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Research Article

Analysis of Students' Self-Efficacy in Solving Mathematical Problem through Problem Based Learning

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ABSTRACT

Students with good self-efficacy are generally able to overcome challenges in various aspects of life. This study aimed to measure students' self-efficacy in learning mathematics in the Mathematics Education Department of Malikussaleh University during the 2024/2025 academic year. With technological support, PBL can be implemented more interactively and flexibly, enabling students to access learning resources, engage in online discussions, and develop problem-solving abilities independently. A qualitative research method was employed, with data collected through a questionnaire. The subjects of this study were students enrolled in the Mathematics Education Department at Malikussaleh University. The data analysis in this study was carried out through three stages: data reduction, data display, and conclusion drawing. A total of 41 students participated in the study. The results showed that 6 students (15%) had high self-efficacy, 31 students (75%) had moderate self-efficacy, and 4 students (10%) had low self-efficacy. The average self-efficacy score among students was 76.47%. Based on these findings, students of the Mathematics Education Department at Malikussaleh University can generally be categorized as having a moderate level of self-efficacy. Analysis of the questionnaire data indicates that most students put significant effort into solving the problems assigned by lecturers, and some reported never procrastinating on tasks. While some students disagreed with completing tasks only at the deadline, others disagreed with the idea of never postponing tasks and stated that they preferred to work under deadline pressure. Strengthening this psychological construct is crucial not only for deepening students' understanding of mathematical concepts but also for improving their preparedness and effectiveness as future mathematics teachers.

Keywords: Self-Efficacy; Mathematics Problems; Problem-Based Learning; PBL; Mathematics Learning; Teaching Mathematics

1. INTRODUCTION

The rapid advancement of technology and the internet has had a profound impact on Generation Z. Generation Z refers to the so-called "internet generation" or *digital natives*—children who have been familiar with and actively engaged in current global developments since an early age. The internet has permeated various sectors, including health, defense and security, and particularly education (Fachrul & Filo, 2022). The integration of the internet into the learning process has fundamentally transformed it from traditional, pre–information and communication technology methods into more engaging approaches that capture students' attention (Anggraeny et al., 2020). The rapid growth of technology and internet connectivity has significantly shaped Generation Z, who have grown up in a digital era where social media, mobile devices, and online connectivity are integral parts of daily life (Muliana et al., 2021). The education system is thus expected to develop learners who possess strong communication and collaboration skills, critical thinking abilities, creativity, innovation, and problem-solving competencies.

The development of digital technology has brought major changes to education. Beyond cognitive aspects, students' success in solving mathematical problems is also influenced by self-efficacy—defined as an individual's belief in their ability to confront and complete academic tasks. Self-efficacy refers to one's belief in their capacity to plan and execute the actions necessary to achieve specific goals (Bandura, 1997; Pajares, 1996). This belief is subjective and significantly affects motivation, persistence, and achievement in academic tasks (Schunk, 1989; Zimmerman, 2000). According to Kleppang et al. (2023), Ahmad (2025), and Kania et al. (2020), enhancing self-efficacy among adolescents is of great importance. Improving students' self-efficacy can help reduce anxiety in mathematics learning (Fatwana et al., 2024; Gusteti et al., 2025).

Gaol and Rosito (2023) describe self-efficacy as an individual's ability to assess their own capabilities, encompassing self-confidence, adaptability, cognitive capacity, intelligence, and the ability to perform under pressure. Sudwiarrum et al. (2021) identify self-efficacy as a psychological factor that influences academic achievement. Similarly, Rohantizani et al. (2024) assert that self-efficacy contributes to performance levels that ensure success in completing tasks. Students with high self-efficacy tend to be more confident, more persistent in seeking solutions, and more capable of utilizing technology effectively in the learning process. Self-efficacy has also been shown to significantly influence success in solving assigned problems and tasks (Fadilah & Firdaus, 2024; Rachma et al., 2024).

One widely implemented innovation in education is *Problem-Based Learning* (PBL), a model that emphasizes real-world problem-solving as the core of learning activities. PBL is deemed appropriate for achieving instructional goals and addressing the urgency of learning needs (Ishlahul'Adiilah & Haryanti, 2023). The problem-based approach has been shown to improve students' skills in mathematics learning (Nasution & Suyanto, 2023). Problem-solving is a critical aspect of school mathematics, serving as a means to develop precise, logical, critical, analytical, and creative reasoning. Agustina et al. (2023) state that mathematical problem-solving skills enable students to make decisions, gather relevant information, plan solutions, analyze information, and reflect on their results. With technological support, PBL can be implemented more interactively and flexibly, enabling students to access learning resources, engage in online discussions, and develop problem-solving abilities independently. PBL has been widely applied in mathematics education to help students enhance their critical thinking and problem-solving skills (Jannah & Yasin, 2024).

