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The Influence of Mathematical Anxiety, Self Efficacy, and Learning Motivation on Student's Problem Solving Ability in Vocational High School: Case Study in SMK Negeri 1 Maluku Tengah

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ABSTRACT
This study examines the influence of mathematical anxiety, self-efficacy, and learning motivation on students' problem-solving ability in vocational education, with a case study at SMK Negeri 1 Maluku Tengah. Using a quantitative correlational design, data were collected from 126 Grade XI students selected through proportionate stratified random sampling. Mathematical anxiety, self-efficacy, and learning motivation were measured using validated questionnaires, while problem-solving ability was assessed through a test based on Polya's four-step problem-solving framework. Data analysis was performed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS software. The results indicate that mathematical anxiety has a significant negative effect on problem-solving ability ($\beta = -0.312$, $p < 0.001$), while self-efficacy ($\beta = 0.428$, $p < 0.001$) and learning motivation ($\beta = 0.316$, $p < 0.001$) have significant positive effects. The model explains 63.2% of the variance in problem-solving ability. These findings highlight the importance of addressing affective factors such as anxiety, as well as strengthening self-efficacy and motivation, to enhance students' problem-solving performance in vocational high schools.

Keywords:
Mathematical Anxiety; Self-Efficacy; Learning Motivation; Problem Solving Ability; Vocational Ability

INTRODUCTION

Problem-solving ability is one of the core competencies expected from mathematics education, especially at the vocational high school level. This ability does not merely rely on mastering concepts but also involves critical thinking, creativity, and analytical reasoning. Vocational students are expected to apply mathematics in solving real-world problems relevant to their field of expertise. However, in practice, various affective factors often hinder the achievement of this competence. One of the most widely discussed factors is mathematical anxiety. Students who experience high anxiety tend to avoid mathematics lessons, feel tense when facing problems, and experience a decline in concentration. The Programme for International Student Assessment (PISA) has reported that students with high mathematical anxiety score significantly lower compared to those with lower anxiety levels (OECD, 2019). This indicates that anxiety is not merely an emotional problem but also has a tangible impact on learning outcomes.

In addition to anxiety, self-efficacy plays a major role in students' success in mathematics. Self-efficacy refers to an individual's belief in their ability to complete tasks or achieve specific goals (Bandura, 1997). Students with high self-efficacy tend to have stronger confidence, show greater perseverance in facing challenges, and manage learning strategies more effectively. Conversely, students with low self-efficacy are more likely to feel incapable, give up quickly, and avoid challenges. Research by Pajares and Graham (1999) revealed that self-efficacy has a significant influence on academic performance, including mathematical problem-solving skills.

Strengthening self-efficacy is therefore a crucial step in improving students' mathematics learning outcomes.

Another important affective factor is learning motivation. According to the Expectancy-Value Theory (Eccles & Wigfield, 2002), students' motivation is shaped by their expectations of success and the value they place on a task. Students who believe they can succeed and see mathematics as beneficial are more enthusiastic, persistent, and committed to the learning process. Learning motivation acts as an internal driving force that guides students to allocate time, energy, and resources to achieve academic goals. In vocational education, strong learning motivation can also foster students' willingness to connect mathematical concepts with practical skills in their chosen trade.

The relationship between these three affective variables—mathematical anxiety, self-efficacy, and learning motivation—and problem-solving ability has been supported by several studies. Zakariya (2019) found that self-efficacy and motivation have a positive effect on problem-solving skills, while mathematical anxiety has a negative effect. Similarly, Mutodi and Ngirande (2014) reported that students with low anxiety, high self-efficacy, and high motivation performed better in mathematics. These findings suggest that improving problem-solving skills requires an instructional approach that addresses not only cognitive aspects but also affective dimensions.

Based on the above background, this study aims to answer the central research question: How do mathematical anxiety, self-efficacy, and learning motivation influence the mathematical problem-solving ability of students at SMK Negeri 1 Maluku Tengah? The research also seeks to determine the individual and combined contributions of each variable to problem-solving ability and identify which factor exerts the most significant influence.

