The analysis of mathematics problem-solving skills and its relation with self-efficacy on the students of MTsN 2 Pemalang

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Abstract. The students need to give more attention to their problem-solving skills. Some of them still feel difficult to interpret in suitable ways. The purpose of this study was to identify the relation between mathematics problem-solving skills and self-efficacy in the Chapter Lines and Angles of the students of MTs N 2 Pemalang. The population of this research was the students of seventh grade in MTs N 2 Pemalang. By simple random sampling technique, class 7A was selected as the sample of the research. A mixed method was used, including quantitative and qualitative approach. The result of the research showed that (i) there was significant relation between self-efficacy and problem-solving skills in the score of the students (ii) the students with high self-efficacy answered the questions with detail and complete answers. The steps that the students did were correct and suitable with the problems. It showed that their problem-solving skills were excellent (iii) the students with low self-efficacy answered the question by not giving the detailed information. It showed that they still struggled with their problem-solving skills.

1. Introduction
Indonesian education needs to be improved to achieve the goals of global development era, it also helps Indonesia stay in the right track of global education goals. For time to time, quality standard of Indonesian education should be enhanced to get better outputs, especially students’ capacity. There are some skills need to be possessed by the students to gain good education effects. One of them is problem-solving skill, it is very important to pop students’ awareness up in absorbing learning materials. Particularly in mathematics, problem-solving skill is an integral part of all mathematics learning process [1]. When the students involved to solve non routine-mathematical-task or problem-solving questions, they frequently express various kind of emotion [2].

According to the National Council of Teachers of Mathematics (NCTM), several indicators of mathematical problem-solving skills are: 1) identifying known elements, which is asked, and the adequacy of the necessary elements; 2) formulating a mathematical problem or drafting a mathematical model; 3) implementing strategies to solve various problems (similar and new problems), from inside or outside of the mathematics; 4) describing or interpret the outcome according to the original matter; 5) using mathematics, meaningfully [3]. The student’s problem-solving skills are
influenced by three main factors there are 1) students’ skills in representing problems; 2) students’ skills in understanding the problem scope; (3) student structure of knowledge [4].

In addition, mathematical communication skills and self-efficacy or self-interest in the ability to communicate simultaneously the idea also contributes to learning achievements [5]. Meanwhile, the higher self-efficacy of one’s ability to formulate concepts, convey ideas, and sharpen ideas to convince others[6]. Self-efficacy sense is student’s belief and ability in exert motivation, cognitive resources, and necessarily of an actions in facing certain situation [7]. There is a positive influence of self-efficacy to learner’s value($R^2=0.396$) [8]. The individual who has high self-efficacy considers that their fails are happen because of the lack of their own effort, whereas, the individual who has low self-efficacy considers their fail is caused by their low ability in doing something.

According to the result of National Exam (UN)from Ministry of Education and Culture, the UN score of MTs N 2 Pemalang student is lower than others high-quality-schools in Pemalang. By improving student’s self-efficacy, it may able to lead and increase their problem-solving skills. In Junior High School, the students already understand the basic knowledge of line and angle in geometry material. This knowledge is very important as a basic understanding for further or advance geometry materials. Students are required to have knowledge of line, angle, and corner and its correlation appropriate to the school’s curriculum. However, based on formative evaluation, most of the students have difficulties in solving the problems. It related to the most Indonesian student problem, that geometry is one of the most difficult subject to learn [9]. Based on the explanation, this study aimed to understand the related factors from problem-solving skill of the students when answering questions or in understanding a concept.

2. Methods
This research was conducted in MTs N 2 Pemalang, and as many as 36 students of seventh grade were involved as respondents. A mixed method was used, including quantitative and qualitative approach. The self-efficacy was measured using 30 question in Likert scale questioner instrument, after that, the students grouped into three different categories; low, medium and high class based on efficacy score. After grouping, every class was tested for problem solving competence. Problem solving competencies was measured from the students’ answer in doing five geometry essays. To measure the problem solving skill, a questioner with 20 questions based on the 5 indicators (Table 1).

| Problem-solving Skills Indicators | Code | Total Question |
|----------------------------------|------|----------------|
| Identifying known, asked, and selected elements adequacy of the necessary elements; | ID1  | 4              |
| Formulating mathematical problems or drafting a mathematical model; | ID2  | 5              |
| Implementing strategies to solve various problems (type and new problems) in or out of mathematics; | ID3  | 5              |
| Explain or interpret the outcome according to the original problem; | ID4  | 3              |
| Use mathematics meaningfully | ID5  | 3              |

Non-parametric Kolmogorov-Smirnov and Man Whitney as statistically analysis was applied to distinguish the differences among groups. The analysis was continued to see the correlation between self-efficacy to problem-solving skills, vice versa, using Pearson correlation. Meanwhile, the qualitative approach was conducted by depth-interview to identify how problem-solving skills observed by self-efficacy.
3. Result and Discussion

3.1 Quantitative Analysis

Based on the self-efficacy analysis, the respondents were grouped into three different categories, there were 25.00% of student are in low class, 62.50% in medium and 25.00% in high class. Besides that, the self-efficacy score among the class is significantly different, deviation score between low class to medium was 21.67% then to high class was 50.67% (Figure 1). It means, even in a same grade and educational platform, every student has different ability to organize and mobilize the sources of action needed to manage a solution (in this case is mathematical problem solving).

