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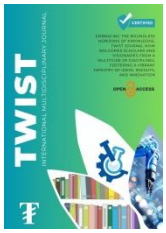

Mathematics Self-Efficacy and Motivation as Predictors of Problem-Solving Skills of Students

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Abstract
The primary purpose of this study is to determine whether mathematics self-efficacy and motivation predict students' problem-solving skills. This study employed a descriptive and correlational research design. Using stratified random sampling, 100 tertiary education students specializing in mathematics were selected as respondents from four public higher institutions in Davao de Oro during the school year 2022-2023. Furthermore, this study employed two adapted survey questionnaires and one researcher-designed questionnaire; all validated to collect data and treated using mean, Pearson-r, and regression analysis. The findings showed that mathematics self-efficacy and motivation among the students are high, while their problem-solving skills are very low. The results also revealed that mathematics self-efficacy and motivation negatively correlated with problem-solving skills. Moreover, only motivation can predict the problem-solving skills of the students. These results encourage educators and administrators to enhance students' problem-solving skills. Furthermore, to improve the applicability of the results, it is imperative to carry out replication studies in various locales. This will validate the durability of these relationships beyond the present research setting and contribute to a more comprehensive comprehension of these issues.

Keywords
Mathematics self-efficacy, Motivation, Problem-solving skills, Tertiary mathematics students, Descriptive-correlational design, Davao de Oro, Philippines

INTRODUCTION

Problem-solving is one of the challenging and frustrating areas for a substantial proportion of students, causing them to feel overwhelmed and dissatisfied with their abilities (Baroja, 2019). Students struggle with problem-solving because they do not comprehend the situation (Ali, 2019). Additionally, when students encounter a word problem, they cannot apply the knowledge they have acquired and lack the necessary knowledge structure for problem-solving (Yalçin, 2018). The primary purpose of learning mathematics is to improve students' problem-solving skills. Mathematics self-efficacy has a significant impact on an individual's goal and success in solving mathematical problems (Chytry et al., 2020). Furthermore, problem-solving is one of the issues that students experience when trying to improve their problem-solving skills. Students require motivation because it influences their problem-solving abilities. The more motivated the students are, the more effort they put into problem-solving (Callan et al., 2021).

In Indonesia, 50% of students were able to respond to the first step in problem-solving, but only 32% were able to solve the second step, and only 27% were able to answer problem-solving totally (Riyadi et al., 2021). Moreover, a study conducted at Universiti Selangor involved four student groups enrolled in various foundation programs in Malaysia. The findings revealed that 70% of the students face challenges in problem-solving and resort to employing strategic approaches until they tackle word problems. In contrast, the remaining 30% seek assistance from external sources to resolve these issues (Maegala et al., 2020). Furthermore, in Thailand, it was found that the students cannot solve mathematics problems and lack skills in problem-solving. It shows that 7.84% have an excellent level of problem-solving

skills, 15.69% have a good level, 33.33% of the student is in the medium level, and 43.14% is in the weak level (Thngkingdang & Thongmoon, 2018).

In the Philippines, the study by Valdez and Bungihan (2019) showed that 92% of overall students in the Philippines have extremely low problem-solving skills, while 8% have low problem-solving skills. Furthermore, in Mandaluyong City, 16 out of 55 students, or 29.10%, have poor problem-solving skills (Collado Jr., 2020). Moreover, a study conducted by Ambasa and Tan (2022) in Valencia City, Bukidnon, Philippines, revealed that all 46 students, accounting for 100% of the sample, exhibited very low problem-solving skills, as evidenced by a mean score of 14.20, indicative of poor performance in this area.

Meanwhile, a public higher education in Davao de Oro conducted an exam survey of the students and revealed that the students have low skills in problem-solving. It shows that 40 out of 50, or 80% of the students, have low problem-solving skills, and only 10 out of 50, or 20%, have high problem-solving skills. Students had difficulties understanding the problem; they also had problems creating an equation because of their lack of understanding of the problem.

Moreover, this research could help the academic community develop solutions based on the abovementioned variables. The findings of this study will be critical for students dealing with the new normal, modular learning, and online programs. Students' problem-solving abilities may be influenced by their mathematics self-efficacy and motivation. In addition, the results of this research can help teachers address the needs and issues of 21st-century education by developing new strategies to help the students be motivated to improve their problem-solving skills, especially now that face-to-face sessions are back.

Furthermore, the research results will be presented to the administrators and teachers to ensure that the findings are broadly disseminated. Tertiary students will be invited to attend a meeting held at the institution. The researcher also wants to discuss the results at a national research convention to scope more prominent spectators. As a result, teachers from the other schools will be aware of the research results, which may help them address similar difficulties and concerns about their students' problem-solving skills.

