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Considering the Mathematical Resilience in Analyzing Students' Problem-Solving Ability through Learning Model Experimentation

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The ability to solve mathematical problems is desired in the 21st century due to its function in improving students' mathematical skills. However, it is observed to be very low among students and this implies there is a need for an appropriate learning model such as blended learning which can be taught online and offline to conduct problem-based learning activities. This research aims to determine (1) the difference in mathematical problem-solving abilities between students taught using a blended learning model and those with problem-based learning by considering their mathematical resilience and (2) the influence between mathematical resilience and students' problem-solving abilities. This is quantitative research conducted using a pretest-posttest randomized experimental design on 233 students at the 7th-grade. The data were collected using tests and questionnaires. The research data analysis technique used was covariance analysis (ANCOVA). The quadrant analysis of the covariance test showed the value of F(1.231) was 12.260 at 0.001 <0.05, and this means there are differences in problem-solving abilities between the two classes of students based on their mathematical resilience. The test concerning the influence showed 0.000 < 0.005, which indicates an influence between mathematical resilience and student problem-solving abilities at 79.8%. The results showed that these two skills influence each other and can improve students' ability to solve mathematical problems. Therefore, in addition to selecting an active learning model for students, educators also need to instill positive mathematical resilience during the learning process due to its effectiveness in increasing the confidence and persistence of students in solving problems.

Keywords: mathematical ability, mathematical resilience, problem-solving, ability problem-solving, learning model

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INTRODUCTION

Mathematical ability is the main knowledge needed in the learning process of all ages (Szczygiel, 2020; Ukobizaba et al., 2021). Moreover, students with the ability can solve problems intelligently. This is due to the fact that the problems in mathematics require appropriate solutions because of their effect on the process and outcome of learning (Rezeki et al., 2021), as well as several other benefits it provides to each student (Hsiao et al., 2017). Some of the related skills to be developed include concept understanding, problem-solving, reasoning, mathematical communication and representation, as well as critical and creative thinking skills (Diana et al., 2020). This means students need to understand the concepts associated with solving problems before engaging in the process. According to (Ester et al., 2021), students often face difficult challenges in solving mathematical problems, indicating the need to understand these problems to develop appropriate strategies to provide answers. This condition is observed to be existing at all levels of education, including high schools. Mathematical problem solving is one of the most difficult aspects in elementary schools (Ozcan et al., 2017; Tzohar-rozen & Kramarski, 2017), Junior High School students have difficulty solving mathematical problems (Angateeah, 2017), most of those in senior high school experience challenges making mathematical connections (Jailani et al., 2020), and those colleges also have low skill levels, thereby, reducing their abilities to solve mathematical problems (Nasir et al., 2021).

Middle-level students are expected to have certain abilities in the process of learning mathematics (Hendriana et al., 2018; Hobri et al., 2020). Moreover, one of these is a problem-solving ability which can improve their understanding of mathematics according to Ozcan et al., (2017); it is also listed in the standard mathematical processes (NCTM, 2000) and can be used to develop students' prior knowledge, skills, and starting points in mathematics (Naqiyah et al., 2020; NCTM, 2000; Palmér & van Bommel, 2020).

Problem-solving ability is an integral part of mathematics learning because it promotes students to solve problems and serves as a skill to learn several concepts in the subject (Palmér & van Bommel, 2020; Son et al., 2020). Its usefulness is indicated in the content standards in the regulation of the Minister of National Education of Indonesia number 22 of 2006 (Minister of Education, 2006), which states that one of the main objectives of learning mathematics is to acquire mathematical problem-solving skills. Moreover, the Indonesian government also includes the importance of solving mathematical problems in the 2013 curriculum. This is necessary because problem-solving skill is highly desirable in the 21st-century industrial space (Ahdhianto et al., 2019; Nakakoji & Wilson, 2020; Rini et al., 2020).

