presents the distribution of students' self-efficacy levels in mathematical problem solving.

Table 1. Level of Students' Self-Efficacy in Problem Solving

Self-Efficacy Level	Frequency	Percentage
High Self-Efficacy	13	41.9%
Moderate Self-Efficacy	14	45.2%
Low Self-Efficacy	4	12.9%
Total	31	100%

As shown in Table 1, most students (14 out of 31, 45.16%) demonstrated moderate self-efficacy, indicating that while they have some confidence in solving mathematical problems, their belief in their abilities is not consistently strong. A substantial proportion (13 out of 31, 41.94%) exhibited high self-efficacy, suggesting positive beliefs toward mathematical problem-solving and readiness to engage with challenging tasks. A smaller group (4 out of 31, 12.90%) was identified as having low self-efficacy.

The presence of students with low self-efficacy is a critical finding, as self-efficacy beliefs strongly influence students' motivation, persistence, and engagement in learning tasks. According to Bandura (1997), students with low self-efficacy are more likely to doubt their capabilities, exert less effort, and disengage when they encounter difficulties. Consistent with previous studies, learners with low self-efficacy tend to avoid complex mathematical tasks and experience heightened anxiety during problem-solving (Pajares & Miller, 1994; Zimmerman & Schunk, 2013).

Although most students were in the moderate self-efficacy category, this result suggests that learners' confidence levels are malleable and can be strengthened through appropriate instructional support. This finding highlights the importance of examining not only self-efficacy levels but also how students with low self-efficacy engage in problem-solving, as discussed in the next section.

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3.2 Problem-Solving Processes of Students with Low Self-Efficacy

Qualitative analysis revealed distinct and recurring patterns in the problem-solving processes of students with low self-efficacy. These patterns were evident across classroom observations, interviews, and video recordings and were characterized by hesitation in task initiation, avoidance behaviors, reliance on external scaffolding, and behavioral mannerisms when facing difficulty.

3.2.1 Hesitation and Avoidance in Task Initiation

A prominent characteristic among students with low self-efficacy was hesitation and avoidance in starting problem-solving tasks. These students often delayed beginning a problem, waited for teacher prompts, or expressed uncertainty before attempting a solution. Such behaviors reflect diminished confidence in their abilities and fear of making mistakes, features commonly associated with low self-efficacy (Bandura, 1997; Linnenbrink & Pintrich, 2003).

Classroom observations showed prolonged pauses, minimal written output, and students staring at worksheets without starting any steps. When faced with unfamiliar or demanding tasks, students sometimes skipped items or disengaged, suggesting avoidance as a coping strategy. Interview data supported these observations, with students reporting tendencies to delay answering until they felt more certain or to abandon tasks when confusion persisted.

Students with low self-efficacy relied heavily on memorized procedures and had difficulty adapting their approaches when initial attempts failed. This rigid and fragmented problem-solving behavior aligns with research showing that students who doubt their abilities are less likely to explore alternative strategies or engage in deeper reasoning (Difranceska et al., 2016; Schunk & DiBenedetto, 2020). Overall, hesitation and avoidance show how low self-efficacy shapes expectations of failure, reducing effort, persistence, and strategic exploration.

3.2.2 Reliance on External Scaffolding

Another recurring pattern was students' strong dependence on external scaffolding. Observations showed that low self-efficacy students often sought confirmation from teachers or peers before moving to the next step in a solution. Even when their responses were correct, they expressed doubt and needed reassurance. This behavior suggests limited confidence in their judgments and insufficient mastery experiences, which Bandura (1997) identifies as critical for developing self-efficacy.

During classroom activities, these students regularly asked clarifying questions, compared answers with classmates, or waited for worked examples before attempting a task independently. While help-seeking can be productive, in this context it appears more as dependency than strategic collaboration. Interview responses showed that students felt more capable when explicit guidance was available, indicating their difficulties were closely tied to perceived competence and confidence. The reliance on external validation underscores how low self-efficacy limits autonomous problem-solving and reinforces dependence on instructional support.

3.2.3 Behavioral Mannerisms During Problem Solving

Beyond cognitive and strategic challenges, students with low self-efficacy displayed distinct behavioral mannerisms during problem-solving activities. Observational notes documented recurring bodily and task-related behaviors, particularly for SLE4, such as habitual fidgeting (curling hair, touching eyelashes or bangs), prolonged staring at materials, and frequent pauses during responses. At times, SLE4 watched instructional videos without attempting the task, refrained from writing, appeared disengaged from written work, or engaged in off-task conversations, indicating difficulty maintaining task focus.

Interview data provided more context to these behaviors. Students described tendencies to pause, delay responses, or stop working when tasks became challenging, which matched the observed interruptions in written work and on-task behavior. These accounts support the view that students' problem-solving processes were marked by

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intermittent engagement rather than continuous, self-directed activity. These reactions disrupted their concentration and reduced their persistence, often resulting in incomplete or abandoned solutions (Burns et al., 2020).

Video recordings corroborated these observations, capturing behaviors such as closing the eyes, resting the head or chin on the desk, playing with hair, and other repetitive gestures while working. During assessment periods, the classroom environment was generally quiet, with several students exhibiting similar mannerisms, including minimal movement, head resting, and brief interruptions in writing.

Evidence from observations, interviews, and video data indicates that low self-efficacy students exhibited observable behavioral patterns, such as fidgeting, prolonged inactivity, and off-task behavior, that sometimes disrupted their task management during factoring activities. These mannerisms coincided with moments of difficulty and were associated with reduced persistence and fragmented engagement in problem-solving tasks.

4. CONCLUSION

This study examined students' self-efficacy in mathematical problem-solving and described the problem-solving processes of students with low self-efficacy. The findings showed that students have varying levels of self-efficacy, with most demonstrating moderate confidence and a smaller proportion demonstrating low self-efficacy. These differences in self-beliefs were reflected in students' engagement, persistence, and approaches to mathematical problem-solving.

Students with low self-efficacy displayed distinct problem-solving patterns characterized by hesitation in task initiation, limited and fragmented strategy use, behavioral mannerisms, and reliance on external support. These behaviors show that self-efficacy influences not only students' motivation but also the coherence and depth of their problem-solving processes.

Overall, the findings highlight the importance of identifying learners with low self-efficacy and understanding their experiences during problem-solving. Addressing affective factors alongside cognitive demands is essential to supporting students' engagement and persistence in mathematics. Recognizing how self-efficacy influences problem-solving behavior enables educators to provide timely instructional support that fosters confidence and persistence. Creating a classroom environment that emphasizes effort, strategic thinking, and learning from mistakes can help reduce anxiety and promote positive self-beliefs among learners.

5. RECOMMENDATIONS

Based on the study's findings, several recommendations are proposed. Teachers are encouraged to identify students with low self-efficacy early and provide instructional support that fosters confidence and persistence in problem-solving. Creating a classroom environment that emphasizes effort, strategy use, and learning from errors may help reduce anxiety and promote positive self-beliefs among learners.

Instructional practices that include guided questioning, constructive feedback, and opportunities for successful problem-solving may help students with low self-efficacy develop more coherent and adaptive problem-solving strategies. Allowing students to verbalize their thinking and reflect on their solutions can also help strengthen their confidence in their own reasoning.

For future research, studies may explore self-efficacy and problem-solving processes across different mathematical topics, grade levels, or learning contexts. Further investigations may also examine how specific instructional practices influence the development of self-efficacy over time, particularly among learners who initially exhibit low confidence in mathematics.

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