RESEARCH PROBLEMS

This research seeks to determine whether mathematics self-efficacy and motivation predict problem-solving skills. This study specifically aimed to provide answers to the following questions:

1. What is the level of mathematics self-efficacy in terms of:
   1.1 Mastery experience;
   1.2 Vicarious experience;
   1.3 Social persuasions; and
   1.4 Physiological state?
2. What is the level of motivation in terms of:
   2.1 Intrinsic value;
   2.2 Self-regulation;
   2.3 Self-efficacy;
   2.4 Utility value; and
   2.5 Test anxiety?
3. What is the level of problem-solving skills of students in terms of:
   3.1 Understanding the problem;
   3.2 Devising the plan;
   3.3 Carrying out the plan; and
   3.4 Looking back?
4. Is there a significant relationship between:
   4.1 Mathematics self-efficacy and problem-solving skills of students?
   4.2 Motivation and problem-solving skills of students?
5. Do mathematics self-efficacy and motivation significantly predict the problem-solving skills of students?

HYPOTHESES

The following hypotheses were tested at a 0.05 level of significance.

1. There is no significant relationship between mathematics self-efficacy and the problem-solving skills of students.
2. There is no significant relationship between motivation and problem-solving skills of students.
3. Mathematics self-efficacy and motivation do not significantly predict the problem-solving skills of students.

LITERATURE REVIEW

Problem-Solving Skills

The essence of mathematics education and learning is problem-solving, which helps to connect the mathematical principles learned with real-world applications (Rauf et al., 2020). In addition, Alcock (2019) states that good problem solvers engage in various tasks while approaching a challenge, such as understanding and interpreting the problem, mathematically expressing the problem, formulating a plan, monitoring progress, and checking the answer. In addition,

familiarity can facilitate students' self-reflection, which, as a metacognitive talent, can benefit the development of problem-solving abilities (Kim & Lim, 2019).

Furthermore, Hiltrimartin (2018) discovered that teachers in Indonesia believe that problem-solving skills necessitate students having a good foundation in mathematics. Also, it has been argued that using technology as a learning resource can help students acquire mathematical problem-solving skills. As a result, numerous initiatives have been made to integrate technology into mathematics instruction to improve students' ability to solve mathematical issues (Wang & Tahir, 2020).

Understanding the Problem

In a particular study, the comprehension of the concepts in mathematics, abilities, and information that students encounter, experience, and gain throughout their preschool years substantially impacts their arithmetic achievement later in life (Ompok et al. 2018). Likewise, Aquino et al. (2019) stated that students' problem-solving skills should be strengthened further. It is a crucial developmental milestone for young students, and it must provide them with opportunities to fully improve their skills, competency, and potential and ensure the students' balance and holistic development.

Furthermore, in the study of Inci Kuzu (2021), the students' possible limitations are a lack of conceptual understanding and weaknesses in verbal language abilities. As a result, the students cannot readily understand the problem. In addition, Schoen et al. (2019) said that it is preferable for students to learn how to answer word problems in mathematics independently to build their problem-solving skills. This is because it allows students to take ownership of their learning.

Devising the Plan

Students often need help formulating problem-solving strategies due to difficulty foreseeing potential outcomes and constructing a structured procedural approach. This challenge arises from their struggle to establish meaningful connections between relevant facts and information, as highlighted by Simatupang et al. (2019). In addition, students needed help creating strategies to maximize value by applying first derivatives in algebraic functions, primarily stemming from their aversion to lengthy and non-routine problem scenarios, as Nikmah et al. (2019) noted.

Furthermore, Rojas-Drummond and Padilla-Melendez (2019) discovered that students utilize diverse problem-solving methodologies, such as drawing diagrams, breaking down the problem into breaking it down, and trial and error. Additionally, the authors argue that teaching students how to create problem-solving plans can help them develop a more organized and systematic approach to problem-solving. Additionally, Kim and Lim (2019) discover that students who are taught to devise problem-solving plans outperform students who are not taught these strategies when solving complex mathematical problems.

Carrying Out the Plan

The planning phase is to carry out the strategies devised with diligence and accuracy to obtain a solution. Students make operational errors in their calculations while carrying out the plan (Simatupang et al., 2019). The execution of mathematical operations by students while carrying out the plan could have been improved by a lack of mathematical knowledge, skills, logical thinking and reasoning, and interest in using learning tools and materials (Alvi & Nausheen, 2019).

In addition, carrying out a plan to solve mathematical problems involves several cognitive processes, such as monitoring one's progress, evaluating the plan's effectiveness, and making necessary adjustments (Xu & Huang, 2021). Furthermore, Moustafa (2019) suggests that explicit instruction on how to carry out a problem-solving plan can help students develop a more efficient and practical problem-solving approach.

