The level of mathematical resilience and mathematical problem-solving abilities of 11th grade sciences students in a senior high school

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Abstract. This study aims to figure out the level of mathematical resilience and mathematical problem-solving abilities of 11th grade sciences students in a senior high school. The subjects of the study were 63 senior high school students in 11th grade sciences, second semester 2018/2019 year who were studied at one of the senior high school in Baleendah, Bandung regency. This research method is a survey, in which the survey is included in one type of research is non experimental. The study design used is cross-sectional designs. There are two sorts of instruments used for this study, namely test and non-test instruments. Test instruments serve for measuring the level of mathematical problem-solving abilities of students, while non-test instruments are in the form of questionnaires, useful for measuring the level of mathematical resilience of students. The results showed that (1) the level of students' mathematical resilience is in the medium level, and (2) the level of students' mathematical problem-solving ability is in the medium level.

1. Introduction

Mathematics and problems are two things that are interrelated and their existence cannot be separated from everyday life. The problem is a difficult situation (which is foreign) to achieve the goal and a way is needed to find a way out. The solution is because there is a problem. Solutions can be obtained because there is the ability to achieve them. This illustrates that problems need solutions, and solutions need capabilities. This means that the problem will not be resolved if there is no solution, and the solution will not be achieved if there is no ability to obtain it. Therefore, it is important for each individual to develop abilities in problem solving.

There is the essence of thinking is the main goal of learning mathematics [1]. One way to achieve the mindset as expected is to develop problem solving skills because the development of thinking skills is always the focus of solving mathematical problems [2]. By learning to solve mathematical problems, students will acquire ways of thinking, perseverance, curiosity, and self-confidence [3]. This indicates that problem solving abilities can train and form a mindset. The ability to solve problems is something special because it is different from other thinking abilities and is a combination of several abilities [4]. Another opinion which also shares the same opinion is that problem solving is an intricate and complex activity due to the need to recall the facts from previous knowledge, need to use various capabilities and problem solving procedures, as well as various other abilities [5]. Success and failure of a person in solving problems is very dependent on interest, motivation, self-confidence of
students [5]. Indicators of problem solving are stated as mathematical problem solving steps because one indicator is not enough to describe all mathematical problem solving tasks, where in for the next indicators and problem solving steps are used as references in the preparation of instruments, worksheets, or teaching materials [6].

Four basic steps in solving the problem [4]. First, a problem solver must analyze the problem to be solved so that he is able to understand the problem better. At the problem analysis stage, a problem solver also classifies the problem by dividing the problem into several parts. This aims to look at the data needs to achieve the right solution and to simplify the problem. Second, a problem solver identifies all the possibilities and risks of each alternative problem solving. At this stage, the problem solver considers the advantages or disadvantages of the existing strategy. Third, the problem solver is required to make a decision on the problem and what strategies should he apply in solving the problem. At this stage, the problem solver began to implement a problem solving strategy based on the information gathered from the first and second steps. Last step, problem solver must review and evaluate the work with the aim to see the strengths or weaknesses of the results of his work.

Every individual must always strive to grow and develop abilities in him, both cognitive abilities and affective abilities. One important attitude possessed by students to dare to solve problems is the ability to mathematically resilience. Resiliency is the affective ability of students to face, overcome, and be strong when dealing with problems during the learning process [7]. In other words, resilience can also be interpreted as a "struggle" of a student in dealing with and overcoming various problems. Related to this matter there are two components when dealing with problems, namely experience and then is a positive response [7]. Understanding of mathematical resilience is another internal factor that is important in mathematics learning, because the main key to overcome the difficulty is persistence (hardiness) [8,9].

Resiliency can also be interpreted as a person's ability to assess, overcome, and improve themselves, students who have resilience mathematically has the ability to foster self-confidence, resilience is also an emotional response to positive academic or social challenges [10]. In the mathematical concept of resilience there is confidence to businesses trying to do the learners to turn a difficult situation into something called the solution [11]. The concept of mathematical resilience is developed with the aim of describing a positive attitude towards mathematics where students can develop various approaches to mathematics learning based on their knowledge and abilities, so that they can overcome existing obstacles [12]. So, mathematical resilience is a positive student learning attitude, in which students believe in their ability to solve mathematical problems [12].

Based on the explanation from the experts above, there are four indicators of mathematical resilience used in this study: (1) learning mathematics is valuable, meaningful, useful, and beneficial for his life, (2) learn from mistakes, give positive responses, and never give up negative or difficult situations he faces when studying mathematics, (3) having a strong desire, persevering, trying hard to continue to struggle difficult challenge or situation, and (4) persistent, diligent, confident, and confident in ability, understanding, and experience that is on him to study mathematics.