It has been discovered that the ability of middle-level students to solve problems in mathematics is low. Wulandari & Jailani (2018) also stated that the ability of fifteen-year-old students to solve problems is in the low category and the same was observe for their skills in solving non-routine problems (Abdullah et al., 2017). This is indicated by the difficulty they encounter in providing solution ideas to examples provided by their teacher, with some only spending much time understanding the problem without having the ability to find appropriate solutions (Ozcan et al., 2017). Moreover, students are not familiar with non-routine problems because they usually solve routine problems, which involve the provision of examples followed by similar exercises. They normally become confused when they are provided with tests that are similar to the examples provided by teachers, thereby leading to difficulty in learning mathematics (Salihu, 2018; Wijaya et al., 2019). This usually reduces their motivation in solving these problems due to their belief that they do not have the required ability to solve the problems (Fitri et al., 2019). This phenomenon is known as negative mathematical resilience, and it is caused by unattractive methods of teaching mathematics, which reduces the response of students to lessons and leads to boredom. Moreover, some other causative factors include the lack of diversity in learning methods which places more responsibility on a teacher, thereby making students passive in the process as well as the lack of appropriate media to teach and learn mathematics (Kenedi et al., 2019; M. Rohmah & Sutiarso, 2017).

This means there is a need to start giving students non-routine problems which require mastery of concepts, high-level thinking, and application of mathematical principles (Abdullah et al., 2017; Kablan & Uğur, 2020). in order to improve their mathematical problem-solving abilities (Kablan & Uğur, 2020). Teachers also need to instill the nature of having high mathematical resilience in students to enhance their self-confidence and belief in their ability to solve problems in mathematics, eliminate fear and anxiety, and be aware of support from other places (Johnston-Wilder et al., 2016; Lee & Johnston-Wilder, 2017). A positive mathematical resilience has the ability to support students in solving mathematical problems and increase their preparedness to face these problems (Hakim & Murtafiah, 2020; Hidayatul et al., 2020; Muntazhimah & Ulfah, 2020).

It is easier to acquire problem-solving ability when there is positive mathematical resilience, but this is dependent on the learning model used. This means it is important for teachers to select a good learning model which has the ability to make students enthusiastic about learning in order to improve the outcomes (Rezeki et al., 2021). The learning model should be student-centred which allows active participation of the students in the learning process while their thinking skills in solving problems are enhanced by teachers functioning as facilitators (Maksum et al., 2021). This is necessary because the learning process in the 21st-century requires the preparation of students to have the skills and competencies needed in the Industrial Revolution 4.0 (Simanjuntak et al., 2021).

Active and effective learning such as blended and problem-based learning can strengthen students' mathematical problem-solving abilities (Ukobizaba et al., 2021). It is important to note that blended learning is a combination of two or more learning models, approaches, and technology, both online and offline (Bahri et al., 2021; Hrastinski, 2019). Meanwhile, problem-based learning directs students towards problems requiring resolutions and has been confirmed to be effective in improving the ability of students to learn (Saputro et al., 2020; Surur et al., 2020). The selection of these two models is expected to provide good benefits for students in solving mathematical problems.

The problems identified led to the conduct of this research considering the fact that there are rare previous studies on the concept. However, some similar studies were observed such as Surur et al. (2020) on problem-based learning and problem-solving ability, Fitriani et al. (2021) on blended learning and learning mathematics, and Lyakhova & Joubert (2022) on blended learning and mathematical resilience. It is very rare to see those that combine the two learning models in determining students' problem-solving abilities. Therefore, this consideration of the mathematical resilience showed that this present research is not only concerned with the problem-solving ability of the students alone. It is believed that the ability to solve mathematical problems is influenced by the mathematical resilience. It assumes that a person can solve problems by having good abilities and due to the influence of feelings, anxiety, confidence, desire, and a sense of being able to solve problems provided in mathematics which is the hallmark of mathematical resilience. Moreover, this also determines the differences in the applied learning models and their effects on mathematical problem-solving abilities based on the mathematical resilience of the student. Based on the description of the problems previously mentioned, this research was conducted to determine the differences in problem-solving abilities of students taught using the blended learning model and those taught using problem-based learning with due consideration for their mathematical resilience.

Research Questions

The research questions formulated based on the problems identified are stated as follows:

1. Is there a difference in mathematical problem-solving ability between students taught using blended learning and problem-based learning models with consideration for their mathematical resilience?
2. Is there a influence between mathematical resilience and problem-solving abilities?

Literature Review

Problem-Solving Ability

Problem-solving is an attempt to find solutions to difficult problems (Martinez, 1998; Nasution et al., 2019; Polya, 1985). In contrast, a person's mathematical problem-solving ability is the ability to solve difficult and non-routine mathematical problems (Evans et al., 2020; Prayekti et al., 2020). This ability was reported by Polya (1985) to have four stages which include understanding the problem, planning a solution, solving the problem, and rechecking.