Looking Back

In this phase, it is interpreting the results obtained into the context of the problem. Students' error is their inability to understand the results obtained in the context of the problem in mathematics and present their arguments (Simatupang et al., 2019). In Alvi and Nausheen's (2019) study, however, students should have attempted to validate solutions by considering alternative explanations. They did not try different approaches because they focused on a single, sequential, step-by-step method to solve the problems.

Moreover, Zawojewski and Cai (2020) highlight the value of retrospective analysis in problem-solving, asserting that students can pinpoint strengths and weaknesses by reflecting on their process, ultimately enhancing their problem-solving skills. In addition, students who reflect on their mistakes and use this information to guide future mathematical problem-solving tend to improve their performance over time (Brizuela & Earnest, 2019).

Mathematics Self-Efficacy

Mathematics self-efficacy is a significant aspect of individual influences that significantly contribute to mathematics success of students' (Zakariya, 2022). Mathematics self-efficacy affects students' choice of difficult problems, as well as their level of determination and dedication in challenging situations (Zakariya et al, 2019). In addition, students who possess a strong perception of mathematics self-efficacy have less mathematics anxiety and, as a result, are less likely to fail math (Rozgonjuk et al, 2020; Zakariya, 2021).

Moreover, according to the findings of Gregory et al. (2019), there exists a positive correlation between an enhanced perception of mathematical self-efficacy and students' proficiency in problem-solving tasks. In addition, in order to be good in problem-solving, teachers must establish and monitor mathematics self-efficacy of students throughout the process of learning in mathematics by implementing approaches that foster a good effect in mathematics learning and teaching (Greenfield & Deutsch, 2020).

Mastery Experience

It is a term that refers to the beliefs of competence created as a result of prior experience with a related task (Lin et al., 2018). In addition, mastery experience captures the students' understanding of their previous academic achievements in mathematics and focuses on these understandings. It is essential in determining one's mathematical self-efficacy (Zientek et al., 2019).

Moreover, Murrieta Loyo and Reyes Cruz's (2019) study investigates the mastery experiences of foreign language teachers based on their academic experiences and the impact on their mathematics self-efficacy beliefs. The results stated that the teachers' perceived self-efficacy was lower during the initial years due to a lack of actual practice. However, gradually, with reflection, training, and effort, their perceived self-efficacy improved. Furthermore, Biliny (2019) conducted a study to assess the effectiveness of mastery experience group counseling in enhancing students' career-making mathematics self-efficacy. It shows in the result that there was a difference in effectiveness levels in improving career decision-making mathematics self-efficacy, with the combination of two sources of experience, namely vicarious experience and mastery experience, producing the best results.

Vicarious Experience

Individuals who have poor general mathematics self-efficacy discover information about vicarious experience to be substantially less useful for their mathematics self-efficacy in completing a set task. This contrasts with those with high general mathematics self-efficacy (Wilde and Hsu, 2019). To add, Otengei et al. (2017) suggested that having a vicarious experience is a viable alternative to stimulate professional motivation. Additionally, Onyango et al. (2020) state that students with a high level of vicarious experience have a greater tendency to demonstrate high levels of behavior modification. This assertion is based on the fact that, if the students have high vicarious experience they are more likely to be exposed to similar situations.

Likewise, building vicarious experiences, a technique known for boosting an individual's mathematical self-efficacy, can be effectively achieved through methods like imagery, as emphasized by Giardina (2022). These vicarious experiences center around the social comparison of an individual's performance with peers possessing similar talents, constituting the second source of mathematics self-efficacy, as stated by Wilde and Hsu (2019).

Social Persuasions

Students develop mathematics self-efficacy through social persuasion while listening to other people's verbal persuasion. Besides, social persuasion predicts mathematics self-efficacy more accurately than mastery experience (Lau et al. 2018). In addition, Falco and Summers' (2019) findings suggest that the messenger's identity is as significant as the message's content. Still, more study is necessary to understand better how students make sense of social persuasions.

In addition, Barton and Dexter (2020) discovered that social persuasion is essential in establishing beginning levels of positive mathematics self-efficacy. Additionally, students' mathematics self-efficacy tends to experience enhancement when they receive positive reinforcement and encouragement from their parents and teachers, fostering their belief in their academic capabilities. This effect is particularly pronounced in children, as they are more inclined to trust and internalize the affirmations and support provided by influential figures in their lives, as noted by Celestine (2019).

Physiological State

The physiological state is an influence that might interfere with or distract from the working memory processes associated with mathematics (Pizzie & Kraemer, 2021). To clarify, it involves greater awareness of physiological feelings and heightened physiological arousal and negative cognitive interpretations of that physiological arousal, which may influence students' problem-solving skills (Jamieson et al., 2020). In addition, findings from recent studies imply that the physiological state is connected with mathematics anxiety when other cognitive aspects are also considered (Strohmaier et al., 2020).