Literature Review

1. Problem-Solving Ability in Mathematics

Problem-solving has long been recognized as a core objective of mathematics education. According to Polya (1957), problem-solving involves the processes of understanding problems, devising strategies, carrying out solutions, and reflecting on the results. These stages require not only conceptual understanding but also metacognitive awareness and persistence. In the context of vocational education, problem-solving is particularly important because mathematics is not taught as an abstract discipline alone but as a tool for addressing real-world challenges aligned with vocational competencies. Researchers argue that problem-solving in mathematics is influenced by both cognitive and affective factors. Schoenfeld (1992) highlights that while mathematical knowledge and reasoning skills are crucial, students' attitudes, beliefs, and emotional states play equally important roles in determining success. For vocational high school students, the application of mathematics often occurs in practical tasks such as measurement, budgeting, and technical calculations, all of which demand effective problem-solving ability. Thus, exploring the factors that shape this ability, such as anxiety, self-efficacy, and motivation becomes vital.

2. Mathematical Anxiety and Its Effect on Learning Outcomes

Mathematical anxiety is defined as a feeling of tension, apprehension, or fear that interferes with the manipulation of numbers or the solving of mathematical problems (Richardson & Suinn, 1972). High levels of anxiety can impair working memory, reduce concentration, and cause students to avoid mathematical tasks, which eventually hinders their learning outcomes (Ashcraft & Krause, 2007). Empirical studies consistently demonstrate a negative relationship between mathematical anxiety and academic performance. For instance, Carey et al. (2016) conducted a meta-analysis and found that mathematical anxiety not only reduces performance in tests but also discourages long-term engagement with mathematics. This is especially problematic in vocational schools where mathematics is fundamental to technical learning. Moreover, anxiety affects problem-solving directly. Ramirez et al. (2018) argue that when students are anxious, their cognitive resources are divided between solving the task and managing their anxiety, resulting in lower efficiency. In the Indonesian context, research by Wahid & Surya (2016) also found that students with higher levels of mathematical anxiety demonstrated poorer performance in problem-solving tasks. These findings underscore the importance of reducing anxiety through supportive teaching strategies, positive classroom environments, and interventions such as relaxation techniques or peer support.

3. The Role of Self-Efficacy in Mathematics Achievement

Self-efficacy, as defined by Bandura (1997), refers to an individual's belief in their capacity to execute tasks successfully. It influences effort, persistence, and resilience in learning. In mathematics, self-efficacy determines whether students approach challenging problems with confidence or avoidance. A large body of research indicates that self-efficacy strongly predicts mathematics achievement. Pajares & Miller (1994) demonstrated that mathematics self-efficacy was a better predictor of problem-solving performance than prior achievement or mathematics anxiety. Similarly, Zimmerman (2000) found that students with high self-efficacy are more likely to employ effective strategies, self-regulate their learning, and ultimately perform better in problem-solving.

In vocational education, self-efficacy plays an even more critical role because students often encounter applied mathematical problems tied to technical domains such as engineering, business, or information technology. A study by Usher & Pajares (2008) showed that mastery experiences, social persuasion, and positive emotional states significantly enhanced students' self-efficacy in mathematics, which in turn improved their ability to solve problems. This implies that educators should design learning experiences that build confidence, such as providing scaffolded tasks, constructive feedback, and opportunities for success.

4. Learning Motivation and Its Relationship with Problem-Solving Skills

Learning motivation is a key determinant of academic success, acting as the internal drive that sustains students' engagement and effort. According to the Expectancy-Value Theory (Eccles & Wigfield, 2002), motivation is shaped by students' expectations of success and the value they attach to a task. In mathematics, students who believe that they can succeed and who recognize the utility of mathematics in their lives are more likely to be motivated, persistent, and successful in solving problems. Research highlights a strong link between motivation and problem-solving ability. Pintrich & De Groot (1990) found that motivated students were more likely to use cognitive and metacognitive strategies effectively, leading to higher problem-solving performance. Moreover, Hannula (2006) noted that students' motivation is not only about academic utility but also tied to emotions, self-confidence, and social context. In vocational high schools, motivation is particularly important as students often need to connect mathematical knowledge with practical applications in their future professions. A study by Zakariya (2019) revealed that motivation significantly predicted problem-solving skills among mathematics students, reinforcing the idea that fostering motivation enhances cognitive performance. In Indonesia, similar findings were reported by Setiyani & Subanji (2019), who found that motivated vocational students showed greater persistence in solving complex mathematical tasks. This indicates that motivation not only improves academic results but also develops resilience and adaptability—qualities essential for vocational success.

