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THE IMPROVEMENT OF STUDENTS' MATHEMATICAL REASONING ABILITY AND MATHEMATICAL RESILLIENCE USING CONTEXTUAL TEACHING AND LEARNING

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ABSTRACT

This research is motivated by the low mathematical reasoning ability of students which is indicated by the difficulty in understanding math problems in the form of story problems, as well as the level of mathematical resilience of students in one of the private junior high schools in Indramayu towards mathematics subjects. The purpose of this study was to determine the effectiveness of Contextual Teaching And Learning Based on Augmented Reality learning which is seen based on the increase in students' mathematical reasoning abilities through Contextual Teaching And Learning Based on Augmented Reality learning And to find out the level of students' mathematical resilience. This research was conducted at a private junior high school based on an Islamic boarding school in Indramayu. The research was conducted in class IX using 2 available classes, namely class IX A with 28 students as the Experimental class and class IX B with 26 students as the Control class. This study uses a mix method with explanatory sequential design. The instruments used in this study include mathematical reasoning ability test instruments on the material of curved side space shapes and mathematical resilience scales. The results of this study indicate that Contextual Teaching and Learning based on Augmented Reality is effective in improving students' mathematical reasoning abilities and achieving student learning completion.

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INTRODUCTION

Mathematics is a discipline that plays an important role in various aspects of life. Various problems that are often found in life cannot be separated from mathematics. Therefore,

mathematics is a science that is taught at every level of education in Indonesia. In Permendikbudnas Number 22 of 2006, it is stated that one of the objectives of learning in schools is for students to be able to use reasoning on patterns and properties, perform mathematical manipulation in making generalizations, compile evidence, or explain mathematical ideas and statements. This shows that mathematical reasoning skills are one of the main parts of learning objectives.

Reasoning ability is an event of the thinking process. The term reasoning ability is translated from the term reasoning which means drawing conclusions (Wulandari 2011). Drawing conclusions must of course be accompanied by a series of activities such as remembering something, imagining, memorizing, calculating, connecting several concepts, creating a concept or estimating various possibilities.

Mathematics is indeed not an easy subject to learn. So that in the learning process, various difficulties and obstacles will be encountered that affect students' interest in learning Iman and Firmansyah (2019) Therefore, the right attitude is needed to overcome the obstacles and difficulties encountered in the learning process. In a study conducted by Sari and Untarti (2021), it was stated that perseverance is very much needed by students to be able to solve existing problems, students' resilience attitudes can enable students to face problems as challenges and not as obstacles.

Resilience is a person's ability to rise from difficulties or setbacks that occur in their lives (Uyun 2012) . While mathematical resilience includes a persistent or tough attitude in facing difficulties, working or learning collaboratively with peers, having language skills to express mathematical understanding, and mastering mathematical learning theories (Mulyana and Sumarmo 2015).

The results of an interview conducted with Mrs. Syahida, S.Pd as a mathematics teacher at the junior high school on January 16, 2023, obtained information that students' mathematical reasoning abilities were still lacking, as seen from the many students who were not able to solve problems that required reasoning skills such as questions in the form of stories. In addition, the teacher also said that students give up easily when they find questions that are quite difficult. Meanwhile, the use of technology in the learning process is very rarely done due to limited facilities and lack of teacher knowledge regarding technology-based learning media.

Therefore, the selection of learning models should be based on learning models that can explore students' mathematical reasoning and resilience abilities. Such as the contextual teaching and learning (CTL) learning model. The CTL approach can train students to be more confident, and can work together to solve existing problems, students are able to draw their own conclusions from learning activities (Sari and Untarti 2021). Referring to Permendikbud No. 22 of (2016), concerning the standards of the education process and secondary, one of the principles of learning is the use of information and communication technology to increase the efficiency and effectiveness of learning. However, in reality there are still many teachers who tend to apply inappropriate learning approaches or strategies, such as conventional learning or have not utilized technology optimally Sudirman et al. (2020).