Moreover, many studies have indicated that a person's emotional state can significantly affect their ability to do mathematical tasks, with physiological conditions playing an incredibly crucial part (Buratta et al., 2019). The enhanced psychological response and the unpleasant feelings that an individual experiences because of manipulating numerical problems or analyzing numerical information are also included in the definition of the physiological condition (Luttenberger et al, 2018).

Motivation

It is an essential part of the educational process, including the study of mathematics; hence, if students lack the motivation necessary for successful learning, their mathematical performance will suffer (Barbieri et al., 2019). In addition, it is essential to implement and encourage effective teaching practices, such as combining learning methodologies in

cooperative environment and problem-solving approaches, to increase students' interest and motivation for mathematics (Ahmed et al., 2020).

Moreover, students are eager to commit extra learning time to the type of task design in the research conducted by Cho (2021). Individuals are motivated to learn if the word problem is straightforward. Also, Irhamna et al. (2020) state that a student's motivation to study mathematics is vital since it increases their interest and excitement to solve problems and learn concepts independently and as part of a small cooperative group.

Intrinsic Value

Persistence in one's work is vital, and those who possess genuine motivation often perceive their job activities as both the means and ends, leading to a convergence between the activity and its intended purpose, as Fishbach and Woolley (2022) observed. In addition, Henry et al. (2019) explain how the concept of intrinsic value can demonstrate how behaviors and pursuits that are done for their own sake and endeavors that are carried out because they bring about a sense of contentment inside one's self are examples of behaviors that are intrinsically motivational and, as a result, foster sustained engagement.

Moreover, as described by Longhurst (2019), intrinsic value is the inner drive that arises from the inherent satisfaction derived from an activity or the sense of achievement gained through working on or completing a task, distinct from external incentives such as money or grades. Additionally, Cherry (2019) contends that intrinsic value does not preclude the pursuit of incentives; rather, it signifies that external rewards alone are inadequate to sustain an individual's motivation. However, if the assignment does not pique the student's interest, the prospect of a high grade is insufficient to keep that student motivated to work on the project (Li, 2021).

Self-regulation

It is described as the capacity to participate in the learning process as an independent individual in terms of metacognition, motivation, and behavioral views (Van Gog et al., 2020). In addition, students who can effectively self-regulate their learning are aware of the information they are about to learn, are aware of their own weaknesses and strengths, are motivated to study, and can effectively apply and monitor the techniques that they use to achieve their learning objectives (Losenno et al., 2020).

Moreover, self-regulation is the capacity to self-regulate, assess academic ability and motivation, handle staff members and their environment, actively engage in decision-making, and bring out all the learning experience (Cai et al., 2020). Self-regulation plays a crucial role in students' attainment of desired grades, relying on both personal determination and external factors within the learning process to foster continuous learning and ultimately secure the intended educational outcomes (Meiliana & Aripin, 2019).

Self-efficacy

It encompasses a learner's willingness to attempt, persevere, and complete tasks. When students face failure, it can often be attributed to either a lack of essential skills or having the necessary skills but lacking the self-efficacy to apply them effectively. As Cherry (2019) underscores, individuals' beliefs about their abilities profoundly shape their thoughts, actions, and emotions. Additionally, self-efficacy is particularly significant for students as it can significantly impact their performance by motivating them to excel in various tasks, overcome challenges, and set and achieve their goals, as Mabalay et al. (2020) highlighted.

Moreover, high self-efficacy predicts higher problem-solving success in all fields of expertise. Self-efficacy predicts, motivates, and moderates student achievement and learning (Ayllón et al., 2019). Furthermore, Stewart et al. (2020) stated that self-efficacy is multidimensional and should be examined in the domain of Science, Technology, Engineering, and Mathematics (STEM); this means that a gauge of science self-efficacy may differ from a gauge of physics self-efficacy.

Utility Value

It is a practical learning activity that will take place in the classroom to assist students in drawing connections with their own lives and between the content that they are learning (Hulleman & Harackiewicz, 2019). In addition, expectations (students believe they can complete the task) and values are two components of the basic model of student motivation. Students are likelier to attempt to solve a task if their expectations and values are high. The concept of utility value can be conceptualized as a specific instance of the value attributed to a problem in a given task, the value attributed to problem-solving in a particular activity, or the value attributed to learning materials or a course with a specific object (Harackiewicz & Priniski, 2018; Krawitz & Schukajlow, 2018).