2. Methods
The subjects of this study were 63 high school students (male and female) in 11th grade science who were in the second semester of the 2018/2019 academic year. They were 15–17 years old. The study was conducted in one of the senior high schools in the Baleendah, Kabupaten Bandung. This research method is survey, in which the survey is included in one type of research is non experimental. The study design used is cross-sectional designs, since researchers only collected data one at a time [13]. The data collected in the form of the results of tests of students' mathematical problem solving abilities and the results of students' mathematical resilience questionnaire. Before the researchers collected data, the researchers first had to prepare two types of instrument, namely test and non-test instruments. Test instruments are useful for measuring the level of mathematical problem solving abilities of students, while non-test instruments are in the form of questionnaires, useful for measuring students' mathematical resilience.
Resilience questionnaires were modified from Resiliensi Matematik (3rd Mathematical Resilience) [14]. This instrument was given to all research subjects after they completed the test of mathematical problem solving abilities. Questionnaires consist of 42 statements with details of indicators 1 and 2 each consisting of 11 statements, and 10 statements each representing indicators 3 and 4. In addition to the statement, the questionnaire is also equipped with five choices of answers, namely: Often Once (SS), Often (SR), Sometimes (KD), Rarely (JR), and Rarely (JS). Respondents’ answers were measured using a Likert scale with scores 5, 4, 3, 2, and 1 for positive statements, while for negative statements the score is the opposite. In the other hand, the researcher made a test instrument by modifying from the Algebra textbook. The questions are made up of four essay with the highest score is 4 and the lowest score is 0 for each items. All data that has been collected, either from test or non-test instruments are processed and calculated by using software IBM® SPSS® Statistics 22 and the software Microsoft® Office® Excel 2016.

3. Result and Discussion

3.1. Mathematical Resilience

Questionnaires for mathematical resilience were given to 63 students who were the subjects in this study, where questionnaires were given after students finished working on the tests of mathematical problem-solving abilities. Each student is given time to fill out the questionnaire according to their opinions. Table 1 shows the results of measuring students’ mathematical resilience for each indicator.

| Indikator | Mean (X̄) | µ | Standard Deviation (s) | σ |
|-----------|-----------|---|------------------------|---|
| Indicator 1 | 40.46 | 33 | 6.190 | 7.33 |
| Indicator 2 | 35.27 | 33 | 5.820 | 7.33 |
| Indicator 3 | 32.29 | 30 | 4.871 | 6.67 |
| Indicator 4 | 32.83 | 30 | 4.647 | 6.67 |

Indicator 1 has the highest average value, then followed by the second, fourth and third indicators. This means that students’ mathematical resilience is dominated by indicator 1, which means that most students perceive that mathematical learning is valuable, meaningful, useful, and beneficial to life. Next for indicator 2 shows perception the positive from students in terms of learning from mistakes, giving a positive response, and never giving up on the negative or difficult situations they face when learning mathematics. On indicator 4, where the average value is in the third position illustrates that not a few students who do not have a persistent, diligent, confident, and confident attitude towards their ability, understanding, and experience in learning mathematics. This has at least a little impact on student opinions for indicator 3, which has the lowest average value. This can be interpreted that not many students have strong, persistent desires, strive to continue to struggle with difficult challenges or situations.

The results of the mean comparison for each indicator indicate that the empirical mean (X̄) higher than the hypothetical average (μ). This gives the meaning that students’ perceptions are high (positive) for each indicator of mathematical resilience. Other comparisons show that the empirical standard deviation (s) is lower than the standard deviation of a hypothetical (σ) for each indicator of mathematical resilience. This means that students’ perceptions of each indicator are mathematical resilience have a low variation. In other words, students’ perceptions of one another are similar. Furthermore, Table 2 shows the categorization of the level of students’ mathematical resilience for each indicator.
Based on the Table 2, the researcher views that the ability of students' mathematical resilience is at a moderate level. These results can at least provide an outline that students are quite capable of controlling themselves when facing difficult situations and want to try to survive or rise from these difficult situations. Most of students answer that are quite high on indicator 1 can be said to be the main factor that influences student attitudes towards other indicators. This is because students will be more interested and motivated to learn mathematics if they believe that mathematics is valuable [11]. This means that students believe that mathematics learning has benefits and value for their lives so that the basis is their motivation to learn it. Student’s perceptions are quite high on the importance of mathematics for life and their world shows that students have quite high motivation in learning mathematics, so their attitude when facing difficulties that occur while studying mathematics is also quite positive. This result is in line with the theory put forward by the expert that it is more valuable students understand mathematics, the more great motivation to learn it, and the greater it is their possibilities survive in the face of difficulties [11].