PBL emphasizes learning through real-world problems that must be solved either individually or in groups. This model is believed to enhance students' self-efficacy by providing opportunities for active engagement in the learning process, participation in discussions, and independent solution-finding (Wardhana et al., 2023). According to Rohantizani et al. (2024), PBL is a learning model that helps teachers create a problem-centered learning environment, allowing students to gain more authentic learning experiences. Tan (2021) describes PBL as an innovative approach that begins with the presentation of contextual problems, encouraging students to actively learn in order to arrive at solutions.

In the digital era, various technology-based platforms, such as Google Forms have been widely used to measure students' self-efficacy through online questionnaires, enabling faster, more efficient, and more accurate data collection. Google Forms has become an essential tool in educational research, particularly for large-scale data collection unconstrained by time and location (Diana, 2024). Its use in assessing students' self-efficacy within PBL-based mathematics learning offers several advantages, including ease of access, flexibility in responses, and streamlined data analysis. With automation features and integration with Google Sheets, the collected data can be directly processed quantitatively to identify patterns in students' self-efficacy in problem-based learning contexts. However, despite the widespread application of technology in education, there remains a scarcity of research that specifically examines the relationship between PBL, students' self-efficacy, and the use of technology in data collection. Therefore, this study aims to analyze students' self-efficacy in solving mathematical problems through PBL, using a Google Forms based questionnaire as the primary data collection instrument. The findings of this research are expected to provide valuable insights for educators and researchers in developing more effective, technology-enhanced mathematics learning strategies, as well as in understanding how students' self-efficacy can be shaped by PBL within digital learning environments.

2. RESEARCH METHOD

This research is a type of descriptive study employing a qualitative approach. Qualitative research is characterized by the use of descriptive data, typically in the form of written or spoken language, obtained from observed individuals or social actors. It is intended to explain and analyze phenomena, events, social dynamics, attitudes, beliefs, and perceptions at the individual or group level (Moleong, 2005). The present study focuses on assessing students' self-efficacy in mathematics learning. A survey method was employed, involving 41 students from the Mathematics Education Department at Malikussaleh University. Data were collected using a questionnaire specifically designed to measure students' mathematical self-efficacy.

The data analysis in this study was carried out through three stages: data reduction, data display, and conclusion drawing. The data reduction phase involved selecting relevant data, focusing on key information, and coding and categorizing participant responses (Andini et al., 2018). The questionnaire was developed based on indicators constructed by the researcher and employed a Likert scale format. The Likert scale, widely used to assess attitudes and opinions, presents statements accompanied by a range of response options, typically ranging from positive to negative. The rating scale used for each item is detailed in **Table 1**. The self-efficacy scores obtained from the questionnaire were subsequently categorized using Microsoft Excel, following the classification criteria presented in **Table 2**.

Table 1. Scoring of Questionnaire Responses

Student Response Category	Positive Score	Negative Score
Strongly Agree (SA)	4	1
Agree (A)	3	2
Disagree (D)	2	3
Strongly Disagree (SD)	1	4

Source: Adapted from Sugiyono (2019).

Table 2. Self-Efficacy Category Classification

No.	Interval	Category
1	$\times < M - 1SD$	Low
2	$M - 1SD \leq \times < M + 1SD$	Moderate
3	$M + 1SD \leq X$	High

3. RESULTS AND DISCUSSION

The primary objective of this qualitative study is to assess the self-efficacy of prospective mathematics teacher students in the context of mathematics learning. The research was conducted at Malikussaleh University, within the Mathematics Education Department. Data were gathered through a questionnaire administered via Google Forms to a sample of 41 students.

