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Students' Perceptions on Mathematics Problem-solving in Secondary School

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Abstract

Problem-solving is one of the most important skills for students to learn, as it will be applied in their career development and future. However, many students encountered difficulty with their school assignments related to problem-solving questions. This study investigated the perceptions among secondary school students regarding mathematics problem-solving questions. The study used a quantitative approach. Through a questionnaire, data were collected from 106 students from a secondary school located in Johor who were selected as respondents. The questionnaire focused on the perceptions of male and female students in problem-solving questions and the difficulties encountered by students in dealing with these types of questions. All respondents needed to identify the strategies or techniques to answer mathematics problem-solving questions. Both descriptive and inferential analyses were used to achieve the objectives of this study. The results showed that students had a moderate perception of mathematics problem-solving questions, and both male and female students had the same perception. Students also encountered several difficulties in solving mathematics problem-solving questions, and there is a significant difference between male and female students in the difficulties encountered when answering the questions. The highest-ranked technique chosen by students to solve the mathematics problem-solving question was remembering solutions that had been derived before.

Keywords Mathematics Problem-solving, Secondary School, Students' perception

INTRODUCTION

Problem-solving is an important skill for learning mathematics. When studying maths, mathematical facts and content are important but still insufficient to help students learn and understand complex concepts. Problem-solving is the process of constructing and applying mental representations of problems to find solutions to problems encountered in nearly every context [1]. According to [2], problem-solving is a process that involves systematic observation and critical thinking to find an appropriate solution or way to reach the desired goal. There are several definitions of problem-solving. One such definition is that "problem-solving is the process of designing, evaluating, and implementing a strategy to answer an open-ended question or achieve a desired goal" [3]. In mathematics, problem-solving has long been seen as an important aspect of mathematics teaching and learning [4].

Despite this, students appear to struggle with their schoolwork, particularly in mathematics problem-solving [5]. Many students cannot cope with the basic skills needed in mathematics, so it is difficult for them to solve the problems. Students also reported facing difficulties in making accurate interpretations,

memorizing, retrieving facts, maintaining focus, and using their logical thinking [6]. Another study stated that solving mathematical problems is essential to the general purpose of learning mathematics; it is prioritised over the process and, as a result, is the focus of school mathematics and aims to help develop mathematical thinking [7]. Therefore, the purpose of this study is to identify students' perceptions and compare the significant differences between genders in mathematics problem-solving and the difficulties encountered by students in solving mathematics problems. This study also identifies students' strategies or techniques for answering mathematics problem-solving questions. The literature analysis is found next in Section 2. The study's methodology is described in Section 3. The findings and debate are covered in Sections 4 and 5, while Section 6 presents the study's conclusions.

LITERATURE REVIEW

Year after year, the lack of problem-solving skills among students, especially in mathematics, is a problem that teachers try to overcome because they teach different types of students with different levels of understanding. One of the difficulties in learning to solve problems is that many skills need to be developed to be effective problem solvers [8]. Many students are reported to face difficulties in solving mathematical problems because they are unable to master basic skills in mathematics. Moreover, solving mathematical problems does not involve only one method. Using multiple solution methods can also help students find solutions. The multiple-solution method is a method that can be applied in the teaching and learning process, where students will learn various methods to be applied in finding a solution to a single question [9]. It shows that they can find solutions if they overcome the challenges of solving mathematics problems together.

Problem-solving skills are a serious issue that can affect not only student achievement but also students' futures. The lack of problem-solving skills among students has been proven by their contribution to graduate unemployment [10]. According to [11] in Bloom's Taxonomy Interpreted for Mathematics, problem-solving in mathematics lies at the third level of Bloom's Taxonomy of Cognitive Skills, which is application. It shows that problem-solving is at a moderate level for students' skills. A study was conducted among university students from an engineering course to examine their perceptions of practical problem-solving in an e-environment. The findings of the study show that 16.5% of students are not interested in applying mathematical skills to solve engineering problems [12]. This study was extended by [13], who applied the numeration theory framework to engineering mathematics students. The results showed that the difficulty and importance of learning different numeracy skills had been established.

