The Correlation between Mathematical Disposition and Problem Solving in Junior High School Students

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Abstract
The aim of this study is to examine the relationship between mathematical disposition and problem-solving abilities of junior high school students. This research was conducted to understand the extent to which mathematical dispositions contribute to students' problem-solving abilities. The research method used in this study is a survey method with a cross-sectional design involving 25 seventh-grade students from the 2019/2020 academic year in a junior high school in Bandung city. Data on mathematical disposition were collected using a questionnaire, while problem-solving abilities were assessed using a disposition questionnaire instrument. Data analysis was conducted quantitatively using descriptive statistics (including mean, maximum value, minimum value, and standard deviation) and inferential statistics (using the product-moment correlation). The results of the study show that there is a positive correlation between mathematical disposition and students' problem solving abilities with a strong correlation level.
Keywords: mathematical disposition, problem-solving skills

Introduction

Enhancing students' problem-solving skills is one of the main objectives in teaching mathematics at various levels of education (Al-khateeb, 2018). As stated in a report published by the National Council of Teachers of Mathematics (NCTM), the emphasis on and recognition of the importance of mathematical problem-solving have become fundamental needs and central focuses in the standards of mathematics teaching processes in schools (NCTM, 2000). The National Education Association (NEA) also identifies problem-solving skills as one of the core competencies required in the 21st century (Widana et al., 2018) and an integral part of everyday life, playing a crucial role (Reisberg, 2013). Problem-solving is an effort to find solutions to difficult challenges that cannot be immediately resolved (Polya, 2004). A question becomes a problem when it presents a challenging task that cannot be solved through routine procedures already known (Qodariah et al., 2018). In other words, problem-solving requires the effort of thinking about how to find various alternative answers to a specific problem. Therefore, problem-solving skills need to be mastered by students after learning mathematics (Yustiana et al., 2021). According to Xie (Hobri et al., 2018), problem-solving in the NCTM naturally

develops students' ability to solve problems through the exploration of mathematical knowledge.

The steps for problem-solving according to Polya consist of: 1) understanding the problem, which involves identifying the facts, concepts, or information needed to solve the problem; 2) devising a solution plan, which involves preparing a mathematical model of the known problem; 3) executing the solution plan, which involves carrying out the formulated mathematical model; and 4) reviewing the solution, which involves checking the appropriateness or correctness of the answer (Polya, 2004). These four problem-solving indicators proposed by Polya can serve as a guide for systematically and structuredly solving mathematical problems, thereby training students' thinking patterns on how to solve problems encountered in daily life.

Problem-solving is not just about finding solutions; furthermore, it involves adapting one's disposition to embrace continuous improvement and learning. In line with (Kariadinata, Yaniawati, Juariah, Susilawati, & Cahyana, 2019) that mathematical disposition is one of the supporting factors that play a crucial role in the success of the mathematics learning process. Mathematical disposition (productive disposition) refers to the tendency to perceive mathematics as something logical, useful, and valuable, accompanied by beliefs in one's perseverance and success (Kilpatrick et al., 2001). Developing dispositions is also one of the goals of mathematics education in the 2013 curriculum at the junior high school level, where students are expected to have curiosity, attention, perseverance, and confidence in learning mathematics (Dina et al., 2019). The importance of developing mathematical dispositions in mathematics learning is due to students needing the ability to appreciate the utility of mathematics, as well as curiosity and enjoyment in learning mathematics (Sumarmo, 2010). These dispositional attitudes can include self-confidence, curiosity, perseverance, and reflecting on one's way of thinking. These attitudes are highly needed when solving mathematical problems.

The indicators of mathematical disposition according to (NCTM, 2000) are as follows: 1) Confidence in solving mathematical problems, communicating ideas, and providing reasoning; 2) Flexibility in exploring mathematical ideas and trying various alternative models to solve problems; 3) Strong determination to complete mathematical tasks; 4) Interest, curiosity, and ability to discover while working on mathematics; 5) Tendency to monitor and reflect on one's own thinking process and performance; 6) Assessing the application of mathematics in other fields and in everyday life; 7)

Appreciation of the role of mathematics in culture and its value, both as a tool and as a language.