Mathematical Resilience

Resilience is a person's ability to survive adversity and respond positively to situations in order to resolve the difficulties encountered easily (Kooken et al., 2015; Lee &

Johnston-Wilder, 2017). Therefore, mathematical resilience is an attitude of confidence and belief in solving mathematical problems without any promptings they are difficult (Fitri et al., 2019). Some of its indicators include thinking patterns, struggles, self-confidence, having support, optimism, perseverance, and being able to have self-control in difficult situations (Hakim & Murtafiah, 2020; Hendriana et al., 2018; Johnston-Wilder et al., 2016; Lee & Johnston-Wilder, 2017).

Learning Model

The learning models used in this research are blended and problem-based models. Blended learning is the process of combining two or more forms of learning such as online and offline, offline with computers, as well as two or more other learning models (Bryan & Volchenkova, 2016; Fisher & Kusumah, 2018; Goos et al., 2020; Helsa & Kenedi, 2019; Hrastinski, 2019; Kashefi et al., 2012; Ojaleye & Awofala, 2018; Pertiwi et al., 2019; Supriadi et al., 2014). Meanwhile, problem-based learning constructs the knowledge that students have based on the context of the problem in order to formulate appropriate solutions (Arends, 2015; Birgili, 2015; Ojaleye & Awofala, 2018; Ramadhani et al., 2019; Simanjuntak et al., 2021; Sugiyono, 2016).

METHOD

Research design

This is a quantitative research analyzed through the statistical process (Creswell, 2013). It is using a pretest-posttest randomized experimental design. The pretest-posttest used did not focus on providing initial and final tests related to the mathematical problem-solving ability but rather leads to the consideration of some variables including mathematical resilience and student problem-solving abilities. The mathematical resilience was managed as a covariate variable while problem-solving ability was the dependent variable and they were provided in a pretest before the learning model treatment was applied after which a posttest was provided with only the mathematical problem-solving ability. The research design is, therefore, presented in the following Figure 1.

Table 1
Pretest-posttest randomized experimental design (M.D Gall et al., 2010)

R	O_1	X_{BL}	Q_2
R	O_1	X_{PBL}	Q_2

Description:
X_{BL} : The mathematics learning process using blended learning treatment
X_{PBL} : The mathematics learning process using problem-based learning treatment
O_1 : Pretest on mathematical resilience and problem-solving abilities
O_2 : Posttest on mathematical problem-solving abilities

The pattern of the relationship between the variables is shown in Figure 1.

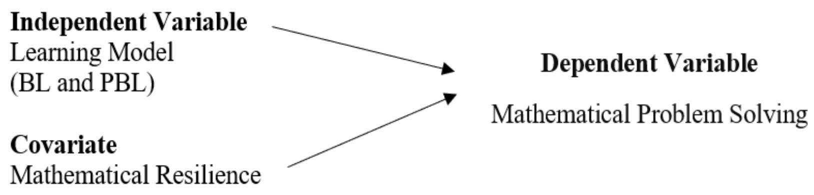

Figure 1
The pattern of relationships between the variables

Research Sample

The research was conducted on 7th-grade Junior High School students in Langsa City, Aceh, Indonesia, with the samples selected through cluster random sampling, which involves random selection of participants (Gall et al., 2003). This process led to the selection of 233 students of 12 to 13 years old from 4 schools including State Junior High Schools 1, 2, 4, and 6 Langsa. It is important to note that 120 students were used in the blended learning class with 32 selected from School 1, 32 from School 2, 32 from School 4, and 24 from School 6 while the remaining 113 students in the problem-based learning class include 30 from School 1, 28 from School 2, 32 from School 4, and 23 from School 6.

Data Collection and Instruments

Data were collected using tests and questionnaires to determine the difference in mathematical problem-solving abilities of students taught using the blended learning model and those with problem-based learning by considering their mathematical resilience. Furthermore, it was also applied to determine the effect of mathematical resilience on students' problem-solving abilities.