Factors that cause students' difficulties in solving mathematical problems are that they seem to have problems absorbing information well, have weak prerequisite conceptual abilities, and are careless [14]. For the first factor, students are confused when determining the meaning of words and cannot abstract the problem into mathematical patterns. In that situation, students tend to answer direct questions where the questions are in the form of numbers, but most problem-solving in mathematics is in the form of sentences, which makes it difficult for students to understand clearly. For the second factor that hinders the understanding of prerequisite concepts, students seem to have issues solving problems because they do not know the basic lessons in the topic. The third factor is the carelessness of students. They are not careful with the use of formulas and numbers and thus this becomes the most frequent mistake they make. According to a study by [15], although exercises are always given in class and it is a common way to train and test students' understanding of the concept of using narrative, the ability to interpret problems into mathematical concepts can be challenging, especially for non-science students. The results of the study show that despite the difficulty they faced, students enjoy doing math problems in a group discussion.

In this context, past researchers have focused on teacher strategies to improve problem-solving skills. To make decisions to solve problems and understand problems, software applications can help in modelling the system [16]. As we know, the implementation of technology in education seems to be increasing year by year because it is very helpful in education. For example, control technologies such as MindTools [17] or the Jigsaw cooperative learning strategy integrated with Geogebra [18] are some software that can help teachers teach effectively. Mathematics is a core subject in most science and technology courses and some social programs [19]. However, due to the low achievement in

mathematics exam results, the study of using PowerPoint as a tool in teaching mathematics has been given positive feedback regarding mobility and learning satisfaction. A similar study by [20] to evaluate the students' satisfaction using the fuzzy theory perspective was implemented. The results of the study found that students like to use the PowerPoint application wherever and whenever they want when learning mathematics. Therefore, the use of PowerPoint in teaching and learning is seen as an effective way to solve mathematical problems.

RESEARCH METHODOLOGY

This study involves a quantitative approach that will be conducted using both descriptive and inferential methods. Descriptive statistics is the statistical description of the data set, while inferential statistics is the drawing of inferences or conclusions based on a set of observations [21]. Descriptive studies normally analyse the data by using the mean and standard deviation, while inferential statistics require further tests such as an independent sample t-test, regression, or other tests to analyse the data. A descriptive study will be used to determine students' perceptions, difficulty levels, and strategies or techniques to answer mathematics problem-solving questions. An inferential study will be used to compare the perceptions and difficulties encountered by students when answering mathematics problem-solving questions between male and female students. By referring to Krejcie and Morgan's sample size determination table, the target sample of this study is 106 form 3 students from a secondary school located in Pasir Gudang, Johor. The Form 3 students are chosen as a sample since they are in the intermediate form. These students typically have a solid foundation in mathematics concepts but may still encounter challenges in problem-solving, making them an ideal group to provide insights into their experiences and perceptions.

This study uses simple random sampling to collect the data. In this selection method, all the individuals have an equal opportunity to participate in the study, and the selection process is entirely random. It ensures unbiased representation and equal probability for the population [22]. A pilot study is conducted first to check the reliability of the questionnaire. It is conducted on a smaller scale than the main, full-scale study. In other words, the pilot study is important for improving the quality and efficiency of the main study [23]. The questionnaire is distributed to 10 secondary students. The data obtained is analysed using Statistical Package for the Social Sciences (SPSS) to determine its reliability and validity. Table 1 shows the result of the pilot study, where the value of Cronbach's alpha is greater than 0.7.

Table 1 Pilot Study Test

Cronbach's Alpha	Number of items
0.772	18

The questionnaire is divided into three parts. Section A consists of questions on the demographic profiles of class and gender. Section B aims to identify students' perceptions of mathematics problem-solving. It consists of 8 items. Next, Section C determines the difficulties students encounter when solving mathematics problems. This part consists of 10 items. In Section B, the questions use a Likert scale to examine students' level of agreement, which are strongly disagree, disagree, neutral, agree, and strongly agree with the statement, while Section C provides a list of several strategies that students can choose from in solving mathematics problem-solving questions.

FINDINGS AND DISCUSSIONS

Demographic profile

Findings for Section A consist of information on gender and class as shown in Table 2 and Table 3 below.

