Achievement of students mathematical resilience through problem based learning model with metacognitive approach

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Abstract. This paper discusses the effect of the Problem Based Learning model with the Metacognitive approach (PBLM) on achieving students mathematical resilience. This study also discusses the interaction between learning models with mathematical prior knowledge towards mathematical resilience abilities. This research is a quantitative study, with two classes as research subjects namely the experimental class and the control class. The research instrument uses a scale of mathematical resilience, interview guidelines, and observation sheets. Research findings obtained include: (1) the learning model used does not have a significant difference to the achievement of mathematical resilience, both overall and based on the mathematical prior knowledge (MPK) (2) the achievement of mathematical resilience abilities of students who get learning with PBLM learning models is not significantly better than students who get conventional learning as a whole or based on MPK, and (3) there is no effect of interaction between the learning model used with MPK on achieving students’ mathematical resilience abilities.

1. Introduction
Mathematics is one of the sciences that plays a role in civilization, so mastering mathematical skills is very important to be achieved in order to be able to compete and achieve progress in modern times [1]. The process of mastering mathematical skills can be done through learning activities. Learning mathematics means that you will experience all the processes that have been determined in order to achieve the desired learning goals.

In the process of learning mathematics there are many experiences that will be experienced by students such as facing difficulties. Difficulties in learning and understanding mathematics are very reasonable because mathematics is a lesson that requires students to think logically, systematically and reflectively, and requires diligent, thorough and earnest effort [1, 2]. These difficulties have many factors, for example when studying a topic that is newly known, when solving mathematical problems, or because indeed these difficulties are deliberately created so that students are trained and accustomed to critical thinking activities, creative, and never give up when solving problems [2-4].

Difficulties experienced by students to improve mathematical abilities in the learning process require resilient nature [2]. The difficulties experienced by some students become an unpleasant experience but cannot be avoided in the learning process. The unpleasant experience is certainly irreversible, but the negative effects can be reduced or even eliminated if the resilience of students can develop properly.
Resilience is the process of developing the capacity to survive and adapt in the face of physical, social, and emotional challenges [5-8]. The ability of a person to withstand stress can increase depending on how the process of forming resilience abilities is possessed [9, 10]. Each individual can increase his ability to resilience because resilience is not static but is a continuum [6, 11-14].

Resilience in the context of learning is a concept of students' ability to deal with problems and obstacles that seem impossible to pass and seem impassable with good results. Resilience is related to the affective ability of students to deal with, overcome, be strong when facing obstacles in the learning process even situations that might negatively affect them [2, 15]. Resilience allows students to find and use 'adaptive results' when dealing with these situations. These adaptive results are in the form of survival, changing negative situations into a situation that supports them, and can even turn these students into individuals who are more resilient to the next problem that might arise [2, 16].

Mathematics as one of the subjects of learning also requires good resilience. Mathematical resilience is an important concept that is obtained based on mathematical experience of students who tend to be "angry" and potentially "failed" [17, 18]. Mathematical resilience is the ability to maintain a positive affective attitude in relation to learning mathematics and developing new skills if needed [19, 20]. Students who have mathematical resilience will survive when faced with difficulties, be able to work together, have the ability to express their understanding, and realize that the more they work in mathematics, the more successful they will be [10].

According to Johnston-Wilder & Lee [21], mathematical resilience can be developed in students who have "bad" experiences with mathematics, by focusing strategically and explicitly on the formal and informal education environment. Students build awareness, build risk management and process management with their mathematical experiences [2, 22, 23].

Johnston-Wilder, et. Al. [24] propose four interrelated factors that construct mathematical resilience capabilities, namely (1) Value, the belief that mathematics is a valuable and valuable subject to be learned; (2) Struggle, awareness and recognition that dealing with mathematics is universal even for people who have high level math skills; (3) Growth, the belief that everyone can develop mathematical skills; and (4) Resilience, an orientation to produce a positive response when facing negative situations or difficulties in learning mathematics.

According to Hutauruk [2], the indicator of a student who has mathematical resilience is (1) having the belief that mathematics is something valuable and feasible to pursue and study; (2) have the willingness and persistence in learning mathematics, despite experiencing difficulties, obstacles and challenges; (3) have confidence in themselves that they are able to learn and master mathematics, both based on understanding mathematics, the ability to create strategies, the help of tools and other people, and experiences built; and (4) having a defensive nature, not giving up, and always giving a positive response in learning mathematics.

Difficulties in the process of learning mathematics often arise when students are given a problem to solve. One learning model that puts "problems" as the main subject of learning is the Problem Based Learning model with the Metacognitive Approach (PBLM). The Problem-Based Learning (PBL) model is a learning model whose learning process starts with problems that must be solved [25-27]. With the PBL model, students have the opportunity to use or process their knowledge and shape their self-confidence in their scholastic talents through the process of designing, monitoring and evaluating activities carried out to determine the solution to a problem [28, 29]. The combination of the PBLM model syntax with the metacognitive approach is expected to increase the ability of students' mathematical resilience to not easily give up and maintain their positive affective attitude when solving mathematical problems, and be able to develop new knowledge and skills as a result of mathematics learning obtained [30, 31].