Realizing the importance of mathematical problem-solving skills and disposition, the facts on the ground show otherwise. According to OECD data, the performance of Indonesian students in mathematics is low compared to other countries (OECD, 2014). Previous research has shown that students make mistakes when solving problems in probability, where all problem-solving skill indicators fall into the low category (Akbar et al., 2018). Rahmawati's study also indicates that students are unable to apply facts, concepts, principles, and procedures to solve mathematical problems related to problem-solving, resulting in most students facing difficulties in solving mathematical problem-solving tasks (Irawan & Iasha, 2021). Furthermore, no students have a high or moderate negative mathematical disposition (Susilo et al., 2020). Low disposition is demonstrated by Sukamto's research, which categorizes students' mathematical disposition as low with a percentage of 61.9%. Students can develop their mathematical disposition as they learn various aspects of mathematical abilities. However, if they fail to solve problems, they lose confidence (Dina et al., 2019).

Studies on mathematical disposition or problem-solving abilities have been conducted extensively, but publications discussing the relationship between mathematical disposition and problem-solving abilities of junior high school students using product-moment correlation have not been found. Therefore, this research is conducted with the aim of determining and analyzing the relationship between mathematical disposition and problem-solving abilities of junior high school students. This study is guided by the research question: "What is the correlation between mathematical disposition and problem-solving abilities of students?”

Method

This research is a quantitative study using the correlational study method. Correlational studies aim to test and analyze the relationship between two research variables, namely mathematical disposition and problem-solving ability. Data collection was conducted using a cross-sectional design and to perform the data analysis, SPSS 26.0 software was used as a tool. The selection of this design is based on data from both variables collected simultaneously and within the same time period (Cohen, 2018). The participants in this study were 25 seventh-grade students in one of the junior high schools

in Bandung city during the academic year 2019/2020. The selection of participants was done purposively, based on recommendations from the respective mathematics teacher, and the students have studied plane geometry topics.

Table 1. Validity test scores of the instrument.

No.	Instrument	Pearson Product Moment Value	Description
1.	Mathematical disposition questionnaire	0,436 – 0,592	Valid
2.	Problem-solving ability questions	0,431 – 0,564	Valid

Based on Table 1, the data collected in this study pertains to mathematical disposition and problem-solving abilities. The mathematical disposition questionnaire used is the result of Lomri's design (Lomri, 2020) with a scale weight using a Likert scale of 1-4 (1- strongly disagree; 4-strongly agree). The questionnaire consists of 25 questions that encompass indicators such as having self-confidence in one's abilities, being flexible in trying various problem-solving strategies, being diligent in learning, having curiosity and inventiveness, and tending to monitor and reflect in actions and thoughts. The mathematical disposition questionnaire has undergone adequate validation processes. Each statement in the questionnaire has a Pearson Product Moment correlation value ranging from 0.436 to 0.592, where these values are greater than the critical value (r-table) of 0.396, indicating a significant relationship (significant at $\alpha = 0.05$) (Table 1). Additionally, the instrument used also exhibits acceptable reliability, as evidenced by a Cronbach's Alpha value of 0.653, which exceeds 0.6 (Table 2).

Table 2. Reliability test scores.

No.	Instrument	Cronbach's Alpha Value	Description
1.	Mathematical disposition questionnaire	0,653	Reliable
2.	Problem-solving ability questions	0,624	Reliable

Based on Table 2, the second instrument used is a problem-solving ability test. The test consists of 8 essay questions with the topic of quadrilateral geometry, representing indicators of mathematical problem-solving abilities, which include: identifying the required data to solve the problem, planning problem-solving procedures, executing the developed problem-solving strategies, and interpreting problem-solving results. The validation process of the problem-solving ability test instrument was conducted using Pearson Product Moment. The validation results showed that only items 2, 3, 4, and 7 had significant Pearson Product Moment values at a significance level of $\alpha = 0.05$. The Pearson

Product Moment correlations for the eight test items ranged from 0.431 to 0.564 and were significant at a significance level of $\alpha = 0.05$ (refer to Table 1). Therefore, the problem-solving ability test instrument used in this study consisted of four test items. Furthermore, the reliability of the instrument was tested using Cronbach's Alpha. The problem-solving ability test instrument demonstrated acceptable reliability, as indicated by a Cronbach's Alpha value of 0.624 (greater than 0.6) (refer to Table 2).