Moreover, utility value treatments only appear to be effective under specific circumstances, and this finding underscores the importance of determining those circumstances in subsequent research (Rosenzweig et al., 2019). In mathematics, utility value is not determined by the desires of an individual but rather by the requirements of society or the economy as a whole (Di Martino, 2019).

Test Anxiety

Academic assessment situations have a relatively stable tendency to elicit a disproportionate emotional response due to concern about potential negative consequences and poor performance (Balogun et al., 2017; Putwain & Symes, 2018).

Furthermore, Howard (2020) concluded that some people are motivated by anxiety, such as "I better study hard for the upcoming exams, or I might fail," which may disrupt cognitive functioning for others, resulting in poor academic achievement. As a result, the relationship between exam grades and test anxiety may vary depending on the level of anxiety experienced.

Moreover, a significant number of research have discovered a relationship between test performance and test anxiety. Students who tend to worry less about their schoolwork tend to attain higher grades than their classmates who tend to worry more (Von der Embse et al., 2018). In addition, Jerrim (2022) discovered that academic achievement is negatively connected to test anxiety. It is debatable whether this is only less academically capable students more likely to change education-related anxiety issues.

METHODOLOGY

Research Design

This quantitative study utilized the descriptive-correlational research design. Quantitative research design is the systematic approach to analyzing and collecting numerical data. It tests causal relationships and finds averages and patterns that generalize results to larger populations and predictions (Bhandari, 2022). Furthermore, a descriptive research design defines individuals, conditions in their natural state, or events (Siedlecki, 2020).

In addition, correlational research designs investigate relationships between variables without allowing the researcher to manipulate or control them (Cherry, 2023). It aims to describe and identify relationships between variables in terms of their strength and direction without introducing a change in outcome.

Research Respondents

The research respondents of this study are tertiary education students specializing in mathematics in public higher institutions in Davao de Oro during the school year 2022-2023. The respondents were chosen using stratified random sampling. The researcher used an online Raosoft Sample size calculator with a margin of error of 5% and a confidence level of 95% to determine the total number of respondents.

The total population of the higher education institutions involved is 134. In addition, the sample size of 100 respondents was obtained using the Raosoft Sample size calculator. School A has 33 students, 22 in School B, 21 in School C, and 24 in School D. The study was conducted at four branches of Davao De Oro State College, a public higher institution in Davao De Oro.

Research Instrument

This research employed a two-part adapted and one researcher-created questionnaire, validated by an expert panel and pilot-tested. The two adapted questionnaires measured mathematics self-efficacy and motivation, and the researcher created the problem-solving questionnaire.

Furthermore, the instrument used in measuring Mathematics Self-Efficacy was adapted from Usher and Pajares (2009) with a cronbach alpha coefficient of 0.80, while for Motivation it was adapted instrument from Glynn et al. (2011) with a cronbach alpha of 0.85, and to measure the problem-solving skills of students, the researcher made a questionnaire that was validated by experts. The tool comprises five items with different questions on different topics in mathematics, and it is five points for each question to measure the indicators of problem-solving: understanding the problem, devising the plan, carrying out the plan, and looking back. The researcher also made a rubric to check the answers of the respondents.

Statistical treatment

The information obtained from each instrument was recorded and tallied in this research. It was evaluated and analyzed using the following statistical tools in with the study's purpose:

Mean

This tool was used to determine the level of mathematics self-efficacy, motivation, and problem solving skills of students. This was used to answer the statements for problems 1, 2, and 3.

Standard deviation

This tool was used to determine how to spread mathematics self-efficacy and motivation to students' problem-solving skills.

Pearson r

This tool was used to determine the degree of correlation between mathematics self-efficacy and problem-solving skills and the relationship between their motivation and problem-solving skills.

Multiple Regression Analysis

This statistical tool was used to assess the potential impact of mathematics self-efficacy and motivation on the problem-solving skills of students, with the aim of establishing whether these factors have a statistically significant influence.

RESULTS AND DISCUSSION

Level of Mathematics Self-Efficacy of Students

Table 1 presents an overview of the mathematics self-efficacy levels. Out of the four indicators, vicarious experience exhibited the highest mean score of 3.85, while social persuasion followed closely with a mean score of 3.56. Both of these indicators can be described as having a high level of influence. Furthermore, the physiological state had the lowest mean score of 3.00, indicating a moderate level based on descriptive analysis.

Table 1 Level of Mathematics Self-Efficacy

Indicator	Mean	SD	Description
Mastery Experience	3.46	0.64	High
Vicarious Experience	3.85	0.56	High
Social Persuasion	3.56	0.72	High
Physiological State	3.00	0.85	Moderate
Over-all Mean	**3.47**	**0.47**	**High**

Moreover, the data indicates that the overall mean of mathematics self-efficacy is 3.47, which can be described as high. This suggests that there is a strong presence of mathematics self-efficacy among the respondents. The standard deviation of 0.47 reveals that the responses of the respondents are relatively consistent, indicating a similarity in their levels of mathematics self-efficacy. This also implies that their mathematics self-efficacy is clustered with the mean. In addition, students show a strong belief in themselves that they can do mathematics. Students who believe in their abilities are likelier to achieve their academic potential and develop a deeper appreciation for mathematics.