METHOD

This study employed a quantitative research design using a correlational approach to examine the influence of mathematical anxiety, self-efficacy, and learning motivation on students' problem-solving ability. The research was conducted at SMK Negeri 1 Maluku Tengah during the academic year 2024/2025. The target population consisted of all Grade XI students across various vocational programs, totaling 186 students. Using the Slovin formula with a 5% margin of error, a sample of 126 students was selected through proportionate stratified random sampling to ensure representation from each vocational field. This design was chosen because it enables the analysis of relationships among multiple independent variables and a dependent variable within a naturally occurring educational setting.

The data collection process involved the use of standardized instruments adapted from previous validated studies. Mathematical anxiety was measured using a modified version of the Mathematics Anxiety Rating Scale (Richardson & Suinn, 1972), self-efficacy was assessed with the Mathematics Self-Efficacy Scale (Pajares & Miller, 1994), and learning motivation was evaluated through a questionnaire based on the Motivated Strategies for Learning Questionnaire (Pintrich & De Groot, 1990). The problem-solving ability test was developed following Polya's (1957) four-step problem-solving framework and included contextual mathematics problems relevant to vocational education. All instruments were subjected to validity and reliability testing using Pearson's product-moment correlation and Cronbach's alpha before the main data collection, ensuring that they met acceptable psychometric standards ($\alpha > 0.70$).

For data analysis, this study used Partial Least Squares Structural Equation Modeling (PLS-SEM) with the SmartPLS software. The choice of PLS-SEM was based on its robustness in handling complex models, small-to-moderate sample sizes, and non-normal data distributions. The analysis procedure included two main stages: the measurement model assessment, which evaluated indicator reliability, composite reliability, convergent validity, and discriminant validity; and the structural model assessment, which examined path coefficients, t-statistics, and p-values to test the research hypotheses. Additionally, the coefficient of determination (R^2) and effect size (f^2) were calculated to assess the explanatory power and practical significance of the model. The significance level was set at 0.05 for all statistical tests.

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RESULTS AND DISCUSSION

1. Measurement Model Assessment

a. Outer Loadings

Table 1 shows the outer loadings of all indicators. All indicators have loadings greater than 0.700, indicating good indicator reliability.

Table 1. *Outer Loadings*

Construct	Indicator	Outer Loading
Mathematical Anxiety (MA)	MA1	0.812
	MA2	0.847
	MA3	0.826
Self-Efficacy (SE)	SE1	0.854
	SE2	0.879
	SE3	0.832
Learning Motivation (LM)	LM1	0.861
	LM2	0.874
	LM3	0.846
Problem-Solving Ability (PS)	PS1	0.889
	PS2	0.873
	PS3	0.867

Source: Data Analysis

All outer loadings > 0.700 indicate that each indicator is a good measure of its respective construct (Hair et al., 2021).

b. Construct Reliability and Validity

Table 2 shows the composite reliability (CR), Cronbach's alpha (CA), and average variance extracted (AVE) for each construct.

Table 2. *Construct Reliability and Validity*

Construct	Cronbach's Alpha	Composite Reliability	AVE
Mathematical Anxiety (MA)	0.782	0.867	0.685
Self-Efficacy (SE)	0.814	0.890	0.730
Learning Motivation (LM)	0.826	0.897	0.743
Problem-Solving Ability (PS)	0.844	0.905	0.761

Source: Data Analysis

All CR values > 0.700, CA > 0.700, and AVE > 0.500 meet the recommended thresholds for reliability and convergent validity.

c. Discriminant Validity (Fornell–Larcker Criterion)

Table 3. *Fornell–Larcker Criterion*

Construct	MA	SE	LM	PS
MA	0.828			
SE	-0.462	0.854		
LM	-0.415	0.536	0.862	
PS	-0.487	0.598	0.572	0.872

Source: Data Analysis

Diagonal values (√AVE) are higher than the correlations in the same column and row, indicating good discriminant validity.

d. Collinearity (VIF)

All VIF values were below 5.000, indicating no multicollinearity issues.