The data is analyzed quantitatively using two types of statistics, namely descriptive statistics and inferential statistics. In the data analysis with descriptive statistics, calculations are performed for the mean, minimum-maximum values, standard deviation, and frequency. This analysis is applied to mathematical disposition data and problem-solving abilities. By using descriptive statistics, information about the level of mathematical disposition and problem-solving abilities can be expressed in more detail. The categorization of calculus concept understanding is based on hypothetical statistical techniques (Sugiyono, 2012) and is grouped into three levels: high, moderate, and low. Further information can be found in Table 3.

Table 3. Classification of problem-solving skill scores.

No.	Category	Score
1.	High	score > 7,07
2.	Moderate	3, 07 < score ≤ 7, 07
3.	Low	score ≤ 7, 07

In this study, data analysis was conducted using inferential statistics by employing the Pearson product-moment correlation method. The purpose of this correlation analysis was to test the relationship between mathematical disposition and problem-solving abilities, both overall and based on the indicators of disposition.

Table 4. Interpretation of correlation coefficient strength criteria.

No.	r value	Interpretation
1.	0,00 – 0,19	Very low or very weak relationship
2.	0,20 – 0,39	Low or weak relationship
3.	0,40 – 0,59	Moderate or moderate-strong relationship
4.	0,60 – 0,79	Strong or strong relationship
5.	0,80 – 1,00	Very strong or very strong relationship

Table 4 shows references or guidelines for interpreting the level of relationship between mathematical disposition and problem-solving ability based on the value of r or Pearson Correlation coefficients.

Results and Discussion

The results of the descriptive analysis regarding the mathematical disposition of junior high school students are presented in Table 5.

Table 5. Description of mathematical disposition.

No.	Indicator	Min	Maks	Mean	Std.Dev
1.	Having self-confidence in one's abilities	1,96	3,20	2,63	0,24
2.	Being flexible in trying various problem-solving strategies	2,22	3,44	2,68	0,30
3.	Being diligent in learning	2,00	3,33	2,82	0,34
4.	Having curiosity and resourcefulness	1,80	3,40	2,64	0,41
5.	Tending to monitor and reflect in actions and thinking	2,00	3,40	2,50	0,33

Based on Table 5, it can be seen that the average scores of statements containing indicators of curiosity and resourcefulness are lower than the average scores of statements containing flexible problem-solving strategies and other indicators. This indicates that students tend to be able to adapt and use various problem-solving strategies with flexibility. Additionally, the average score for the perseverance indicator in learning is higher than the other indicators, with an average score of 2.82. This indicates that students also demonstrate perseverance in the learning process, especially in learning mathematics. Furthermore, the standard deviation values for all five mathematical disposition indicators are relatively small, less than 1, indicating that the data tends to be homogeneous and close to the mean. This also suggests that the score differences among the indicators for each student tend to be consistent. Based on these findings, it can be concluded that students tend to be flexible in trying various problem-solving strategies and are diligent in learning, but they may lack curiosity and resourcefulness.

The problem-solving abilities of 7th-grade junior high school students are illustrated in Table 6.

Table 6. Description of problem-solving abilities.

No.	Ability	Min	Maks	Mean	Std.Dev
1.	Problem-solving abilities	2,75	9,25	5,39	1,68

Based on Table 6, the average total score of students' problem-solving abilities is 5.39, indicating that the students' problem-solving abilities are in the moderate category. This suggests that the students have a sufficient grasp of the problem-solving indicators in the topic of plane geometry. Additionally, the small standard deviation, which is smaller than the mean, indicates that the data on students' problem-solving abilities tends to be uniform and close to the average value. This signifies that the students' problem-solving abilities tend to be uniformly moderate.

Table 7. Problem-solving ability categories.

No.	Abilitiy	High	Moderate	Low
1.	Problem-solving Ability	20%	72%	8%

In Table 7, the categories of students' problem-solving abilities are displayed. It can be observed that the majority of students (72%) fall under the moderate category in problem-solving ability. This indicates that a significant number of students have a good understanding of the content on plane geometry, which includes the indicators of this ability.

The Pearson's product moment correlation coefficient between mathematical disposition and students' problem-solving ability can be seen in Table 8

Table 8. Correlation between mathematical disposition and problem-solving ability problem-solving ability.

