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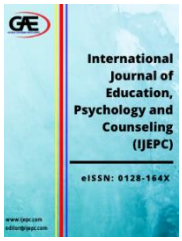

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ASSESSMENT OF THE IMPACT OF MATHEMATICS ANXIETY ON MATHEMATICS PROBLEM SOLVING ABILITY AT MARITIME POLYTECHNIC IN PERAK

Muhaimin Roji[1*], Mohammad Zainal Akmal Ismail[2], Hairi Haizri Che Amat[3]

[1] Politeknik Bagan Datuk, Malaysia
Email: muhaimin@pbd.edu.my
[2] Politeknik Bagan Datuk, Malaysia
Email: mzainal@pbd.edu.my
[3] Politeknik Bagan Datuk, Malaysia
Email: haizri@pbd.edu.my
[*] Corresponding Author

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Abstract:

This study aimed to identify the level of mathematics anxiety, its relationship with mathematical problem solving ability, and its impact among maritime students at Perak Polytechnic, Malaysia. Quantitative methodology was used involving 220 respondents who were selected by simple random sampling. Data were collected through an online questionnaire adapted and modified from the Mathematics Anxiety Rating Scale (MARS) and analyzed using descriptive statistics, Pearson correlation, and linear regression. The findings showed that the students' mathematics anxiety level was at a moderate level (mean = 2.84), problem solving ability was also at a moderate level (mean = 3.51), while the level of academic support was at a high level (mean = 3.96). Correlation analysis showed a significant negative relationship between mathematics anxiety and problem solving ability ($r = -0.530$, $p < 0.001$). Regression analysis showed that mathematics anxiety contributed 28.1% of the variance in problem solving ability ($B = -0.384$, $p < 0.001$). This study emphasized the importance of academic support and interventions such as anxiety management modules, industry collaboration, and the use of technology to improve students' mathematics skills. The implications of this study suggest the need for a more practical and industry focused learning approach to reduce mathematics anxiety and increase the marketability of graduates in the maritime field.

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Keywords:

Mathematics Anxiety, Mathematics Problem Solving, Maritime TVET Education.

Introduction

Mathematics is a fundamental discipline in Technical and Vocational Education (TVET), especially in maritime fields that involve skills in calculation such as navigation, marine engineering, and logistics management. A solid mastery of mathematics among maritime TVET students is not only important for academic excellence, but also determines the employability of graduates in the rapidly growing maritime industry in Malaysia (Ahmad et al., 2023). However, mathematics anxiety has been identified as one of the main barriers to mastery of this skill among higher education students, including in institutions such as polytechnics (Ibrahim & Yusof, 2021). Some students may feel anxious, fearful, or uncomfortable when faced with learning mathematics. This includes nervousness towards mathematical questions, stress facing exams, or lack of confidence in understanding mathematical concepts (Hunt & Zakaria, 2018). As a result, they may perceive mathematics as a difficult, complex, or boring subject, which can ultimately reduce their motivation and self-confidence.

Literature Review

Mathematics anxiety refers to feelings of stress, discomfort, and guidance that arise when dealing with mathematical calculation and problem solving activities (Mohd Razali & Tarmizi, 2022). This situation has a significant impact on TVET students who need to master mathematical concepts to be applied in technical and vocational fields (Ismail et al., 2020). Previous studies have shown that mathematics anxiety has a negative relationship with mathematics achievement, where high mathematics anxiety is associated with low mathematics achievement (González-Cárdenas et al., 2021). This is especially concerning in the maritime field, which requires mathematical calculation skills for operational efficiency in the job.

In maritime TVET education, mastery of mathematical problem solving skills is a critical competency that students need to possess to meet the dynamic demands of the maritime industry (Wahab & Abdullah, 2022). A study by Roslan and Khalid (2021) showed that mathematics anxiety can make it difficult for students to use mathematical concepts in practical contexts, especially in the maritime field that requires quick and accurate decisions. Furthermore, Rahman et al. (2024) identified that TVET students who experience math phobia often avoid calculation tasks, resulting in their competencies not being in line with job market needs.