One example of technology-based media that has been applied in mathematics learning in the 21st century is learning using Augmented Reality (AR) (Agasisti et al. 2018). Augmented Reality (AR) is a technology-based learning media that combines the virtual world with the real world. The results of research conducted by (Runisah et al. 2022), entitled "Impact of Using Augmented Reality On Students' Cognitive and Affective Aspects in Terms of Education Level" obtained the results that the use of AR in the learning process can improve students' cognitive abilities such as visual thinking skills, learning outcomes and conceptual

understanding. The use of AR can improve students' affective abilities such as interest in learning and student learning motivation.

This allows AR to be used to improve students' mathematical reasoning and resilience. The results of a study conducted by (L D Alvira, Ahyaningsih, and Minarni 2022)), entitled "Development of CTL Approach-Based Learning Devices to Improve Critical Mathematical Thinking Skills and Mathematical Resilience of Junior High School Gajah Mada Medan Students" showed that the results of Contextual teaching and learning-based learning that was developed increased with an N-gain score of 0.58 for critical mathematical thinking skills and 0.51 for mathematical resilience. Based on the description above, this study focuses on the use of AR-based CTL learning models to improve students' mathematical reasoning and resilience.

METHOD

The research method used to answer the problem formulation in this research is Mix-Method Research Design. This method was chosen according to its characteristics because the research questions to be answered include outcomes and processes that involve combining qualitative and quantitative data.

This research uses an explanatory sequential design (explanatory sequential design), this design has two stages. The first stage is collecting and analyzing quantitative data, then followed by the second stage, namely collecting and analyzing qualitative data which is based on the results of quantitative data. The first stage of this research is collecting and analyzing quantitative data to answer the first problem formulation, namely improving the mathematical reasoning abilities of junior high school students whose learning uses the CTL model better than regular learning.

This was then followed by collecting and analyzing qualitative data to answer the second problem formulation, describing the level of mathematical resilience of junior high school students in classes that implement mathematics learning using the CTL model. The subjects in this research were 28 junior high school students in class IX A as an experimental class and 26 students in class IX B as a control class, located at SMPI Darul Fikri Bongas. The instruments used in this research were mathematical reasoning ability tests, mathematical resilience scale sheets.

This test was used to obtain data about the mathematical reasoning abilities of experimental class and control class students before and after learning. The form of the test is in the form of a description. The tests carried out are the initial test and the final test. The initial test is carried out before the learning process using contextual teaching and learning (CTL) which is carried out with the aim of determining students' mathematical reasoning abilities before experiencing learning.

The final test was carried out after the learning process using contextual teaching and learning (CTL) which was carried out with the aim of determining students' mathematical reasoning abilities after experiencing the learning. The following is table 3.1 indicators and test questions that will be tested.

Table 1. Indicators for Mathematical Reasoning Test Questions

No	Question Indicator	Score
1	a. Arrange known and questionable elements b. Sketch a picture and list the known elements c. Checking the adequacy of elements to solve BRSL-wide problems Deductive reasoning, carrying out calculations based on established rules (formulas).	16
2	a Arrange the elements known and asked about.	10

	b Calculate the BRSL blanket area based on the established rules (formula). c Find calculation patterns based on established patterns and rules. Analogical reasoning, Generalized reasoning.	
3	a. Arrange known and questionable elements b. Sketch a picture and list the known elements c. Checking the adequacy of elements to solve BRSL-wide problems Deductive reasoning, carrying out calculations based on established rules (formulas).	13
4	a. Write down the elements that are known and asked about b. Draw a given situation c. Calculate the water that spills if n objects are added. d. Determine the number of objects added if the volume of water spilled is n (generalization).	13
5	a. Write down the elements that are known and asked about. b. Draw a sketch according to the question and include known elements. c. Determine and check the adequacy of buffer wire supplies. Calculating the application of the length of the curved side of the geometric frame in everyday problems Using proportional reasoning (deductive reasoning) to check the adequacy of the supporting wire supply	12

The non-test instrument is a questionnaire containing an attitude scale. This attitude scale contains student statements regarding mathematics learning, the questions given and learning carried out using the CTL learning model. The attitude scale used is a closed attitude scale, meaning that the answers have been provided and students only need to choose one of the alternative answers provided that best suits their opinion. This attitude scale is given to determine the extent of students' responses after learning using the CTL learning model. The following resilience scale indicators in this research include:

Table 2. Resilience Scale Indicators

Indicators	Many statements
Perseverance, confidence/self-confidence, working hard, not giving up easily in the face of problems, failure and uncertainty	8
Willing to socialize, easily provide help, discuss with peers and adapt to their environment	6
Demonstrates curiosity, reflects on research, utilizes a variety of sources	5
Have language skills, self-control and be aware of their feelings/abilities	4
Using failure experiences to build self-motivation	7

The non-test instrument used in this research is an attitude scale, namely a Likert Scale which asks us as individuals to answer a statement with answers of strongly agree (SA), agree (A), disagree (D) and strongly disagree (SD). . The weight for each statement on the attitude scale created can be transferred from the qualitative scale to the quantitative scale as follows.