The implications of the positive results of students on mathematical learning that are valuable for their lives can be seen from the positive perceptions of students in terms of learning from mistakes, giving positive responses, and never giving up on negative or difficult situations they face when learning mathematics. This means that students feel that the difficulties they face are a learning process that needs to be passed. The learning process is considered as a form of student effort in achieving better learning abilities. But in the process, there are at least two factors that can influence this, namely internal factors and external factors. Internal factors are things that arise or are possessed in students, such as the characteristics possessed by students (for example: self-confidence, diligent, easy to give up, adaptable, active, diligent, etc.). The external factors are factors that arise from outside of students, such as family, school, friendship, etc. Both of these factors can also be seen as having a role in forming the character/attitude of students when learning mathematics. From the results of processing the data above, not a few students who do not have a persistent, diligent, confident, and confident attitude towards their ability, understanding, and experience to study mathematics so that this has at least a little impact on student attitudes when dealing with difficult situation. In this case, not many students have strong desires, endure, strive to continue to struggle with challenges or difficult situations. In fact, mathematics and problems are two things that are not mutually exclusive and the ability to overcome them is needed. Therefore a factor this combines two components, that is someone's experience in face up difficulties and responses positive someone to face these difficulties [7,11].

3.2. Mathematical problem-solving skill
The ability of mathematical problem-solving tests is followed by all students who are the subject of research. Students are given approximately 90 minutes to complete all four problem-solving mathematical problem types with the main material being polynomials. Table 3 shows the results of measuring students' mathematical problem-solving abilities.

| Indicator 1 | Indicator 2 | Indicator 3 | Indicator 4 |
|-------------|-------------|-------------|-------------|
| Low         | 1.6%        | 4.8%        | 3.2%        | 3.2%        |
| Medium      | 52.4%       | 77.8%       | 85.7%       | 82.5%       |
| High        | 46.0%       | 17.5%       | 11.1%       | 14.3%       |

Table 2. The level of students’ mathematical resilience
Results of comparison between empirical means ($\bar{X}$) and hypothetical mean ($\mu$) a is an empirical mean value ($\bar{X}$) higher than the hypothetical mean value ($\mu$). This shows that students’ ability to solve mathematical problems given is good (positive). However, the empirical standard deviation ($s$) value is lower than the standard hypothetical deviation ($\sigma$). This shows that the results obtained by each student are quite varied. Besides of that, Table 4 shows the categorization of the level of students’ mathematical problem-solving abilities.

Table 3. Student’s mathematical problem-solving skill.

| N  | 63 |
|----|----|
| Mean ($\bar{X}$) | 8.4 |
| $\mu$ | 8 |
| Standard Deviation ($s$) | 3.226 |
| $\sigma$ | 2.67 |

Based on the Table 4, the researcher is of the view that students’ mathematical problem-solving abilities are at a moderate level. These results can at least provide a general picture that students are quite capable of overcoming the difficulties they face when learning mathematics. There are two things that the researcher wants to explain about these results. First, researchers see that achievement students’ ability to solve mathematical problems is positive. This should be appreciated because students are considered capable enough to face the challenges of solving existing problems. The polynomial material that is the subject matter of the research test instrument is indeed a material that has not been studied recently by students, so that students’ memories related to the material are still good. It may therefore also have a positive impact on the student’s achievement of mathematical problem-solving skills. In addition, the achievement of mathematical problem-solving abilities of students at a moderate level can also be influenced by the level of mathematical resilience that students have. Another research shows that between mathematical resilience and student academic ability there is a positive and significant relationship, such as mathematical resilience used to predict the level student academic ability [11].

Table 4. The level of students’ mathematical problem-solving skill.

| Percent  | Frequency |
|----------|-----------|
| Low      | 17.5%     | 11        |
| Medium   | 61.9%     | 39        |
| High     | 20.6%     | 13        |
| Total    | 100%      | 63        |

4. Conclusion

Based on the research conducted, it can be concluded that the level of resilience and mathematical problem-solving abilities of students is at a moderate level. In mathematical resilience, student scores for each indicator are in the medium category with the results of percentages that do not differ greatly between each indicator. The percentage result for indicator 1 is 52.4%, indicator 2 is 77.8%, indicator 3 is 85.7%, and indicator 4 is 82.5%. On the other hand, students’ mathematical problem-solving abilities are also in the medium category with a percentage gain of 58.7%.
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