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Mathematical resilience: Is that affecting the students' mathematics achievement?

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Abstract. Mathematical resilience is an attitude that necessary for the student to respond positively in the face of difficulties in study mathematics. The difficulties in study mathematics may influence the students' mathematics achievement. The purpose of this research is to describe the relation between students' mathematical resilience and students' mathematics achievement. This research involves quantitative descriptive study. The researcher collected data with two types of instruments, test and non-test instruments. The instruments are mathematics achievement test and mathematical resilience questioner. The participants of this study consisted of 28 students from a health vocational high school in Yogyakarta, Indonesia. The results indicate that there is no relation between mathematical resilience and student's mathematics achievement. More findings and suggestions will be explained in the text.

1. Introduction

Good learning in mathematics will help the student to solve a problem in another branch of sciences [1]. Not just for the academic purpose, learning mathematics also help student connecting mathematics abstract concepts with the real problem through mathematics representations [2]. Although not all students will become a mathematician, a student who learning mathematics can apply, analyze, evaluate, and synthesize their knowledge to solve problems in everyday life [3][4]. The teacher can identify how well students understanding mathematics from student's mathematics achievement. But, sometimes the result is low. This condition can be caused by the difficulty in learning mathematics [5]. In mathematics class, the difficulty of learning mathematics is one problem that is often faced by both, teacher and students [6][7]. During the learning process in the class, the teacher has prepared all of the materials including a lesson plan, worksheet, the media of learning using the learning strategy that is matched with the material of learning and the characteristic of the student. But, it is founded that there are some students that cannot reach their maximum score and the result has not satisfied, include in Indonesia [8]. One of the reasons is that the students have a difficulty of learning mathematics includes understanding the mathematics' language, remembering the knowledge, understanding the concept, communicate the metacognitive, misconception, fail to justify, and less experience using algorithm [9][10][11][12]. The difficulty of learning mathematics can be seen in the process of learning. The process of learning can be seen from behaviourism perspective and cognitivist perspective.



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There are eight themes of cognitive psychology that are related to education especially in the topic of teaching and learning. The eight themes consists of (1) learning is a constructive, not a receptive, process, (2) mental frameworks organize memory and guide thought, (3) extended practice is needed to develop cognitive skills, (4) development of self-awareness and self-regulation is critical to cognitive growth, (5) motivation and beliefs are integral to cognition, (6) social is fundamental to cognitive development, (7) knowledge, strategies, and expertise are contextual, and (8) a cognitive approach to teaching implies new approach assessment [13]. Point number (4), (5), and (6) show that the affective aspect may influence the learning activity of student. Many kinds of research in mathematics education show that student's affective aspect especially attitude towards mathematics is low [14]. Student sometimes feels worried, tired and afraid toward mathematics and feel that mathematics is not important so they refuse to learn mathematics[15][16][17]. It can be caused by many factors, frequently caused by the experiences of learning difficulty and the challenge of learning mathematics. The response from the student of difficulty while learning mathematics can be seen from student's mathematical resilience [18] [19].

Resilience is student's optimism and positive self-regard even under a disadvantage, considers perseverance in the face of problems and emerges in case of certain challenges [20][21]. In other words, mathematical resilience is a positive attitude in order to make student not easily give up in the face of adversity when solving mathematics problem through discussion and research about mathematics [22]. In mathematics, mathematical resilience investigates the learning psychology of student. It is important for student because student who has good mathematical resilience will be motivated to give a positive response to all of the difficulties in learning mathematics [18]. The good respond is expected to increase the student's attitude toward mathematics, later it will influence the student's mathematics achievement although there are difficulty and challenge in learning mathematics. Mathematical resilience according to consists of three aspects, which are value, struggle, and growth. Value is related to the level of student's awareness about the importance of learning mathematics to reach their goal and help them to success. The struggle is related to student's belief that sometimes student need struggle to learn mathematics, although they face difficulty in learning mathematics, it does not mean they cannot learning mathematics. Growth is related to student's belief that they can develop their mathematics skill [18].