Data were collected based on two classes which include the blended learning and problem-based learning classes. They were both provided with a mathematical resilience questionnaire and a problem-solving ability test as a pretest before the learning models were applied. The blended learning was subsequently conducted online and offline while the problem-based learning was only offline and a posttest was applied to both classes in the form of mathematical problem-solving ability test after these learning models have been used on the classes.

The test was designed to have an essay question of 4 items and a questionnaire with 40 statements. These instruments were tested for validity and reliability before their application. The validity test was conducted using 7 experts including 4 lecturers and 3 mathematics teachers. Validation sheets and questionnaires were provided to these experts to check the suitability of the test items and questionnaires in order to ensure the language used is easy for students to understand. The assessment values were later calculated using the Aiken validation index (Aiken, 1980, 1985) which is also known as index V as follows.

$$V = \frac{\Sigma s}{[N(c-1)]}, where\ S = r - l_o \text{..........(1)}$$

Description:

V : Aiken validation index
N : Number of raters
c : The highest rating score is 5
r : The number given by the rater
l_o : The lowest rate is 1

The range of V numbers obtained is between 0 to 1 with p < 0,05 and the items with closer value or equal to 1 have the higher validity while those close to or equal to 0 have lower validity (Aiken, 1985). Meanwhile, the reliability test was conducted using Cronbach Alpha with the criteria that 0.80-1.00 is very high, 0.60-0.79 high, 0.40-0.59 moderate, 0.20-0.39 low, and 0.00- 0.19 is very low (Riduwan et al., 2013).

Instrument Trial Results

Test

The test instrument was validated by seven experts on a scale of 1 to 5 based on the provisions of Aiken and the results obtained from expert 1 was 4.3, expert 2 was 4.2, expert 3 was 4.5, expert 4 was 4.4, expert 5 was 4.4, expert 6 was 4.3, and expert 7 was 4.5. It is important to note that N = 7 and this means l_o = 1 as follows.

$S\ expert\ 1 = 4{,}3 - 1 = 3{,}3$, $S\ expert\ 2 = 4{,}2 - 1 = 3{,}2$, $S\ expert\ 3 = 4{,}5 - 1 = 3{,}5$, $S\ expert\ 4 = 4{,}4 - 1 = 3{,}4$, $S\ expert\ 5 = 4{,}4 - 1 = 3{,}4$, $S\ expert\ 6 = 4{,}3 - 1 = 3{,}3$ and $S\ expert\ 7 = 4{,}5 - 1 = 3{,}5$

Then,

$$V = \frac{3{,}3 + 3{,}2 + 3{,}5 + 3{,}4 + 3{,}4 + 3{,}3 + 3{,}5}{[7(5-1)]}$$

$$V = 0{,}84$$

The Aiken validation assessment criteria showed that V coefficient was 0.84 and this implies the test instruments have high validity. The results of the reliability test are also presented in the following Table 2.

Table 2
Test results of reliability statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.886	.904	4

Table 3
Item-total statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Item_1	18.03	72.099	.805	.757	.837
Item_2	18.13	69.449	.942	.922	.772
Item_3	17.84	66.006	.940	.942	.773
Item_4	24.87	127.516	.565	.651	.950

The tables show that the total value of Cronbach Alpha increased by 0.886, and this is considered to be a very high-reliability value. This means the validity and reliability tests have confirmed that the items of the mathematical problem-solving ability are feasible to be used for research.

Questionnaire

The questionnaire used was also tested for validity and reliability, and it was discovered to be valid and highly reliable, and this means it is suitable to be used for this research.

Data Analysis

Data were analyzed statistically after prerequisite tests including normality, homogeneity, linearity, and the significance of the regression direction have been conducted. The aim was to determine the relationship between mathematical resilience which was the covariable, and mathematical problem-solving ability, which was the dependent variable. These two variables are expected to have a linear relationship for both the blended learning and problem-based learning classes. Moreover, the slope of the regression line from each relationship was analyzed for homogeneity using the regression line generated based on the relationship between mathematical resilience and mathematical problem-solving in the two learning models that do not intersect.

The two classes, blended and problem-based learning, were provided two lessons to determine their effectiveness. The blended learning class was expected to provide changes because it was taught both online and offline in order to satisfy the present 21st-century and future learning needs while the problem-based learning class was only taught offline. The two classes are independent variables and emphasis was placed on the comparison of their means before the treatments were applied. This implies the comparative test was prioritized while prediction test was applied as a form of control for external variables influencing the results of the treatments. The control variable was mathematical resilience and it was referred to as the covariate variable while the mathematical problem-solving ability is the dependent variable applied to determine the students' abilities after the treatments have been provided. It is important to note that all the data obtained were tested for normality.