Furthermore, it coincides with the research conducted by Negara et al. (2021), which shows that the students display a high level of mathematics self-efficacy. Students with a strong sense of mathematics self-efficacy have a high level of self-assurance in their abilities to succeed well in the subject, relying on their skills and knowledge. Additionally, the research conducted by Arafin et al. (2021) revealed that students have a high level of mathematics self-efficacy. Students who believe in themselves have high mathematics self-efficacy. Moreover, the research conducted by Kamsurya et al. (2022) indicated that individuals with a high level of mathematics self-efficacy exhibit confidence, preparedness, and belief in their capabilities.

Level of Motivation of Students

Table 2 presents a comprehensive overview of the motivation levels exhibited by tertiary education students specializing in mathematics. Out of the five indicators examined, the indicator of intrinsic value showed the highest mean score of 4.26, indicating a descriptive equivalent of very high. This suggests that intrinsic value is consistently present and observable in all instances. Subsequently, the utility value has an overall average of 4.18, corresponding to a descriptive equivalent of high, which further indicates its frequent manifestation. Furthermore, it is worth noting that test anxiety had the lowest mean score of 3.41, indicating a descriptive equivalent of high. This suggests that individuals frequently experience test anxiety.

Moreover, the data reveals an average score of 3.89, indicating high motivation among the respondents. The analysis of motivation dispersion, as indicated by the respondents' responses, yielded a standard deviation of 0.47. This finding suggests that a majority of the participants have provided comparable answers. This suggests that their motivation tends to cluster around the mean. In addition, the students show that they enjoy learning mathematics, putting some effort into learning and answering mathematics problems. Also, the students build confidence in themselves and think about how the mathematics they learn will be helpful in the future. Their interest in mathematics and recognition of its value beyond the classroom environment can drive them to participate in math-related activities and seek out additional challenges actively. Additionally, motivated students are more likely to persist through difficulties, view mistakes as opportunities for growth, and achieve success in mathematics.

Table 2 Level of Motivation

Indicators	Mean	SD	Description
Intrinsic value	4.26	0.68	Very High
Self-regulation	3.99	0.64	High
Self-efficacy	3.60	0.72	High
Utility value	4.18	0.67	High
Test anxiety	3.41	0.72	High
Over-all Mean	**3.89**	**0.47**	**High**

The result is supported by the study of Suren and Kandemir (2020), whose research found the motivation levels exhibited by students to be high. The result also showed that the students enjoy learning mathematics and are making an effort in solving word problems in mathematics. In addition, Mohand and Mohand (2023) revealed in their study that the students have high motivation. They added that students with a high level of motivation tend to hold favorable attitudes toward teaching approaches and can better focus on their studies and concentrate on complex mathematical tasks. Furthermore, Ariati et al. (2021) conducted a survey revealing that the students are highly motivated. The findings also revealed

students are motivated by a combination of things: their understanding of the material, the teacher's attitude, and an appropriate amount of homework that supplements learning.

Level of Problem-Solving Skills of Students

The data presented in Table 3 shows the level of problem-solving skills among the tertiary education students specializing in mathematics. The data included the mean and standard deviation of the four indicators. Based on the result, understanding achieved the highest average score of 20.18, indicating a descriptive classification of very low. This means that the student's knowledge of problem-solving is very poor. The standard deviation of understanding based on the responses of the respondents is 3.46, which indicates that the data is spread out from the mean. Meanwhile, the three indicators, devising a plan, carrying out the plan, and looking back, got a very low descriptive equivalent, and the data are spread out from the mean. The devising a plan attained a mean of 19.63 with a standard deviation of 3.28, carrying out the plan has a mean of 18.96 with a standard deviation of 3.58, and the looking back has a mean of 18.88 with a standard deviation of 3.64. This implies that students have very poor at devising a plan, which is the skill to draw strategies for solving mathematics problems. Also, the students have a very low level of problem-solving skills in carrying out the plan, which is the skill to perform the method to solve the problems in mathematics. Lastly, students have bad problem-solving skills in looking back, which is the skill to check and validate their solution.