Supporting the argument above, another study describes that student who has mathematical resilience having these characteristics: (a) belief that mathematics has value and is needed to be learnt and mastered; (b) having a will and perseverance to learn mathematics, although facing difficulty, restriction and challenge; (c) having belief that they can learn and mastering mathematics including understanding mathematics, constructing strategy using media and their experiences; and (d) having wanderer and struggle attitudes and use to gives a positive response in learning mathematics [23]. Other characteristics are delivered that mathematical resilience is a strong will to learn mathematics so the student will have these characteristics: (a) having a growth mindset; (b) understanding the value of mathematics for the learner; (c) knowing that to learn mathematics, struggle is needed to be success; and (d) understand how to find and get the support to success in mathematics [24].

Based on the characteristics that are founded by researchers, so in this research mathematical resilience is defined as the student's positive respond toward the difficulties in learning math and including three aspects: (a) learning mathematics is having value and important; (b) learning mathematics need struggle and perseverance; and (c) having confidences in the ability learning mathematics.

The purpose of the research is to describe the correlation between students' mathematical resilience and students' mathematics achievement. The research is done in a private healthy vocational school. The characteristics of the student are different from the characteristics of high school students. Students of a vocational school are prepared to work in the real world. The focus of vocational students' study is their work experience. The consequence is some of them have little effort to learn the subject in the class. But their work experience gives them a growth mindset and a struggle attitude to face difficulty.

2. Research Method

The research is a descriptive quantitative research correlation approach. This research describes the relation between students' mathematical resilience and student's mathematics achievement. The participants of the research are 28 students from a private vocational school located in a city in the Province of Yogyakarta Special Region, Indonesia. All of the students are from the 11th-grade nurse class.

There are two instruments in this research that are student's achievement test for trigonometry chapter and mathematical resilience questioner. The student's achievement of trigonometry chapter consists of sinus's rule and cosines' rule problems. The type of student's achievement test of trigonometry chapter is multiple choices with 15 items and scored by the structured rule of scoring, one point if the answer is right for each item. The non-test instrument is mathematical resilience questioner. The responses on all items are given on a 5-point scale ranging from "Absolutely disagree" (1) to "Absolutely agree" (5). Examples of items are: "Everyone faces difficulty while learning mathematics" and "Mathematics is necessary for my future".

First of all, the test and non-test instruments are scored by the structured rule of scoring. Then, the normality test is done to know which the sample comes from data that have a normal distribution. The normality test and correlation test is done using SPSS and Kolmogorov Smirnov with significant 0,05.

3. Result and Discussion

3.1. Result

After the data collection activity, the next step is scoring the achievement test and the mathematics resilience questionnaire so the data is ready to be analyzed. Normality test and correlation test are done using SPSS software. Normality test is aimed to see is the data from a population that is distributed normal and the correlation test is aimed to see the relation between mathematical resilience and the student's mathematics achievement. Table 1 shows the result of the normality test using SPSS.

Table 1. The result of the normality test using SPSS.

	Kolmogorov-Smirnov		
	Statistic	df	Sig.
Achievement test	.156	28	.081
Mathematical resilience	.143	28	.150

The normality test shows that the significant score in the Kolmogorov Smirnov's column for achievement test is 0.081 and for the mathematical resilience is 0.15. It can be seen that both, achievement mathematics and mathematical resilience having significant score more than 0.05 so the data is from a population with a normal distribution.

Table 2. The result of the correlation test using SPSS.

		Achievement test	Mathematical resilience
Achievement test	Pearson Correlation	1	-.049
	Sig. (2-tailed)		.803
	N	28	28
Mathematical resilience	Pearson Correlation	-.049	1
	Sig. (2-tailed)	.803	
	N	28	28

Table 2 shows the result of the correlation test using SPSS. In table 2 the results of the correlation test between mathematical resilience and students' mathematics learning outcomes are presented. From table 2 it can be seen that the value of sig. obtained is 0.803 and the Pearson Correlation is .049. The results obtained show that there is no correlation between the resilience of mathematics and students' mathematics learning outcomes.