Table 2 The Distribution of Respondents based on Gender

Gender	Frequency	Percentage (%)
Male	55	52
Female	51	48
Total	106	100

Table 2 shows the number of respondents based on their gender. Of 106 respondents, 55 (52%) of them are male students, while the rest of them, which is 51 (48%) students, are female.

Table 3 The Distribution of Respondents based on Class

Class	Frequency	Percentage (%)
Bestari	31	29
Ehsan	32	30
Gigih	17	16
Jujur	26	25
Total	106	100

Table 3 shows the percentage of respondents according to their classes. Four classes from Form 3 are involved in this study. It consists of 31 (29%) students from 3 Bestari, 32 (30%) students from 3 Ehsan, 17 (16%) students from 3 Gigih, and 26 (25%) students from 3 Jujur.

Students' perception of mathematics problem-solving questions

Table 4 The Distribution of the Respondent's Perception of Mathematics Problem-solving Questions

Items	N	Mean	Standard deviation
I feel it is difficult for me to solve mathematics problem-solving questions.	106	3.42	1.042
I took a long time to solve mathematics problem-solving questions.	106	3.61	0.835
I managed to answer all problem-solving questions during the examination.	106	2.83	1.073
managed to get a final answer to problem-solving questions during my examination.	106	2.92	0.963
I managed to get a higher mark in mathematics problem questions.	106	2.50	1.007
I managed to show my work solutions for problem-solving questions in the correct order.	106	2.95	0.930
I can solve most of the mathematics problem-solving questions on my own.	106	3.22	1.005
I need my teacher's guidance whenever I want to solve questions related to mathematics problem-solving.	106	3.85	0.974
Overall	106	3.16	0.9786

The finding in Section B is shown in Table 4 with a total of respondents (N) is 106. The overall mean for students' perceptions of mathematics problem-solving questions is 3.16. It showed that students have a moderate perception of questions related to mathematical problem-solving. Most of the respondents needed the teacher's guidance to solve the questions with a mean (M) is 3.85 and a standard deviation (SD)

is 0.974. Students took a long time to solve mathematics problem-solving questions (M = 3.61, SD = 0.835). Other than that, students found it difficult to solve mathematical problem-solving questions (M = 3.42, SD = 1.042). The finding also showed that most students disagree that they get a higher mark in mathematics problem-solving questions (M = 2.50, SD = 1.007).

Table 5 Group Statistics for Students' Perceptions of Mathematics Problem-Solving Questions Between Gender

Gender	N	Mean	Standard Deviation	Standard Error Mean
Male	55	25.56	3.736	0.504
Female	51	25.04	3.316	0.464

Table 5 shows the mean students' perceptions of mathematics problem-solving questions; males at 25.56 (SD = 3.736) and females at 25.04 (SD = 3.316), respectively. An independent sample t-test was conducted to identify whether there is a significant difference in students' perceptions between male and female students. The hypotheses are shown below:

H_0: There is no significant difference between male and female students based on students' perceptions of mathematics problem-solving questions.
H_1: There is a significant difference between male and female students based on students' perceptions of mathematics problem-solving questions.

Table 6 Independent Samples t-test for Students' Perceptions of Mathematics Problem-solving Questions

	Gender	N	Mean	Standard deviation	t	df	Sig (2-tailed)
Test score	Male	55	25.56	3.736	0.762	104	0.448
	Female	51	25.04	3.316			

Based on Table 6, it is found that there is no significant difference in perceptions of mathematics problem-solving questions between male students (M = 25.56, SD = 3.736) and female students (M = 25.04, SD = 3.316) with t(104) = 0.762, p-value = 0.448 > 0.05. Thus, the null hypothesis is accepted. Both groups have the same perception of mathematical problem-solving questions.