No.		Problem-solving Ability
1.	Mathematical Disposition	0,663

Table 8 shows the Pearson's product moment correlation value of 0.663 between mathematical disposition and problem-solving ability. The analysis of the obtained data indicates r_{hitung} (0.663) > r_{tabel} (0.396), which means there is a correlation or relationship between mathematical disposition and problem-solving abilities. In this study, the Pearson Correlations value is positive, suggesting a positive relationship between the two variables, or in other words, an increase in mathematical disposition corresponds to an increase in students' problem-solving ability. Furthermore, the obtained correlation coefficient

(Pearson Correlations) of 0.663 indicates a strong correlation or relationship between mathematical disposition and students' problem-solving ability.

Based on the above findings, the main discovery of this research is the existence of a strong correlation between mathematical disposition and problem-solving abilities of junior high school students, specifically in the topic of quadrilateral geometry. This finding is consistent with previous studies that indicate a relationship between students' mathematical disposition, which includes their affective aspects, and their cognitive aspects. Having a positive affective aspect is associated with a good cognitive aspect (Kamid et al., 2021). In this case, the cognitive aspect refers to problem-solving abilities. Mathematical disposition and problem-solving abilities have a strong and significant positive relationship (Rezita & Rahmat, 2022). This is because mathematical disposition and learning motivation influence problem-solving abilities (Hutajulu et al., 2019) with a percentage of 68.3% in the SPLDV matrix (Aliah et al., 2020). Therefore, the higher the mathematical disposition and learning motivation of students, the higher their problem-solving abilities will be.

The next finding from this research is that the level of students' problem-solving ability falls into the moderate category. Students with a high mathematical disposition category are able to carry out all stages of Polya's problem-solving process. Students with a moderate mathematical disposition category can perform the stages of understanding the problem, devising problem-solving plans, and implementing the plans. Additionally, students in the low mathematical disposition category are able to carry out the stage of understanding the problem (Yustiana et al., 2021). Despite the Covid-19 pandemic situation, students still possess a good attitude or tendency to think rationally and reflectively in making decisions under certain conditions (Wiradinata et al., 2021).

To enhance mathematical disposition and problem-solving skills, attention should be given to the learning process. This is because students' experiences in the classroom with their mathematics teacher can influence their mathematical disposition, which in turn impacts their academic achievement (Kilpatrick et al., 2001). Several methods, strategies, models, or approaches to learning can be used by teachers or educators to improve disposition, including the problem-solving approach (Mulyasari et al., 2018), contextual approach supported by VBA (Visual Basic Application for Excel) instructional media (Chotimah et al., 2018), Realistic Mathematics Education (RME) (Özkaya & Yetim, 2017) with an outdoor approach (Haji et al., 2019), discovery learning model (Dina et al., 2019),

CORE (Connecting, Organizing, Reflecting, Extending) learning model (Yaniawati et al., 2019), 21st-century learning model and Challenge Based Learning model (Yulianto et al., 2020), and REACT strategy (Relating, Experiencing, Applying, Cooperating, and Transferring) (Sari & Darhim, 2020).

The CORE Learning Model is also suitable for developing mathematical problem-solving skills (Irawan & Iasha, 2021). Another learning method that supports students' problem-solving abilities is the cooperative learning model. According to (Susilawati, 2015), cooperative learning is a learning model that supports group discussion activities, thus effectively encouraging students to demonstrate a deeper understanding of problems. There are many types of cooperative learning that can be used in teaching, such as the Think Pair Share model, the Formulate Share Listen Create (FSLC) model, the Thinking Aloud Pair Problem Solving (TAPPS) model, cooperative Scrift, and many more. Meanwhile, when implementing e-learning in mathematics education, researchers suggest that future online learning should create innovative, easily understandable, and engaging learning materials. Teachers can utilize various online learning platforms that offer attractive features and facilitate online learning, such as Google Classroom, Edmodo, Schoology, and others.

Conclusion and Suggestion

The research results show that the Pearson's product moment correlation value between mathematical disposition and problem-solving ability is 0.663. The calculated correlation coefficient (Pearson Correlations), which is greater than the tabled correlation coefficient (0.396), indicates that there is a positive correlation between mathematical disposition and problem-solving ability. This correlation has a strong level of correlation, indicating the potential for a deep relationship between aspects of mathematical disposition and concrete steps in solving mathematical problems. Based on the results of the study, teachers can apply interesting learning to encourage the development of positive mathematical dispositions and future researchers are expected to be able to use the role of mathematical disposition on other mathematical abilities.

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