The normality test was conducted using the Kolmogorov Smirnov and Shapiro Wilks tests on SPSS 26 while the homogeneity test was through Levene's test of equality of error and the linearity test was analyzed using a graph plot. The data is believed to be normal and homogeneous when the sig. value > 0.05.

The covariance analysis (ANCOVA) was applied to determine the difference in mathematical problem-solving abilities between students with blended learning model and those with problem-based learning with consideration for their mathematical resilience after the prerequisite test has been met. Meanwhile, quadrant analysis of covariance which involves combining comparative and correlation tests, was applied in the situation where the prerequisites are not satisfied (Ghozali, 2018). Covariance analysis was conducted because of covariate variables were used as the controller in the research while simple regression analysis was used to determine the influence of mathematical resilience on students' problem-solving abilities. It is important to note that all the data were processed using SPSS 26.

FINDINGS

The results of the prerequisite tests conducted including normality, homogeneity, and linearity are presented in the following tables 4.

Table 4
Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Residual for Mathematical_Problem_Solving	.080	233	.001	.974	233	.000

a. Lilliefors Significance Correction

Table 4 shows that the significance value is 0.000 from Shapiro-Wilk and 0.001 from Kolmogorov-Smirnov which are < 0.05 and this means the data is abnormal.

Table 5
Homogeneity

Levene's Test of Equality of Error Variancesa
Dependent Variable: Mathematical_Problem_Solving

F	df1	df2	Sig.
2.070	1	231	.152

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + Mathematical_Resilience + Learning_Model

Table 5 shows that the significance value is 0.152 which is > 0.05 and this means the data is homogeneous. Meanwhile, the results for the linearity test of the blended learning and problem-based learning classes are presented in the simple scatter graph of Figures 2 and 3, respectively.

Blended learning class

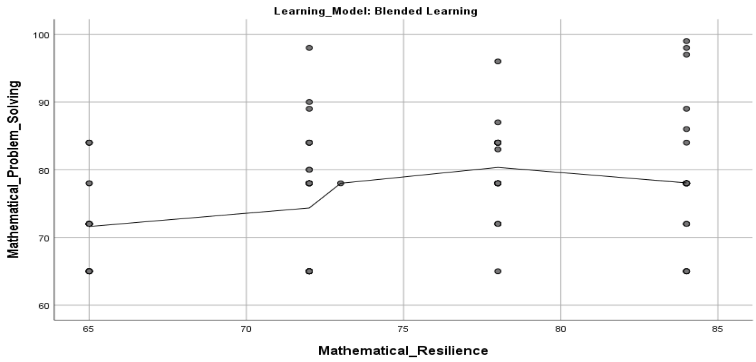

Figure 2
The results of the linearity test for the blended learning class

Problem-based learning class

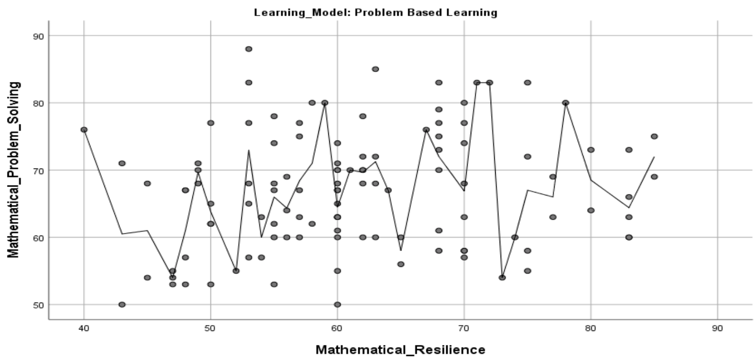

Figure 3
The results of the linearity test for the problem-based learning class

Figures 2 and 3 show the distribution of dots on the mathematical resilience and mathematical problem-solving ability is not in a straight line and this means there is no linearity between the data for the two variables. Furthermore, the regression line homogeneity test was conducted on the two learning models and the results are presented in the following table 6.