Table 3 Level of Problem-Solving Skills of Students

Indicators	Mean	SD	Description
Understanding	20.18	3.46	Very Low
Devising a plan	19.63	3.28	Very Low
Carrying out the plan	18.96	3.58	Very Low
Looking back	18.88	3.64	Very Low
Over-all Mean	**19.41**	**3.33**	**Very Low**

Moreover, the collective average of students' problem-solving skills is 19.41, indicating a descriptive categorization of very low. This suggests that the problem-solving skills of students are subpar. The analysis of problem-solving skills among tertiary education students specializing in mathematics indicates that the standard deviation of their responses is 3.33. This finding suggests that the majority of the respondents have provided comparable answers. Additionally, the students showed very poor problem-solving skills in mathematics.

The findings are consistent with Haryanti et al. (2019), who found that most students cannot understand the given word problems in mathematics. With that, students encountered errors when attempting to convert a word problem into a mathematical model, including inaccuracies in formulating equations and creating visual representations. It resulted in the students being unable to solve the mathematical word problems. Moreover, the study of Warger (2018) found that students have difficulties understanding the problem, and the selection and implementation of suitable problem-solving strategies pose challenges for students, particularly in relation to the computational aspect of problem-solving. Additionally, students often neglect to engage in the crucial step of verifying their solutions. Furthermore, according to Velez et al.'s study (2023), their investigation revealed that students exhibited markedly low problem-solving skills in mathematics. They added that the students have difficulties understanding the concept, analyzing the problem, identifying the correct solution, establishing the equation, and simplifying the expression.

Significance of the Relationship of Mathematics Self-Efficacy and Motivation Towards Problem-Solving Skills of Students

Table 13 displays the findings on the correlation of mathematics self-efficacy and motivation levels with problem-solving skills. The study results indicate a substantial negative correlation between the independent variables and the dependent variable. The results suggest a statistically significant inverse relationship between students' mathematics self-efficacy and problem-solving abilities ($p<0.05$). The obtained r-value of -0.296 indicates a negative correlation between the abovementioned variables. This means that when the mathematics self-efficacy among tertiary education students specializing in mathematics increases, their problem-solving skills decrease. On the contrary, their problem-solving skills are high when their mathematics self-efficacy are low.

Table 4. Significance of the Relationship of Mathematics Self-Efficacy and Motivation Towards Problem-Solving Skills of Students

Independent Variables	Problem-Solving Skills		
	r	p-value	Decision on Ho
Mathematics Self-Efficacy	-0.296	0.003	Significant
Motivation	-0.364	0.000	Significant

In the findings of Hay et al. (2022), they stated that mathematics self-efficacy negatively correlates with students' problem-solving skills. It implies that the higher mathematics self-efficacy, the lower the students' problem-solving performance in mathematics. In addition, Donolato et al. (2019) also claim that higher mathematics self-efficacy is correlated with lower problem-solving skills of students, and the studies suggest that improving students' mathematics

self-efficacy could also lead to poor problem-solving in mathematics. The research by Hay et al. (2022) and Donolato et al. (2019) suggests an inverse relationship, correlating higher mathematics self-efficacy with lower student problem-solving skills. This contradicts the findings of Akkan et al. (2019), Fatmasari et al. (2021), and Callan et al. (2021), which indicate a positive association between mathematics self-efficacy and problem-solving skills. Hay et al. (2022) and Donolato et al. (2019) findings imply that overly high mathematics self-efficacy might not always translate into better problem-solving skills of students, and there might be cases where students with inflated mathematics self-efficacy struggle in problem-solving tasks. This contrasts with the notion in Akkan et al. (2019), Fatmasari et al. (2021), and Callan et al. (2021) studies, where high mathematics self-efficacy is associated with improved problem-solving skills. Moreover, based on the findings, the null hypothesis is rejected.

Similarly, Table 4 presented in this study demonstrates a statistically significant inverse correlation between student motivation and problem-solving skills ($p<0.05$). The obtained r-value of -0.364 indicates a negative correlation between motivation and problem-solving skills of students. This implies that an inverse relationship exists between the level of motivation exhibited by tertiary education students specializing in mathematics and their proficiency in problem-solving. In addition, having a high level of motivation does not guarantee that the students will perform highly in mathematics problem-solving.

The findings are consistent with the research conducted by Tran and Nguyen (2021), which posited a negative association between student motivation and problem-solving abilities. They stated that if the students have developed high motivation, they will likely have lower mathematics problem-solving skills. Additionally, Liu et al. (2020) asserted that there is a negative correlation between students' motivation and problem-solving skills. They stated that even if the students have high motivation in learning mathematics, it is not guaranteed that they can also get a high performance in problem-solving in mathematics. The findings from Tran and Nguyen (2021) and Liu et al. (2020) that higher motivation is correlated with lower problem-solving skills of students contradicting the findings from Baars et al. (2017) and Fatimah et al. (2019), which suggest a positive relationship between motivation and problem-solving skills. Tran and Nguyen's (2021) and Liu et al. (2020) findings imply that overly high motivation might not always result in high problem-solving skills in students, and there might be cases where students who are motivated have struggled with problem-solving tasks. This contrasts with the studies of Baars et al. (2017) and Fatimah et al. (2019), where high motivation is associated with high problem-solving skills. Furthermore, based on the findings, the null hypothesis is rejected.