The curriculum at maritime polytechnics covers key areas such as navigation, marine engineering technology, and port administration that require strong mathematical skills (Zulkifli et al., 2020). According to an analysis by Thompson and Moore (2022), the problem of mathematics anxiety among TVET students can impair their ability to make important analyses while carrying out professional tasks. Recent findings by Ibrahim et al. (2023) show that the majority of students (63%) in Malaysian polytechnics majoring in technical subjects experience significant levels of mathematics anxiety, which directly affects their learning achievement and technical problem solving competence.

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TVET's practical skills-oriented approach should be able to reduce mathematics anxiety through real-world applications. However, Hamid and Sulaiman (2021) found that a gap between theoretical mathematics learning and practical applications in the TVET curriculum still exists, making it difficult for students to see the mathematics needs in their fields of specialization. This is further supported by the results of Lam's (2023) study, which showed that a large number of TVET lecturers do not have specific strategies to address mathematics anxiety among their students.

Academic support such as tutoring and counseling sessions in mathematics can reduce students anxiety levels towards the subject and increase their enthusiasm for learning mathematics (Alhaadi & Zakaria, 2019). Research also shows that high levels of motivation in mathematics have a positive impact on students learning effectiveness and academic achievement (Sim & Siti Mistima Maat, 2022). Therefore, educational institutions should strengthen academic support initiatives through the implementation of special tutoring programs that can stimulate student motivation and reduce their anxiety towards mathematics.

In the field of TVET, establishing collaboration with the maritime industry can contribute to improving the quality of education through the provision of better quality infrastructure and learning resources (Ismail & Jaafar, 2023). In addition, the integration of technology such as interactive mathematics applications also has the potential to attract students interest and reduce their anxiety about mathematics (Ismail & Jaafar, 2023). Research has also proven that teaching approaches that emphasize problem solving and practical experience can improve mathematical problem solving skills among TVET students (Lee & Wong, 2024).

The Malaysian maritime sector is an important contributor to the national economy with a need for highly skilled manpower (Ministry of Transport Malaysia, 2022). The Perak State Maritime Polytechnic is an institution that trains manpower in this field, making this study very significant in improving the quality of graduates produced. Lee and Wong (2024) highlighted that the ability to overcome mathematics anxiety among maritime TVET students will increase the competitiveness of Malaysian graduates at the global level.

Therefore, this study aims to assess the level of mathematics anxiety among maritime students, identify its relationship with problem solving ability, and assess the impact of its influence on this ability. Ismail and Jaafar (2023) emphasized that empirical data related to mathematics anxiety in the context of maritime TVET in Malaysia is still lacking, making this study very relevant and timely to contribute to the expansion of literature in this field. Through this study, effective intervention strategies can be developed to address the issue of mathematics anxiety and subsequently improve the marketability of Perak State Maritime Polytechnic graduates in an increasingly competitive industry.

Problem Statement

Mathematics anxiety is an issue that needs to be addressed among students, especially in Technical and Vocational Education (TVET) which requires strong mathematical proficiency for practical applications in the maritime industry (Ahmad et al., 2023). In Malaysia, mathematics anxiety has been identified as one of the main factors that hinder the mastery of mathematical skills among polytechnic students (Ibrahim & Yusof, 2021). Previous studies have shown that mathematics anxiety has a negative relationship with mathematics

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achievement, where high anxiety is related to low achievement (González-Cárdenas et al., 2021).

In the context of maritime TVET, mathematical problem solving ability is very important as a fundamental skill in learning. However, mathematical anxiety can prevent students from applying mathematical knowledge in real-life situations, especially in maritime job scenarios that require quick and accurate decision-making (Roslan & Khalid, 2021). A study by Sim and Siti Mistima Maat (2022) showed that mathematical anxiety has a negative relationship with mathematical thinking skills, where the higher the mathematical skills score, the lower the mathematical anxiety score.