Table 6
Regression line homogeneity test

Tests of Between-Subjects Effects						
Dependent Variable: Mathematical_Problem_Solving						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6066.227a	3	2022.076	28.985	.000	.275
Intercept	8587.096	1	8587.096	123.089	.000	.350
Learning_Model	98.696	1	98.696	1.415	.236	.006
Mathematical_Resilience	1100.522	1	1100.522	15.775	.000	.064
Learning_Model * Mathematical_Resilience	243.664	1	243.664	3.493	.063	.015
Error	15975.765	229	69.763			
Total	1217705.000	233				
Corrected Total	22041.991	232				

a. R Squared = .275 (Adjusted R Squared = .266)
The results showed that 0.063 > 0.05 and this means the covariate regression with the dependent variable in each class is homogeneous.

These analyses showed that the requirement for the one-way ANCOVA test is not satisfied as indicated by the fact that the data are not normal and linear. This led to the shift to a non-parametric test in the form of quadrant analysis of covariance. Meanwhile, this analysis requires knowing the corrected mean from the results of the one-way ANOVA test as indicated in the following Table 7 for each class.

Table 7
Corrected mean results

Learning Model	Mathematical Resilience		Mathematical Problem Solving		Difference	Enhancement	Corrected Average	Notation
	M	SD	M	SD				
Problem Based Learning	51,54	10,534	66,88	8,728	15,34	30%	68.411	a
Blended Learning	68,09	6,991	76,11	8,481	8,02	12%	74.672	b

The quadrant analysis of covariance was conducted afterward and the results are presented in the following table 8.

Table 8
Results of quadrant analysis of covariance

ANCOVA					
Unstandardized Residual					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	42190.168	1	42190.168	12.260	.001
Within Groups	794944.904	231	3441.320		
Total	837135.073	232			

The results showed that F(1,231) = 12,260 at 0.001 < 0.05 significant value, and this means there is a significant difference between the problem-solving abilities of students taught using blended learning and those with problem-based learning based on the consideration for mathematical resilience. Moreover, the results of the analysis conducted to determine the influence between mathematical resilience and students' problem-solving abilities are presented in Tables 9 and 10.

Table 9
Regression output results

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.444a	.798	.792	60.199347

a. Predictors: (Constant), Rank of Mathematical_Resilience

Table 9 shows that the R value is 0.444 and the coefficient of determination (R Square) is 0.798. This signifies that the students' mathematical problem-solving ability was influenced by mathematical resilience. It is, however, important to note that the magnitude of the effect is 0.798 or 79.8% and this indicates the effect is influenced by other variables.

Table 10
Results of the linear regression equation

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	65.066	7.943		8.192	.000
	Rank of Mathematical_Resilience	.444	.059	.444	7.532	.000

a. Dependent Variable: Rank of Mathematical_Problem_Solving

Table 10 shows that the effect mathematical resilience and students' problem-solving abilities can be written in a simple regression which is Y=α+βX. Column B shows the constant value (α) and the coefficient value on the mathematical resilience variable (X). Therefore, the regression equation is Y=65,066+0,444X. It was also discovered that sig. value was 0.000 < 0.005 and this further confirms the existence of the effect of these variables. The magnitude of the effect is presented in Table 9 to be 0.798 and this means 79.8% of mathematical problem-solving students are influenced by mathematical resilience while the rest are influenced by other variables.

DISCUSSION

This research aims to determine the differences in mathematical problem-solving abilities of students taught with blended learning model and those with problem-based learning model based on the consideration of their mathematical resilience. The covariance test showed there was a significant difference in the problem-solving abilities between these two classes. It is important to note that it is impossible to conduct post hoc further tests on non-standard residuals which are groups with less than three classes and this means students' mathematical problem-solving abilities are different for the two learning models with the focus on mathematical resilience. Active learning models such as blended learning can strengthen students' mathematical problem-solving abilities (Mayasari et al., 2020; Ukobizaba et al., 2021), make them understand concepts, learn independently, train to collaborate in learning (Yuberti et al., 2019), improve mathematical skills (Setiawan et al., 2022), increase achievement (Indrapangastuti et al., 2021; Ojaleye & Awofala, 2018) and have a positive effect on both the learning outcomes and their attitudes when learning (Lin et al., 2016). This implies the selection of an active learning model for students can have a positive effect on their abilities.