![Figure 1](image1.png)

**Figure 1.** Self-efficacy (A) and problem solving score (B) among category group (p < 0.05)

For deeper analysis, the student’s self-efficacy in low class was significantly different with medium and high class (p < 0.05), likewise in medium class to high class (p < 0.05). Based on the indicator, only the first indicator (ID1) in high class and medium is not significantly different. The lower indicator in all categories is ID5 (Figure 2).

![Figure 2](image2.png)

**Figure 2.** Problem solving score in each self-efficacy category

The problem-solving score was confirmed by observed score during learning process. In the observed score, all problem-solving indicators in the low class were significantly different compared to the other categories (Table 2).
Table 2. The average problem-solving score compared to each category

| Group | Indicators | ID.1       | ID.2       | ID.3       | ID.4       | ID.5       |
|-------|------------|------------|------------|------------|------------|------------|
| Low   |            | 10.33 ± 2.08<sup>a</sup> | 8.67 ± 1.15<sup>a</sup> | 10.67 ± 1.15<sup>a</sup> | 5.33 ± 0.58<sup>a</sup> | 3.67 ± 1.15<sup>a</sup> |
| Medium|            | 16.00 ± 1.73<sup>b</sup> | 17.00 ± 1.00<sup>b</sup> | 17.67 ± 1.53<sup>b</sup> | 9.67 ± 0.58<sup>b</sup> | 9.67 ± 0.58<sup>b</sup> |
| High  |            | 18.67 ± 0.58<sup>b</sup> | 22.67 ± 1.15<sup>c</sup> | 23.67 ± 2.00<sup>c</sup> | 12.00 ±2.00<sup>b</sup> | 12.00 ±1.00<sup>b</sup> |

Superscript-alphabetic mark (a, b, c) is representing the significantly different among groups.

Based on the analysis for representative group sample (3 sample per group), the problem-solving score was difference among student categories, the low self-efficacy group, significantly different to the medium, and high group (p < 0.050). In other words, students with high self-efficacy are better to those of students with medium or low self-efficacy[11]. In other hand, sample group was indicated there were a correlation between self-efficacy and problem solving.

However, in the classical assessment that was conducted to all student, it was shown that the p score was 0.822, (p > 0.05) or the null hypothesis is accepted. It means that there is no interaction between self-efficacy with the problem-solving skills. The great impact between self-efficacy and problem-solving skills towards the average student value is shown in R² value of 0.806 = 80.6%.

Based on analysis, most of the student in all groups has a low capacity in using mathematics meaningfulness and formulating mathematical problems or drafting a mathematical model (ID5). The student may have problems on make a conclusion from the problem and reconnect the concept (ID4). Meanwhile, the student in low and medium groups has well implementation in identifying known, asked, and selected elements adequacy of the necessary elements (ID1) and implementing strategies to solve various problems type and New problems) in or out of mathematics (ID3).

3.2 Qualitative Analysis

To understand about students’ self-efficacy and problem-solving deeply, an interview was conducted with involving three students for each group, as representations. The interview process was conducted to understand: 1) magnitude, it is a measurement of the difficulty level of geometry essay; 2) strength, it is depict amount of a student’s conviction in performing successfully at diverse levels of difficulty; 3) generality, it is a degree to which the expectation is generalized across situations (Table 3).

Table 3. The Analysis self-efficacy Dimension based Indicator and Sub indicator of Problem Solving