Table 3. Students' Self-Eficacy Levels

Score Interval	Range	Number of Students	Percentage	Category
$\times < M - 1SD$	X < 55.83	4	10%	Low
$M - 1SD \leq \times < M + 1SD$	55.83 ≤ X < 66.79	31	75%	Moderate
$M + 1SD \leq X$	X > 66.79	6	15%	High

Based on the data presented in **Table 3**, it was found that 4 students (10%) demonstrated a low level of self-efficacy, while 31 students (75%) exhibited a moderate level, and 6 students (15%) showed a high level of self-efficacy in learning mathematics. These findings indicate that, overall, the self-efficacy level of students in the Mathematics Education Department at Malikussaleh University for the 2024/2025 academic year falls within the moderate category. This conclusion is substantiated by the fact that 75% of the participants, equivalent to 31 students, demonstrated a moderate level of self-efficacy.

Table 4. Percentage and Categorization of Student Self-Efficacy by Indicator

No.	Indicators	Score Obtained	Expected Total Score	Percentage	Category
1	Confidence in solving questions of various difficulties and determining the solution	1009	1312	76.9%	Moderate
2	Belief in persistence when facing challenges	870	1148	75.78%	Moderate
3	Belief in achieving goals and solving new problems	635	820	77.44%	Moderate
	Total Score	2514	3280	230.12%	Moderate
	Average	838	1093.3	76.47%	Moderate

The following section presents the research findings on self-efficacy for each indicator. The first self-efficacy indicator concerns students' confidence in their ability to solve problems of varying levels of difficulty, as well as their belief in being able to understand and determine appropriate problem-solving strategies. The questionnaire results yielded a score of 76.9%, placing this indicator in the moderate category. Analysis of the questionnaire data shows that most students believe they can confront and complete mathematics tasks. Almost all students reported feeling challenged when faced with difficult mathematics problems. However, there were also students who expressed doubt or a lack of confidence when given challenging mathematics tasks, primarily due to limited understanding and lower proficiency in mathematics. At times, such students were also reluctant or unwilling to work on complex mathematics problems. This suggests that some students have not yet fully developed confidence in their abilities and require guidance to enhance their skills in tackling difficult

problems (Rahayu & Pratama, 2021). Nevertheless, students generally continued to make efforts to complete their work, indicating a genuine commitment to accomplishing mathematics tasks in line with their perceived self-efficacy. These findings are consistent with Tamba and Santi (2021), who state that belief in one's own abilities is essential when confronted with demanding tasks in order to achieve desired outcomes.

The second self-efficacy indicator relates to students' belief in their perseverance when facing questions and academic challenges, with questionnaire results showing a score of 75.78%, also within the moderate category. This aligns with the findings of Arifah and Lestari (2023), who reported a learning self-efficacy score of 75%, also categorized as moderate. Analysis of the data in this study indicates that most students sought clarification from peers or lecturers regarding material they did not understand. The majority also did not give up easily before attempting to solve problems and find solutions. However, some students still felt hesitant to ask questions when they struggled with certain material, while others admitted to giving up before making any real effort to solve the problems. These findings suggest that students need stronger emotional regulation and problem-solving strategies to avoid premature disengagement (Putra & Wijaya, 2023).

The third self-efficacy indicator concerns students' belief in their ability to achieve learning goals in mathematics and to solve problems they have never encountered before. This indicator obtained a score of 77.44%, also categorized as moderate. Analysis of the questionnaire data indicates that most students put significant effort into solving the problems assigned by lecturers, and some reported never procrastinating on tasks. While some students disagreed with completing tasks only at the deadline, others disagreed with the idea of never postponing tasks and stated that they preferred to work under deadline pressure. These findings align with the views of Rohantizani et al. (2024) and Yulita & Defrinal (2025), who emphasize that self-efficacy is rooted in an individual's belief in their own abilities.

4. CONCLUSION

The findings of the study indicate that 6 students (15%) exhibited a high level of self-efficacy, while the majority—31 students (75%) were classified as having a moderate level, and 6 students (10%) demonstrated low self-efficacy. The average self-efficacy score across the cohort was 76.47%, placing the overall group in the moderate category. These results suggest that students enrolled in the Mathematics Education Department at Malikussaleh University generally possess a moderate degree of confidence in their academic abilities, particularly in mathematics-related tasks. However, this level of self-efficacy remains below the ideal threshold for future educators. Given the strong correlation between self-efficacy and academic performance, particularly in mathematics learning and instruction, it is essential to implement strategies that can enhance students' self-efficacy. Strengthening this psychological construct is crucial not only for deepening students' understanding of mathematical concepts but also for improving their preparedness and effectiveness as future mathematics teachers.

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