Table 3. Criteria for Attitude Assessment

Alternative Solutions	Assessment Weight	
	Positive Statements	Negative Statements
Strongly Agree (SA)	4	1
Agree (A)	3	2
Disagree (D)	2	3
Strongly Disagree (SD)	1	4

After all the data is obtained from the research results in the form of students' mathematical reasoning scores and students' mathematical resilience scores which have been processed into interval scores. Each data from the experimental class and control class was analyzed statistically using the SPSS version 2.0 program. The analysis techniques in this research are as follows:

The increase in students' mathematical reasoning abilities between the experimental class and the control class can be analyzed based on pre-test and post-test data from each class. So the analysis used to answer the problem formulation uses 2 independent sample test analysis (T test or Mann Withney test). First, carry out prerequisite tests such as normality tests. In order to simplify the data analysis process, all statistical tests in this research used the SPSS version 2.0 program.

The normality test was carried out on the pre-test and post-test score data on the mathematical reasoning ability of control class and experimental class students. This test was carried out to determine whether the data was normally distributed or not, using the Shapiro-Wilk test with a significance level of 5%. If the probability value is > 0.05 then the data is normally distributed, whereas if the probability value is < 0.05 then the data is not normally distributed.

The Mann Withney test is a statistical test carried out to determine whether there is a difference in the medians of two independent samples. The Mann Withney test is used if the data does not meet the prerequisite tests. The Mann Withney test hypothesis in this research is as follows:

$$H_0: \mu_1 = \mu_2$$
$$H_1: \mu_1 \neq \mu_2$$

μ_1 and μ_2 respectively are the average of experimental class students' mathematical reasoning ability and the average of control class students' mathematical reasoning ability.

The statistical test used to determine the level of mathematical resilience of students in the control class will be carried out using descriptive analysis to describe and describe the level of mathematical resilience of students in the experimental class. First determine the mathematical resilience category, according to Sriffudin (Kurnia, Royani, Hendiana, et al. 2018), to determine the categorization of the mathematical resilience scale in research it is necessary to look for the lowest and highest values, then look for the ideal mean (M) with the formula × (highest value + lowest value), and find the standard deviation (SD) with the formula × (highest value – lowest value). The mathematical categorization of resilience is presented in the following table:

Table 4. Mathematical Resilience Categories

Mathematical Resilience	Mathematical Resilience Categories
$X \geq (M + 1SD)$	High Resilience
$(M - 1SD) \leq X < (M + 1SD)$	Medium Resilience
$X < (M - 1SD)$	Low Resilience

RESULTS AND DISCUSSION

Results

Improving the mathematical reasoning abilities of junior high school students whose learning uses the CTL model is better than regular learning.

The results of the N-Gain normality test for the experimental class and control class are presented in the following table.

Table 5. Normality Test Results

Clas		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	df	Sig.
N_Gain	experimental class	,154	28	,085	,952	28	,224
	control class	,227	26	,001	,873	26	,004

Based on the results of the normality test, sig. The experimental class is 0.085 and sig. Control class is 0.001. This shows that the data is not normally distributed, so the analysis will continue using the Mann Withney test:

Table 6. Mann Whitney Test Results

	N_Gain
Mann-Whitney U	,000
Wilcoxon W	351,000
Z	-6,316
Asymp. Sig. (2-tailed)	,000

The results of the Mann Withney test obtained the Asymp value. Sig. (2-tailed) is 0.000 < probability value 0.05 so that Ho is rejected and Ha is accepted. This means that improving the mathematical reasoning abilities of junior high school students whose learning uses the CTL model based on AR technology is better than regular learning.