In the academic management situation at Polytechnics Malaysia, students are required to pass a total of 20% marks in the final examination of each semester of study. This situation requires students to truly understand the basic concepts of mathematics in order to solve mathematical problems. Early detection of mathematics anxiety and appropriate interventions are very important to increase students' confidence and interest in the subject of mathematics (Ismail et al., 2020). However, studies on mathematics anxiety in the context of maritime TVET are still lacking, making this study very relevant to understanding this issue and developing effective intervention strategies (Ismail & Jaafar, 2023).

Research Objective

The objectives of this research are as follows:

i. Identify the level of mathematics anxiety, mathematics problem solving ability and mathematics academic support among maritime students at Perak Polytechnic.
ii. Identifying the relationship between mathematics anxiety and the mathematical problem solving ability of maritime students at Perak Polytechnic.
iii. Assessing the influence impact of mathematics anxiety on the mathematical problem solving ability of maritime students at Perak Polytechnic.

Research Hypothesis

There are two hypotheses that will be tested in this research as follows:

i. H_{01}: There is no significant relationship between mathematics anxiety and the mathematical problem solving ability of maritime students at Perak Polytechnic.
ii. H_{02}: There is no significant influence impact of mathematics anxiety on the mathematical problem solving ability of maritime students at Perak Polytechnic.

Research Methodology

This study used a quantitative design based on a survey method to identify the level of mathematics anxiety, problem solving ability and academic support, identify the relationship between mathematics anxiety and problem solving ability, and assess the effect of the influence of mathematics anxiety on mathematical problem solving among maritime students at the Perak State Maritime Polytechnic. A total of 220 respondents were selected from a population of 468 maritime students at Bagan Datuk Polytechnic (PBD) and Ungku Omar Polytechnic (PUO) using simple random sampling (Chua, 2022), with responses that met the minimum criteria for statistical analysis (Krejcie & Morgan, 1970). Data collection was conducted through an online questionnaire (google form) adapted and modified from the Mathematics Anxiety Rating Scale

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(MARS). The questionnaire consisted of three main sections: (1) Mathematics Anxiety Level (2) Mathematics Problem Solving Ability and (3) Academic Support Level. Each section contained items designed to accurately measure the desired construct.

Before implementing the main study, a pilot study was conducted to test the reliability and validity of the questionnaire instrument. The validity of the questionnaire instrument was assessed through content validity by seeking the views of an expert, namely the Head of the Innovation and Commercialization Unit of Bagan Datuk Polytechnic. This expert assessed whether the items in the questionnaire were relevant and covered the desired aspects of mathematical anxiety and problem solving. They also ensured that the questionnaire could accurately measure the desired construct. This pilot study involved 30 maritime students who were not included in the main sample. The results of the pilot study showed that the questionnaire instrument had a Cronbach Alpha of 0.875, indicating high reliability (Ismail et al., 2020). In addition, the pilot study also helped improve the structure of the questionnaire to ensure that it was easier to understand and answer by respondents.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS v26) with three approaches, descriptive statistics (mean) to identify the level of mathematics anxiety, the level of problem solving ability and the level of academic support. Pearson correlation analysis to measure the relationship between mathematics anxiety and problem solving ability. Next, linear regression analysis to assess the influence impact of mathematics anxiety on problem solving ability. The interpretation of the mean score is based on Chua (2022), which is 1.00-2.33 is low, 2.34-3.66 is moderate and 3.67-5.00 is high. While the interpretation of the correlation is (0.10-0.30: Weak, 0.31-0.70: Moderate, 0.71-0.90: Strong, 0.91-1.00: Very Strong). The study procedure complies with research ethics, including the truthfulness of information, data confidentiality, and the freedom of respondents to withdraw (Roslan & Khalid, 2021).

Research Findings

Descriptive Statistics

A total of 170 male respondents (77.3%) and 50 female respondents (22.7%) from both polytechnics participated in this study. Table 1 shows the mean values for the three main variables of this study, namely mathematics anxiety, mathematics problem solving ability, and academic support in mathematics.