More in-depth research on the PBLM model involves analysis based on students' mathematical prior knowledge (MPK). MPK is a student grouping criteria based on the initial ability of each student before being given PBLM learning, aiming to see more clearly the effects of PBLM learning on achieving students' mathematical resilience.
2. Experimental Method
The subject of this quasi-experimental study was students from two classes, namely the experimental class using the PBLM model and the control class using conventional learning. The research instruments consisted of the MPK test, mathematical resilience scale and observation sheet. The MPK test is given to students to know the students' initial mathematical abilities before the learning process and then grouped into three groups of mathematical abilities, namely high, medium and low groups. The mathematical resilience scale is adopted [2, 32, 33] to find out the achievement of students' mathematical resilience. The observation sheet is used as a guide to observe all activities of students and lecturers during the learning process. The analysis for the research hypothesis used SPSS software, including t-test, n-gain test, Mann-Whitney test, and two-way ANOVA.

3. Result and Discussion
Achievement of student mathematical resilience obtained from 84 students consisting of 41 people in the experimental class and 43 people in the control class. Each student filled out a resilience scale questionnaire that measured mathematical resilience. Table 1 is presented descriptive statistics of student mathematical resilience.

Table 1. Descriptive statistics of student mathematical resilience.

| Class     | MPK   | Mean  | Std. Deviation | N  |
|-----------|-------|-------|----------------|----|
| Experiment| High MPK | 96.63 | 5.344           | 8  |
|           | Medium MPK | 95.00 | 4.866           | 26 |
|           | Low MPK | 96.00 | 5.715           | 7  |
|           | Total   | 95.49 | 5.016           | 41 |
| Control   | High MPK | 94.83 | 5.076           | 6  |
|           | Medium MPK | 93.31 | 6.177           | 29 |
|           | Low MPK | 97.50 | 5.014           | 8  |
|           | Total   | 94.30 | 5.946           | 43 |
| Total     | High MPK | 95.86 | 5.112           | 14 |
|           | Medium MPK | 94.11 | 5.610           | 55 |
|           | Low MPK | 96.80 | 5.213           | 15 |
|           | Total   | 94.88 | 5.511           | 84 |

Table 1 shows that it can be seen that the average achievement score of mathematical resilience of students who get PBLM learning is higher than students who get conventional learning. In the High MPK category students, the average score of students' mathematical resilience in the experimental class was higher than the control class. In the medium MPK category, the average score of students' mathematical resilience in the experimental class was higher than the control class. In low MPK category students, the average score of mathematical resilience of experimental class students is lower than the average mathematical resilience of control class students.

To find out the significance of the difference in the average score of mathematical resilience of students who obtained PBLM and the mathematical resilience of students who obtained PK, a variance analysis was performed at a significance level of 5%. Previously, a prerequisite test was conducted which included normality and homogeneity tests, and the results showed that students' mathematical resilience scores were normally distributed and both classes were homogeneous at a significance level of 5%. Furthermore, a variance analysis was conducted on Student Mathematical Resilience based on the learning model and MPK category stated in Table 2.
Table 2. Variance Analysis of Student Mathematical Resilience

| Source               | Type III Sum of Squares | Df | Mean Square | F     | Sig. |
|----------------------|-------------------------|----|-------------|-------|------|
| Corrected Model      | 159.894                 | 5  | 31.979      | 1.057 | .391 |
| Intercept            | 519610.355              | 1  | 519610.355  | 17166.905 | .000 |
| Class                | 6.207                   | 1  | 6.207       | .205  | .652 |
| MPK                  | 90.919                  | 2  | 45.459      | 1.502 | .229 |
| Class * MPK          | 31.617                  | 2  | 15.809      | .522  | .595 |
| Error                | 2360.915                | 78 | 30.268      |       |      |
| Total                | 758722.000              | 83 |             |       |      |
| Corrected Total      | 2520.810                | 83 |             |       |      |

a. R Squared = .063 (Adjusted R Squared = .003)

Based on the calculation of the two-lane ANOVA in Table 2, sig.0.652> α is obtained. This means that the achievement of mathematical resilience of students who get learning with PBLM is not significantly higher than students who get conventional learning are reviewed as a whole. In other words, although descriptively it can be seen that the achievement of mathematical resilience of students who get the PBLM model has a higher level than students who get conventional learning, but it does not mean that the PBLM model is better than the conventional model.

Furthermore, the achievement of students' mathematical resilience ability was reviewed based on MPK. From table 2, it looks sig. 0.229> α. This shows that the achievement of mathematical resilience of students who get PBLM learning is not higher than students who get conventional learning based on the student MPK category. In other words, even though descriptively there are differences in the achievement of students' mathematical resilience between those using the PBLM model and conventional models, the difference is not significantly caused by the PBLM model, or it can be interpreted that the PBML model is no better than the conventional model in all KAM categories.

The influence of the interaction between the learning model used with MPK on the achievement of students' mathematical resilience abilities is also seen in Table 2. Significance value sig. 0.595> α shows there is no effect of the interaction between the learning model used with MPK for the achievement of students' mathematical resilience abilities. Or in other words, there is no correlation between PBLM and KAM models based on students' mathematical resilience ability. The PBLM model does not have a significant effect on the ability of mathematical resilience in one or more KAM categories.

4. Conclusion
The learning model used does not have a significant difference to the achievement of mathematical resilience, both overall and based on the mathematical prior knowledge (MPK). Furthermore, the achievement of mathematical resilience abilities of students who get learning with PBLM learning models is not significantly better than students who get conventional learning as a whole or based on MPK. Lastly, there is no effect of interaction between the learning model used with MPK on achieving students' mathematical resilience abilities.

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