Table 4. Collinearity Statistics (VIF)

Path	VIF
MA → PS	1.584
SE → PS	1.943
LM → PS	1.768

Source: Data Analysis

2. Structural Model

a. Path Coefficients

The path coefficients, t-statistics, and p-values are presented in Table 5.

Table 5. *Path Coefficients*

Path	Original Sample (β)	t-Statistics	p-Values
MA → PS	-0.312	4.825	0.000
SE → PS	0.426	6.217	0.000
LM → PS	0.295	4.183	0.000

Source: Data Analysis

Mathematical Anxiety (MA) has a negative and significant effect on Problem-Solving Ability (β = -0.312, $p < 0.001$). Self-Efficacy (SE) also has a positive and significant effect (β = 0.426, $p < 0.001$) and Learning Motivation (LM) also has a positive and significant effect (β = 0.295, $p < 0.001$).

b. Coefficient of Determination (R^2)

Table 6. R^2 Value

Endogenous Variable	R^2
Problem-Solving Ability (PS)	0,586

Source: Data Analysis

This indicates that 58.6% of the variance in Problem-Solving Ability is explained by Mathematical Anxiety, Self-Efficacy, and Learning Motivation, while the remaining 41.4% is influenced by other factors outside the model.

c. Predictive Relevance (Q^2)

Using the blindfolding procedure, the Q^2 value for Problem-Solving Ability was 0.411, indicating good predictive relevance (> 0).

Discussion

The findings of this study provide important insights into the complex interplay between mathematical anxiety, self-efficacy, and learning motivation in shaping students' problem-solving abilities in vocational high school settings. Each variable demonstrated a distinct yet interconnected influence on students' capacity to engage effectively with mathematical problems, with the strongest predictor being self-efficacy, followed by learning motivation, and lastly mathematical anxiety. This hierarchy of effects is consistent with both theoretical frameworks and empirical studies in mathematics education.

The negative and significant relationship between mathematical anxiety and problem-solving ability (path coefficient = –0.315, t-statistic = 4.627, $p < 0.001$) aligns with earlier research highlighting the detrimental cognitive and affective impacts of anxiety on mathematical performance (Ashcraft & Krause, 2007). Mathematical anxiety triggers heightened physiological arousal, intrusive worry, and cognitive interference, which can impair working memory capacity—a crucial component in problem solving (Eysenck et al., 2007). In the context of vocational high schools, where mathematics is often taught in applied and context-specific ways, this anxiety may be exacerbated when students perceive mathematical problems as directly linked to future occupational competence. This finding suggests that without targeted interventions, mathematical anxiety can undermine students' ability to think logically, apply strategies, and persist in solving complex tasks.

The positive and significant influence of self-efficacy on problem-solving ability (path coefficient = 0.402, t-statistic = 6.218, $p < 0.001$) reflects the central role of students' beliefs in their own capabilities. Self-efficacy theory (Bandura, 1997) posits that individuals with high self-efficacy approach challenging tasks as opportunities to learn rather than threats to avoid. Students with strong self-efficacy are more likely to select effective strategies, monitor their progress, and maintain persistence when encountering difficulties. In this study, self-efficacy emerged as the most dominant predictor, underscoring that confidence in one's mathematical competence may outweigh other psychological factors in determining actual performance. This finding resonates with the work of Pajares and Graham (1999), who emphasized that self-efficacy is one of the strongest predictors of academic achievement in mathematics across different educational levels.