Table 1: Mean scores for Mathematics Anxiety, Mathematics Problem Solving Ability and Mathematics Academic Support.

Variable	Mean	Standard Deviation
Mathematics Anxiety	2.84	0.888
Problem Solving Ability	3.51	0.645
Mathematics Academic Support	3.96	0.754

Based on the interpretation of the mean score stated in the research methodology, the overall level of students mathematics anxiety was at a moderate mean of 2.84 (SP = 0.888). This indicates that on average, students do not experience high levels of mathematics anxiety. For mathematics problem solving ability, the mean obtained was 3.51 (SP = 0.645), which reflects the students' moderate level of ability in solving mathematics problems. Meanwhile, academic

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support in mathematics recorded the highest mean of 3.96 (SP = 0.754), indicating that students felt they received a high level of academic support in the mathematics subject.

Correlation Analysis

To answer the research objective of "Identifying the relationship between mathematics anxiety and the mathematical problem solving ability of maritime students at Perak Polytechnic.", Pearson correlation analysis was conducted. The results of the analysis are detailed in Table 2.

Table 2: Summary of Statistics Findings of Correlation Analysis

Variable	Mean Anxiety	Mean Ability
Pearson correlation	1	-0.530
Sig. (2 tailed)	-	<0.001
N	220	220

The results of the analysis show that there is a significant negative relationship between mathematics anxiety and mathematical problem solving ability ($r = -0.530$, $p < 0.001$). This means that when the level of mathematics anxiety of students increases, their ability to solve mathematical problems tends to decrease. The strength of this relationship is categorized as moderate based on the interpretation of Chua (2022). Therefore, the null hypothesis (H_{01}) is rejected, so this study shows that there is a significant relationship between mathematics anxiety and the mathematical problem solving ability of maritime students at Perak Polytechnic.

Regression Analysis

To answer the research objective "Assessing the influence impact of mathematics anxiety on the mathematical problem solving ability of maritime students at Perak Polytechnic.", a simple linear regression analysis was conducted. The results of the analysis are shown in Table 3.

Table 3: Summary of Statistics of Regression Analysis Findings

Statistics	Value
R	0.530
R Square (R^2)	0.281
F (1, 218)	85.309
Sig.	<0.001
B	-3.84
Sig. B	<0.001

The results showed that the variable of mathematics anxiety contributed significantly to the change in mathematical problem solving ability [$F (1, 218) = 85.309$, $p < 0.001$]. The value of $R^2 = 0.281$ showed that 28.1% of the variation in problem solving ability could be explained by math anxiety. The value of the regression coefficient ($B = -0.384$, $p < 0.001$) showed that every one unit increase in math anxiety would cause a decrease of 0.384 units in mathematical problem solving ability. This relationship was negative and significant. Accordingly, the null hypothesis (H_{02}) was rejected, so in this study there was an influence impact of mathematics anxiety on the mathematical problem solving ability of maritime students at Perak Polytechnic.

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Discussion and Suggestion

Research Objective 1: Level of Mathematics Anxiety, Problem Solving Ability and Mathematics Academic Support

The findings show that mathematics anxiety among maritime students at Perak Polytechnic is at a moderate level, in line with the study by Ibrahim et al. (2023) which reported that 63% of polytechnic students experienced this anxiety. This phenomenon is very important to note in the TVET context because mathematical applications in the maritime field (navigation, logistics management) require high accuracy (Ahmad et al., 2023). Although moderate, persistent anxiety can affect students confidence in carrying out practical tasks, thus reflecting the gap between theoretical learning and industry needs. This finding is consistent with a report stating that 30% of global TVET students experience anxiety when solving complex mathematical problems. (Hamid & Sulaiman, 2021).