Table 7 The Distribution of the Difficulties encountered by Students when answering Mathematics Problem-solving Questions

Items	N	Mean	Standard deviation
It is difficult for me to understand problem-solving questions in a short time.	106	3.62	1.037
The words used in problem-solving questions are complicated.	106	3.42	1.051
I managed to understand the whole sentence in problem-solving questions.	106	3.01	1.910
The question relates to mathematics problem-solving is too long.	106	3.51	0.959
I have difficulty putting out important details in solving mathematics problems.	106	3.34	1.004
I have difficulty identifying the topic that relates to the question.	106	3.12	1.005
I felt confused about what I had to start first in solving mathematics problem-solving questions.	106	3.45	1.164
I have difficulty arranging the solutions for problem-solving questions in the correct order.	106	3.31	1.045
I was often clueless whenever I had to answer problem-solving questions.	106	3.39	1.001
I have difficulty showing all work solutions in solving mathematics problem-solving questions.	106	3.42	1.060
Overall		3.36	1.024

Next, Table 7 shows the results of a descriptive analysis conducted to identify the difficulties encountered by secondary students when solving mathematics problem-solving questions. From all items in the questionnaire, it was clear that students encountered several difficulties in solving questions related to mathematical problem-solving. In this situation, the findings showed that most of the students found it difficult to understand the question in a short time (M = 3.62, SD = 1.037). Other than that, the students think that the question relates to mathematics problem-solving and is too long (M = 3.51, SD = 0.959). However, students have less difficulty identifying the topics that relate to the questions (M = 3.12, SD = 1.005) and understanding the whole sentence in problem-solving questions (M = 3.01, SD = 0.910).

Table 8 Group Statistics for Difficulties encountered by Students when answering Mathematics Problem-solving Questions between Gender

Gender	N	Mean	Standard Deviation	Standard Error mean
Male	55	32.45	6.529	0.880
Female	51	34.86	5.539	0.776

Table 8 shows the mean responses relating to the difficulties encountered when answering mathematics problem-solving questions between male and female students at 32.45 (SD = 6.529) and 34.86 (SD = 5.539), respectively. From the results, it was clear that female students encountered more difficulties in answering mathematics problem-solving questions compared to male students. Next, an independent sample t-test was conducted to identify whether there is a significant difference in the difficulties encountered between male and female students. The research hypotheses are shown below:

H_0: There is no significant difference in the difficulties encountered when answering mathematics problem-solving questions between male and female students.
H_1: There is a significant difference in the difficulties encountered when answering mathematics problem-solving questions between male and female students.

Table 9 Independent Samples t-test for Difficulties encountered when answering Mathematics Problem-solving Questions

	Gender	N	Mean	Standard deviation	t	df	Sig (2-tailed)
Test score	Male	55	32.45	6.529	-2.040	104	0.044
	Female	51	34.86	5.539			

An independent t-test was conducted to determine whether the student genders had significant differences in answering the mathematics problem-solving questions. In Table 9, it is found that there is a significant difference in the difficulties encountered when answering mathematics problem-solving questions between male students (M = 32.45, SD = 6.529) and female students (M = 34.86, SD = 5.539), with t (104) = -2.040, p-value = -2.044 < 0.05. Thus, the null hypothesis is not accepted. Both groups encountered different difficulties when answering problem-solving questions related to the mathematics subject.

Students' Strategies or Techniques on How to Answer Mathematics Problem-Solving Questions

A descriptive analysis was conducted on the strategies or techniques that students chose to solve mathematics problems. In Table 10 below, the most chosen technique that the student chose was remembering solutions that have been made before (M = 0.89, SD = 0.318). The other strategies that more than half of the students used were underlining important details such as keywords or numbers (M = 0.68, SD = 0.469) and talking to themselves to understand the problem (M = 0.58, SD = 0.495). The least chosen technique or strategy used is making a simple drawing to understand the situation (M = 0.17, SD = 0.377).

Table 10 Descriptive Statistics of Students' Strategies or Techniques to answer Mathematics Problem-solving Questions

Items	N	Mean	Standard deviation
Underline important details such as keywords or numbers.	106	0.68	0.469
Put out important information in the answer space.	106	0.49	0.502
Make a simple drawing to understand the situation.	106	0.17	0.377
Make a simple flow chart to understand the questions.	106	0.26	0.443
Remember solutions that have been made before.	106	0.89	0.318
Talking to myself to understand the problem.	106	0.58	0.495
Overall	106	0.51	0.434

Generally, this study found that students have moderate perceptions and difficulties in solving mathematics problems. This contrasts with a study by [24], where the study found that many students spend a lot of time learning the basics of higher mathematics and that the skills of practical problem-solving in mathematics are less important. [25] agreed that problem-solving is a useful approach and saw numerous benefits, including making the learners more skilled and confident. However, they recognised practical difficulties both in terms of preparation and implementation, especially in rural schools.