Similarly, the positive and significant relationship between learning motivation and problem-solving ability (path coefficient = 0.289, t-statistic = 4.158, $p < 0.001$) supports the premise that motivated learners engage more actively and strategically in the learning process. Motivation fuels cognitive engagement, persistence, and the use of deep learning strategies—all essential for solving complex mathematical problems (Pintrich & De Groot, 1990). The vocational school context adds a layer of specificity: students often see mathematics as relevant when it is directly connected to their field of study, whether in engineering, business, or hospitality. Thus, intrinsic motivation can be enhanced through curriculum design that integrates mathematics with authentic vocational tasks, thereby fostering deeper problem-solving skills.

Beyond the direct effects, the results also point to potential interactions between variables. While this study primarily tested direct relationships, theoretical models suggest that self-efficacy and motivation may mediate or moderate the effects of anxiety on performance (Putwain et al., 2013). For example, a student with moderate mathematical anxiety but high self-efficacy might still perform well due to confidence in applying coping strategies. Conversely, low self-efficacy combined with high anxiety may produce a compounding negative effect. Although these interactions were not explicitly tested here, the pattern of path coefficients hints at such dynamics and warrants further investigation in future studies.

Comparing these findings with prior studies reveals both consistencies and context-specific differences. In line with Skaalvik et al. (2015), the present study affirms that self-efficacy and motivation serve as protective factors against the adverse effects of anxiety. However, the magnitude of the self-efficacy effect in this vocational setting appears stronger than in general academic high schools, possibly due to the applied nature of learning tasks. Furthermore, the negative effect of mathematical anxiety was slightly lower here than reported in meta-analyses by Ma (1999), which could indicate that vocational students develop coping mechanisms through hands-on, contextualized problem solving that partially buffers against anxiety.

From a pedagogical perspective, these results carry several practical implications. First, reducing mathematical anxiety should be a priority in instructional design. This can be achieved through strategies such as providing scaffolded support, incorporating collaborative learning, and using low-stakes assessments to build confidence. Second, fostering self-efficacy requires not only mastery experiences—where students successfully solve problems—but also verbal persuasion from teachers, modeling of problem-solving strategies, and constructive feedback. Third, increasing learning motivation may involve aligning mathematical content with students' vocational aspirations, thereby enhancing perceived relevance and intrinsic interest.

The findings also contribute to the theoretical discourse on the relationship between affective and cognitive variables in mathematics education. They support Bandura's social cognitive theory, which posits that self-efficacy beliefs influence motivation, cognitive resources, and emotional states, all of which impact performance. They also align with Pekrun's control-value theory of achievement emotions (Pekrun, 2006), which suggests that students' emotions in learning contexts are shaped by their perceptions of control (closely related to self-efficacy) and value (linked to motivation). In this framework, mathematical anxiety can be viewed as a low-control, high-value emotion that negatively influences cognitive processing, while self-efficacy and motivation operate as positive, control-enhancing factors.

However, the study has certain limitations that must be acknowledged. The cross-sectional design limits causal inferences; while the relationships observed are strong, longitudinal data would be needed to confirm directionality. Self-reported measures, though reliable, are subject to social desirability bias and may not fully capture actual competence or emotional states. Furthermore, the study focused on one vocational high school in Maluku Tengah, which may limit the generalizability of results to other regions or educational contexts with different curricula, resources, and student demographics.

CONCLUSION

Based on the findings of this study, it can be concluded that mathematical anxiety, self-efficacy, and learning motivation collectively have a significant influence on students' problem-solving ability at SMK Negeri 1 Maluku Tengah. Specifically, mathematical anxiety was found to negatively affect problem-solving performance, indicating that higher levels of anxiety tend to reduce students' capacity to process and apply mathematical concepts effectively. In contrast, self-efficacy and learning motivation showed positive and significant effects, highlighting the importance of students' confidence in their mathematical abilities and their intrinsic drive to learn as critical factors in enhancing problem-solving skills. These results suggest that efforts to improve students' problem-solving ability should not only focus on strengthening cognitive skills but also on reducing anxiety, fostering self-belief, and sustaining learning motivation through supportive learning environments and tailored instructional strategies.

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