The problem-solving ability was also observed to be influenced by positive mathematical resilience which is a soft skill in learning mathematics. It was discovered that the cultivation of positive resilience during the process of studying leads to the successful achievement of learning outcomes due to the fact that those with this skill are usually able to solve mathematical problems and vice versa. This is in line with the findings of S. Rohmah et al (2020), that students with high resilience have better problem-solving abilities than those with low resilience. Therefore, there is the need for immediate attention on those with negative resilience (Sarmiento et al., 2021). Moreover, this is necessary because having positive mathematical resilience can eliminate anxiety in learning, specifically mathematics due to the existence of self-confidence, perseverance, persistence, and belief that problems in mathematics can be solved effectively (S. Rohmah et al., 2020). Moreover, Ariyanto et al., (2019) reported that the use of problem-based learning was able to increase the overall initial mathematical resilience abilities of students.

This means the mathematical resilience of students also influences their mathematical problem-solving abilities in addition to the learning models applied as indicated by the findings of this research that 79.8% of students' mathematical problem-solving ability is influenced by mathematical resilience while the remaining percentage is determined by other variables. This is in agreement with the results of Hakim & Murtafiah (2020) that one of the factors with a positive effect on mathematical problem-solving ability in students is mathematical resilience. It is the nature of a person to solve problems being faced, specifically in mathematics, based on endurance, self-confidence, and perseverance (Lee & Johnston-Wilder, 2017). Moreover, students with positive resilience do not usually give up easily when faced with problems while those with negative resilience indicated by anxiety, avoiding problems, a negative mindset, and powerlessness normally it difficult to solve these problems. This means mathematical resilience is very important for students in solving mathematical problems successfully.

However, it is important to note that the acquisition of problem-solving abilities in mathematics is certainly not easy due to the need to solve non-routine problems, thereby leading to the need to instill positive mathematical resilience in students and selecting the right learning model. In addition to habituation, these are expected to increase their ability to solve non-routine mathematical problems. The continuous training and familiarization of students with these kinds of problems over time are also expected to improve and increase their understanding of mathematical and future life challenges.

This is in line with the previous findings that non-routine problems can be applied in daily life to develop problem-solving and mathematical thinking skills for students, thereby increasing their knowledge (van Zanten & van den Heuvel-Panhuizen, 2018). They are also discovered to be appropriate for the development of mathematical problem-solving abilities in students (Yazgan & Sahin, 2018). Moreover, Chong, Shahrill, and Li (2019) showed that the provision of non-routine problems by teachers can influence and increase students' confidence in solving mathematical problems properly and correctly.

This research showed that the selection of an active learning model, instilling of positive mathematical resilience in students, and provision of non-routine problems can be used to aid and improve the mathematical problem-solving abilities of students in the future.

Positive mathematical resilience was found to be influencing students' mathematical problem-solving abilities and this means educators need to instill positive mathematical resilience during learning in addition to the selection of an active learning model for students. This is expected to make the students confident and persistent in solving problems and subsequently enhance their mathematical problem-solving skills.

Mathematical resilience was applied in this research to determine students' mathematical problem-solving abilities with a focus on a junior high school in Langsa City, Aceh, Indonesia. Only two classes including the blended and the problem-based learning were used and this implies post hoc tests cannot be conducted for non-standard residuals such as groups of less than three classes. This limited the chances of determining the classes that showed differences. Therefore, it is recommended that further research use more than two classes in order to determine those with differences and also to instill positive mathematical resilience in students in order to enhance their mathematical problem-solving abilities.

CONCLUSION

This research found a significant difference between the problem-solving abilities of students taught using blended learning and those with problem-based learning based on mathematical resilience. It was also discovered that there is an influence between mathematical resilience and students' problem-solving abilities and this means these two factors are interrelated in solving mathematical problems.

RECOMMENDATIONS

It is recommended that teachers practice, improve, and focus on developing mathematical problem-solving ability which is a hard skill, and also to foster positive resilience which is a soft skill in students. This is due to the fact that positive resilience has a positive effect on students' mathematical problem-solving abilities while negative resilience usually leads to difficulties in solving mathematical problems. Therefore, it is pertinent to have continuous study and practical application of these skills in teaching mathematics and conducting mathematical research.

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