The results of a given dataset may be moderate for various reasons. One option is that the variables being measured are distributed in a way that yields modest results and that the sample is representative of the population being researched. This indicates that most of the data is contained in a set of values that are quite close to the mean. The kind of measurements being taken is another factor. We might anticipate the results to be moderate and fall relatively close to the mean if the measured variables are relatively stable and consistent, like the room's temperature or the weight of an object. Finally, the measurement or sampling procedure itself may have produced moderate results. For instance, if the sample size is too small or the measurement tool has a small range, we can see moderate results only because we are unable to catch the more extreme values that might occur in a bigger or more complete dataset. It contrasts with a study by [26] that shows students do not like to read long problems. Thus, students tend to guess without thinking about the solution to the questions. Findings from [27] found that the level of reading skill is an important indicator of students' mathematics achievement. This finding relates to mathematics problem-solving, where questions relate to problem-solving normally in long sentences.

In comparison, male and female students have the same perceptions of mathematics problem-solving questions. A study from [28] showed the same results; they used elementary mathematics teacher candidates as their sample, and there was no significant difference between male and female candidates' perceptions of their problem-solving skills. Other than that, it was found that female students encountered more difficulties when answering mathematics problem-solving questions compared to male students. More difficulties encountered in answering questions lead to low performance in the subject. Furthermore, these results are also consistent with the earlier research by [29], who found that women scored significantly lower than men on the arithmetic and cognitive reflection tests because of math anxiety. Based on the findings, most students chose the technique by remembering the solutions that have been made before to solve mathematics problems. It means that they prefer to recall the problem-solving solution they made previously. This finding supports the study by [8] that students enroll in one of the cognitive strategies, which is rehearsal. Rehearsal requires student teachers to recall past lessons or assignments that have been made.

CONCLUSION

In conclusion, the purpose of this study was to ascertain students' perspectives on mathematical problem-solving issues. The findings indicate modest attitudes and challenges. This is a result of the respondents' potentially varying levels of comprehension of questionnaire items. In addition, this study may be biased despite the use of a basic random sample because it includes a few classes from various backgrounds. Answering some questions involving solving mathematical problems presented some challenges to the

students. Since answering questions that require students to solve problems is essential for earning a higher grade in mathematics, teachers should act to resolve this issue. In addition, this study offered suggestions for students' approaches to solving mathematical problem-solving tasks. As a result, each student had their methods and varied their approaches according to the circumstances and their preferences. Teachers should teach their students how to solve mathematical problems using the same methodology.

RECOMMENDATIONS

This study sought to understand how students think about mathematics while they tackle mathematical problems. The results show moderate problems and views. The exact context in which the data are collected will determine the recommendations for results that are considered moderate. However, some broad factors might alter them. First, moderate results frequently suggest that additional research may be required to fully comprehend the patterns and trends in the data. This entails investigating the connections between the variables, locating any confounding variables, and considering other possible explanations for the observed patterns. To more accurately capture the whole range of variance in the data, it might also be beneficial to expand the sample size or use more sensitive measurement instruments. Second, it can be useful to compare moderate results to predicted ranges of values based on accepted standards or benchmarks when dealing with moderate outcomes. For instance, to determine whether the results are higher or lower than what would be anticipated, it may be good to compare the mean score on a test, which is 3.0, to the average score among similar groups. This can point out areas that might benefit from additional enhancements or treatments. Finally, it's critical to keep the larger context of the research question in mind when interpreting moderate results. Results that appear modest in one setting can be highly significant in another. For instance, a moderate outcome in research examining a treatment's efficacy may signify a considerable improvement in patient outcomes when compared to alternatives. Considering the research topic and the requirements of the population being investigated, it is crucial to consider the practical consequences of the findings.

Students also occasionally had trouble figuring out the solutions to arithmetic problems. Problem-solving is crucial for receiving a good grade in mathematics, so teachers should act to address this issue. In addition, this research offered suggestions for students' approaches to answering mathematical problem-solving questions. According to the findings, each student had their strategies and employed multiple techniques depending on the circumstances and their preferences. When teaching students how to answer mathematical problems, teachers should use the same method.

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