| Magnitude | Strength | Generally |
|-----------|----------|-----------|
| Low group student: During solving the problems, the student did not write the given and asked information. | Low group student: did not understand well in solving the problem, so they did not write the given and asked information. | Low group student: in solving the problem, the student did not write the given and asked information because they can not connect the concept. |
| Medium group student: Student wrote the given and asked information but still incomplete. | Medium group student: already understood the problem but when write the given and asked information and questioned still incomplete | Medium group student: the student were able to connect with the concept but in solving the problems wrote the given and asked information still incomplete |
| High group student: Students able to solve the problem wrote the given and asked information completely. | High group student: completed a good comprehension ability in solving the problem write the given and asked information completely | High group student: in solving the problem wrote the given and asked information completely because they were able to connect with the concept. |
| Low group student were not | Low group student were not | Low group student were not |
|| Magnitude | Strength | Generally |
|---|---|---|
| able to formulate the problem well, it could be seen they answered it without using the proper way even though some of them wrote the correct answer, because due their difficulty in understanding the problem. | able to formulate the problem well, they answered without using the proper way even though some of them wrote the correct answers, it was because they were not confident enough in understanding the problem. | able to formulate the problem well, they answered without using the proper way even though some of them wrote the correct answer, it was because they could not connect with the concept. |
| Medium group student were able to formulate a problem well even though the answers were still incomplete and unclear. | Medium group student were able to formulate the problem well even though the answers were still incomplete and unclear, they were able to formulate the problem based on their confidence capabilities. | Medium group student were able to formulate the problem well even though still incomplete and unclear. |
| High group student were able to formulate the problem well proven by writing completely and clearly because they understand the problem well. | High group student were able to formulate the problem well proven by writing completely and clearly because they understand the problem well, this could happen because they were confident in their ability to understand the problem. | High group student were able to formulate the problem well, proven by writing completely and clearly because they could connect with the concepts. |
| Low group student: although the student answered the question correctly, but the way how to solve it yet written precisely, it was because of their difficulty in understanding problems. | Low group student: although the students answered correctly, but the way how to solve it yet written precisely, it was because they were not enough confident in understanding the problem. | Low group student: although the student answered correctly, but the way how to solve it yet written precisely, it was because they could not connect with the concept. |
| Medium group student were able to use good strategy although some of the answers not precisely correct | Medium group student were able to use good strategy because they were confident enough in his ability though some of the answers not precisely correct. | Medium group student were able to use good strategy and connect with the concepts although their answers were not precisely correct |
| High group student were able to use a good strategy proven by writing completely and clearly because they understood the questions well. | High group student were able to use good strategy proven by writing completely and clearly because of their belief in understanding the questions well. | High group student were able to use good strategy, proven by writing completely and clearly because they could connect the concept very well. |
| Low group student were not able to explain quite well even some of them answered it correctly, but when the teacher asked, they could not answer properly because of the difficulty in understanding problems. | Low group student were not able to explain well even some of them answered it correctly, but when the teacher asked, they could not answer properly because of their belief in understanding the problem were not yet confident. | Low group student were not able to explain well even they answered it correctly, but when the teacher asked, they could not answer properly because they could not connect with the concept. |
| Medium group student were able to explain properly even though not precisely correct. | Medium group student were able to explain properly although not yet precisely correct, they were confident with the ability to solve the | Medium group student were able to explain properly although not yet precisely but they could connect to the concept |
| High group student were able to explain the answer well, | | High group student were able to explain the answer well, |
| Low group student were not able to explain quite well even some of them answered it correctly, but when the teacher asked, they could not answer properly because of the difficulty in understanding problems. | Low group student were not able to explain well even some of them answered it correctly, but when the teacher asked, they could not answer properly because of their belief in understanding the problem were not yet confident. | Low group student were not able to explain well even they answered it correctly, but when the teacher asked, they could not answer properly because they could not connect with the concept. |
| Medium group student were able to explain properly even though not precisely correct. | Medium group student were able to explain properly although not yet precisely correct, they were confident with the ability to solve the | Medium group student were able to explain properly although not yet precisely but they could connect to the concept |
| High group student were able to explain the answer well, | | High group student were able to explain the answer well, |
Magnitude | Strength | Generally
---|---|---
proven by writing the answers completely and clearly because they understood the questions well. | High group student able to explain the answer well, proven by writing completely and clearly because they understand the questions well, they are also confident in their ability. | to explain the answer well, proven by writing the answers completely and clearly because they understand the questions well and can connect with the concept.

- Low group student did not write the conclusion of the problems because of their difficulty in understanding the problems.
- Medium group student able to write conclusions properly.
- High group student able to write conclusions properly.

- Low group student did not write the conclusion of the problems because they were not confident enough in their ability understand the problem.
- Medium group student able to write conclusions properly because of their belief in understanding the problem were good.
- High group student was able to write conclusions properly because of their belief in understanding the matter problem were good.

- Low group student did not write the conclusion of the problems and they were not confident enough in their ability understand the problem.
- Medium group student able to write conclusions properly because they could connect with the concept.
- High group student were able to write conclusions properly because they could connect with concepts and daily life problem.

Table 3 shows the research subjects with a low self-efficacy in writing the given and asked information were still less complete, when they wrote the answer not using mathematical symbols, and there is information that should be write in given to be written as what to asked. The steps used to resolve the problem are not yet precise, not in accordance with the concept, not systematic and do not convey the reason for the completion of the steps. The research subjects with a medium self-efficacy in writing the given and asked information were complete, detailed and uses mathematical symbols but they still make mistakes. Some of the answers were less obvious, able to make image illustrations are appropriate with the problem but not yet perfect, not neat, and there were the descriptions that makes the image becomes unclear. The subjects of research with a high self-efficacy in writing given and asked information were complete, they already used the appropriate mathematical symbols and when they solve the problem, the answers were correct and wrote the conclusions with the context of the problem completely.

4. Conclusion
Based on the results of analysis, it can be concluded that (i) there was significant impact between self-efficacy and problem-solving skills in the score of the students (ii) the students with high self-efficacy answered the questions with detail and complete answers. The steps that the students did were correct and suitable with the problems. It showed that their problem-solving skills were excellent (iii) the students with low self-efficacy answered the question by not giving the detailed information. It showed that they still struggled with their problem-solving skills.

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