3.2. Discussion

Mathematical resilience is one of the affective domains. Some studies reveal that the affective domain also has an influence on student learning outcomes, including the students' mathematics achievement. Several studies have shown that affective aspects such as motivation, beliefs, anxiety, self-esteem and attitudes are closely related to improving mathematics achievement and are predicted to significantly increase cognitive activity and learning outcomes [15][18][25]. Based on this, it is assumed that mathematical resilience also has an influence on students' mathematics achievement. But the result of this study has a contradiction with the statement. It can be seen that there is no correlation between mathematical resilience and students' mathematics achievement. This result is similar to the founding of a study by Tarim and Akdeniz [26] that there is no significant difference was observed regarding students' attitude towards mathematics.

Mathematical resilience is a positive attitude given by students when facing difficulties during the mathematics learning process. Positive attitudes that arise in students are able to provide motivation to believe that they can learn mathematics. This process will lead to a confidence feeling of learning even though it feels difficult. Therefore students with good mathematical resilience tend to learn mathematics based on their sense of comfort and liking so that the cognitive processes that are passed will also get that positive influence. This is in accordance with the opinion expressed by Kookon, Welsh and McCoach [18] that students who are identified as having good mathematical resilience will often say that they like math, are good in mathematics, and will be able to receive help from parents to learn mathematics. But, the aspects of mathematical resilience are not just about the confidence.

The correlation between mathematical resilience and students' mathematics learning outcomes should be viewed from aspects of mathematical resilience itself. The aspects of resilience in this study include: (a) learning mathematics has value and importance; (b) learning mathematics requires hard work and perseverance; and (c) confidence that they are able to learn mathematics. The first aspect is learning mathematics has value and importance. Students who have confidence in the benefits of learning mathematics for their future will be more motivated to learn mathematics despite various difficulties. The second aspect is learning mathematics requires hard work and perseverance. Students, who have high resilience, when facing difficulties learning mathematics, will respond that to learn mathematics it takes more time and effort so they are expected to never give up and keep trying. The third aspect is confidence that they are able to learn mathematics. Positive responses and unyielding attitudes certainly need to be supported by students' confidence that they are able to learn and understand mathematics. This opinion is supported by the statement of Ariyanto et al. [27] which explains that students with good mathematical resilience always foster confidence in their ability to learn mathematics. Students do not think that mathematics is something that can only be understood by others while they cannot even though they face obstacles and failures. Students will remember that they will be able to overcome these difficulties and can understand mathematics. Students will find ways that can help them to overcome the difficulties of learning mathematics and believe in the existence and usefulness of mathematics.

Research by Hutauruk and Priatna [23] found that student's mathematical resilience is dominated by the indicator that most students convinced that mathematics is valuable and necessary to learn and to be mastered. In this research, it belongs to the first aspect, which is learning mathematics has value and importance. Contrary, they also found that fewer students have the nature of survival and never give up that belong to the second aspect, which is learning mathematics requires hard work and perseverance. The attitude of hard work contributes to students an important sense so that students are able to identify characters that lead students to survive when facing difficulties in learning

mathematics [18]. Students who never give up will find ways to overcome the difficulties experienced. These ways will help students get a good learning process so that it affects the learning outcomes of their mathematics. It is not enough just believe that everyone can learn mathematics, but the struggle attitude is also needed. There is also a founding from a study that there is no significant relationship between the level of confidence and willingness towards mathematics achievement [28]. It can be one of the reasons why there are some students that having a good mathematical resilience but still feel difficult to learn mathematics and having low mathematics achievement. Based on the result, this study needs the following research to investigate the factors. The other factors that maybe influence the mathematics achievement are affective characteristics, the background of student's family, the level of school, or the scaffolding that developed by teacher [29][30].

4. Conclusion

Mathematical resilience is defined as a positive response given by students when facing mathematics learning difficulties. Based on the results of the research conducted, it can be concluded that there is no correlation between mathematical resilience and students' mathematics achievement, but further study is needed to investigate the factors.

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