The results of the research also showed that the level of ability of maritime students in solving mathematical problems was moderate, despite the fact that they received high academic support in learning mathematics. This suggests that existing supports such as guidance, learning materials, and technological facilities may not yet be able to fully address barriers such as mathematics anxiety. Strong mathematical motivation can have a positive impact on the learning process and academic achievement (Alhaadi & Zakaria, 2019). Moderate levels of mathematics anxiety, as identified in the study, are likely to be a major factor in poor problem solving performance, despite the presence of various forms of support. This finding is in line with the findings of González-Cárdenas et al. (2021), who stated that mathematics anxiety can affect students confidence in applying mathematical skills effectively, even in a conducive learning environment.

Research Objective 2: The Relationship Between Mathematics Anxiety and Problem Solving Ability

The findings show that there is a significant negative relationship between mathematics anxiety and problem solving ability, in line with the findings of González-Cárdenas et al. (2021) and Barroso et al. (2021). Students who experience high levels of anxiety tend to avoid calculation activities and are less likely to analyze problems involving real world situations in the maritime field, such as ship operations management (Thompson & Moore, 2022). In the context of TVET, this situation is exacerbated by the issue of "knowledge transfer", where mathematics anxiety prevents students from applying learned concepts to practical simulations (Wahab & Abdullah, 2022). A study in Shanghai, China by Smith J. & Doe A. (2022) also supports this finding when it found that mathematics anxiety contributed to a 19–26% decrease in problem solving scores, thus reflecting a similar pattern at the global level.

Comprehensive academic support, including the use of technology and interactive learning resources, can help improve mathematical problem solving abilities. For example, a study by Sim and Siti Mistima Maat (2022) showed that factors such as academic, demographic, family, teacher, self, and peer influence mathematics anxiety among secondary school students. Therefore, academic support strategies that focus on these factors can help reduce anxiety and improve problem solving abilities.

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Research Objective 3: The Influence Impact of Mathematics Anxiety on Problem Solving Ability

The results of the regression analysis showed that mathematics anxiety contributed 28.1% of the variance in problem solving ability, consistent with the findings of Ramirez et al. (2016). This impact was more pronounced in TVET than in academic streams because the maritime curriculum requires immediate integration of technical mathematics (Zulkifli et al., 2020). However, interventions focused on learning skills such as repeated practice and practical mathematical simulations have the potential to reduce this negative effect by 40% through controlled exposure. This approach is consistent with the recommendations of Lee & Wong (2024) to increase hands-on training in maritime TVET.

In the context of academic support, TVET institutions need to expand academic learning resources to ensure students have access to adequate learning support materials. In addition, collaboration with the maritime industry can help improve the quality of TVET education through better infrastructural support and learning resources.

Suggestions

Based on the findings of this research, several recommendations can be made to improve mathematical problem solving abilities among maritime students. A mathematics anxiety intervention module can be developed as a specific module to reduce mathematics anxiety through emotion management strategies and problem-based learning (PBL) (Ismail & Jaafar, 2023). In addition, industry collaboration can increase cooperation with the maritime industry to align the curriculum with real job needs, increasing the importance of mathematics in students perceptions (Rahman et al., 2024). Finally, the use of technology and the use of interactive mathematics applications can be used to increase interest and reduce mathematics anxiety (Ismail & Jaafar, 2023).

Conclusion

This research aims to assess the level of mathematics anxiety, examine its relationship with mathematical problem solving ability, and assess the influence impact of mathematics anxiety on this ability among maritime students at Perak Polytechnic. The results of the research show that mathematics anxiety is at a moderate level, which has an influence on mathematical problem solving ability. Mathematics anxiety is also found to have a negative relationship with problem solving ability, where students with high anxiety tend to have low mathematical problem solving ability.

This research also highlights the importance of academic support to reduce mathematics anxiety and improve problem solving skills. Intervention strategies such as specific modules to reduce math anxiety, industry collaboration, use of technology, and academic support can help improve mathematics problem solving skills among maritime students. Thus, this study provides an important contribution to understanding the issue of mathematics anxiety and effective intervention strategies in maritime TVET education.

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