Level of Students' Mathematical Resillience

The analysis used to answer the problem formulation uses descriptive analysis. Based on data processing techniques, the following categories are obtained:

Table 7. Categories of Mathematical Resilience for Middle School Students

Mathematical Resilience	Mathematical Resilience Category
$X \geq 60$	High Resilience
$40 \leq X < 60$	Medium Resilience
$X < 60$	Low Resilience

The results of the descriptive analysis test of the level of mathematical resilience of experimental class students are obtained in the following table:

Table 8. Descriptive Analysis of Mathematical Resilience

Descriptive	Score
N	28
Mean	63,89
Median	65,00
Mode	59
Std. Deviation	7,010
Variance	49,136
Range	31
Minimum	44
Maximum	75
Sum	1789

In Table 8 above, the lowest mathematical resilience score is 44 and the highest score is 75, the middle score is 65, and most students get a score of 59. While the average student mathematical resilience score is 63.89 based on the students' mathematical resilience category in Table 7, it can be seen that The level of mathematical resilience of students in the experimental class is in the high category because it is > 60.

Discussions

Improving the mathematical reasoning abilities of junior high school students whose learning uses the CTL model is better than regular learning.

Apart from the test results which show that the reasoning ability of the experimental class is better than the control class, this result is also proven by the enthusiasm of students in the experimental class being better and more active in asking questions, analyzing and exploring the material provided. This atmosphere is in contrast to the control class which tends to be passive and only listens to the teacher's explanation. This was triggered because all the students were students from an Islamic boarding school so that unusual learning became a special attraction for students because this activity was something new and rarely experienced by students. Therefore, this research is in line with research conducted by (Kurnia, Royani, Hendiana, et al. 2018), in their research the results were obtained that students who studied with the CTL approach experienced an increase in their mathematical reasoning abilities.

The results of the test showed that the use of AR-based CTL can achieve learning completeness, this was triggered because students were directed to reason and discuss and find their own ways to solve questions or problems given through the SAS given during the learning process. Based on the increase in mathematical reasoning abilities and student learning completeness, this proves that the use of AR-based CTL is effective in improving the mathematical reasoning abilities of junior high school students. These results are in line with research conducted by (Syamsuddin and Utami 2021), in their research it was concluded that the use of CTL is effective for application in mathematics learning in junior high schools.

Likewise, in research conducted by Nurhusain et al. (2022), in his research it was found that the CTL approach could improve the mathematical reasoning abilities of class VII students. As for research conducted by (Sitanggang, Tamunan, and Sauduran 2022), the results of the research concluded that the use of CTL can improve students' mathematical reasoning abilities.

The level of mathematical resilience of junior high school students in classes that apply mathematics learning using the CTL model.

The results of the descriptive analysis of mathematical resilience scores show that students' mathematical resilience attitudes are in the high category. These results are in line with research conducted by (Habibah, Fathani, and Nursit 2021b), where in their research the results obtained stated that students have different levels of resilience ranging from low, medium to high, this can be seen from several indicators that were not achieved by students who have low and medium levels of resilience.

These results are in line with the results of research conducted by (Kurnia, Royani, Henriana, et al. 2018) with the results of their research showing that students have varying levels of resilience from low, medium, to high categories. Likewise, the results of research conducted by (Lairani Dwi Alvira, Ahyaningsih, and Minarni 2022) btained the results that the use of CTL can increase students' mathematical resilience.

The high level of resilience possessed by students in this study can occur because students are accustomed to applying several indicators in mathematical resilience into the daily lives of students who are also Islamic boarding school students such as indicators: 1. Showing a desire

to socialize, easily providing assistance, discussing with peers and adapting to the environment. 2. Generating new ideas/ways and finding creative solutions to challenges. 3. Having the ability to control oneself and being aware of one's feelings.

CONCLUSION

There is an increase in junior high school students' mathematical reasoning abilities by using the contextual teaching and learning model. The level of mathematical resilience of junior high school students using the contextual teaching and learning model is in the high category. As for suggestions for future research, they should pay attention to the following points: 1. Availability of tools to support the learning media that will be used such as: smartphones and adequate internet networks. 2. The holograms that will be used should use good printer quality so that they can be recognized by the devices used.

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