Significance of the Influence of Mathematics Self-Efficacy and Motivation on Problem-Solving Skills

Table 5 presents the results of the regression analysis, examining mathematics self-efficacy and motivation as predictors of students' problem-solving skills. The findings indicate that of the variables examined, only Motivation predicts problem-solving skills of students as evidenced by a p-value of 0.023. Furthermore, the statistical analysis reveals that mathematics self-efficacy does not predict problem-solving skills of students ($p>0.05$), as indicated by a p-value of 0.618.

Table 5. Regression Analysis of the Mathematics Self-Efficacy and Motivation towards Problem-Solving Skills

Independent Variable	Unstandardized β Coefficients		Standardized Coefficients		p-value	Remarks
	B	Std. Error	Beta	t		
(Constant)	29.688	2.681		11.073	0.000	
Mathematics Self-Efficacy	-0.485	0.969	-0.068	-0.501	0.618	Not Significant
Motivation	-2.211	0.959	-0.315	-2.304	0.023	Significant
R= 1.367;	R square= 0.135				p= 0.000	

Moreover, the coefficient of determination (R square) of 0.135 indicates that the model can explain 13.5% of the variability in problem-solving skills among tertiary education students specializing in mathematics. The coefficient of 86.5% suggests the extent to which additional variables can account for the variability observed in the problem-solving abilities of tertiary education students specializing in mathematics.

This result is related to the study of Dela Peña and Baluyos (2022), who stated that motivation predicts mathematics students' problem-solving skills. This implies that the level of motivation in mathematics among students is a determining factor for their proficiency in mathematical problem-solving. In addition, it is consistent with the findings of Del Villar and Napawit (2018), who observed a high correlation between motivation and problem-solving of the students. This is because their performances are the result of their accomplishments. Additionally, the drive of students to enhance their cognitive processes plays a crucial role in attaining academic success. Moreover, students' motivation is a driving force that compels them to take action and exert considerable effort to enhance their enthusiasm for engaging in academic tasks. Additionally, Li et al. (2020) found that motivation is the contributing factor to students' performance in problem-solving in mathematics.

Moreover, the study of Shimizu (2022) revealed that mathematics self-efficacy has insufficient evidence to predict students' problem-solving skills. Additionally, it is also aligned with the study of Kaskens et al. (2020) that mathematics self-efficacy does not predict students' problem-solving skills. The authors added that some students with high self-efficacy cannot solve word problems in mathematics even if they have confidence in themselves. They will inevitably have doubts and give up, especially if the word problem in mathematics is too difficult for them.

CONCLUSION

Based on the findings of this investigation Mathematics self-efficacy is high among tertiary education students specializing in mathematics, Motivation is high among tertiary education students specializing in mathematics and the tertiary education students specializing in mathematics exhibit very poor problem-solving skills. There is a weak negative correlation exists, r = -0.296, between the level of self-efficacy in mathematics and problem-solving skills among tertiary education students specializing in mathematics. Moreover, a weak negative correlation r = -0.364 exists between the motivation levels and problem-solving skills of tertiary education students specializing in mathematics. Additionally, Motivation significantly predicts students' problem-solving skills, while mathematics self-efficacy does not significantly predict students' problem-solving skills.

On the bases of the aforementioned findings of the study and drawn conclusions, students must engage in regular problem-solving exercises and encourage themselves to explore various approaches to solving a problem in mathematics. Moreover, students must collaborate with their peers and seek help from teachers and mentors. Students are also encouraged to develop a growth mindset by highlighting that intelligence and mathematical skills may be gained through hard work, practice, and perseverance. Moreover, teachers might teach the students the procedures to understand the problems and assimilate real-world problems in solving word problems so that they would see the significance of solving in their daily lives and how mathematics is applicable in everyday situations. Teachers employ a variety of activities and integrate diverse teaching strategies to enhance their students' problem-solving skills. Teach them to embrace challenges, view mistakes as learning opportunities, and believe in their potential for growth. Furthermore, Heads of higher institutions may work together to increase student engagement in mathematics. They can ensure that the necessary materials, resources, activities, and differentiated instruction are provided and used to meet students' motivation and learning needs. Lastly, future researchers may examine the outcomes of this study to formulate interventions aimed at identifying additional elements that could enhance mathematics self-efficacy and motivation, particularly in the context of problem-solving skills among students.

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DECLARATION OF CONFLICT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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