Published by
Tadris Matematika
IAIN Syekh Nurjati Cirebon

EduMa: Mathematics Education Learning And Teaching
December 2021, Vol 10 No 2 Page 198 – 205
https://syekhnurjati.ac.id/jurnal/index.php/eduma/index
p-ISSN: 2086-3918, e-ISSN: 2502-5209

EduMa
MATHEMATICS EDUCATION LEARNING AND TEACHING
article link: https://syekhnurjati.ac.id/jurnal/index.php/eduma/eduma/article/view/9087

Effectiveness of Contextual Teaching and Learning on The Ability to Mathematical Relational Understanding in Junior High School

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article info

How to cite this article:

Nurhana, F., & Abdullah, A. A. (2021). Effectiveness of Contextual Teaching and Learning on The Ability to Mathematical Relational Understanding in Junior High School. Eduma : Mathematics Education Learning And Teaching, 10(2), 198 - 205. doi:http://dx.doi.org/10.24235/eduma.v8i2.9087

Article history:

Received: 10 05, 21

Accepted: 12 01, 21

Published: 12, 21

abstract

The low ability of students' mathematical relational understanding is caused by the lack of student activity in learning and the lack of students' understanding of concepts and implementing concepts in real life. This study aims to determine the contextual teaching and learning model's effectiveness on students' relational understanding abilities on the prism and pyramid concept. This type of research uses a quasi-experimental research design with a non-equivalent control group design and sampling using the purposive sampling technique. The instrument used to determine the ability of relational understanding in the form of a description test is 9 questions that have been tested for feasibility. Based on statistical calculations, the experimental class average is 70.103 and the control class average is 63.25. After calculating the average difference test against the data, it is obtained t_{count} =1.793 and t_{table}=1.66. It can be concluded that the average mathematical relational understanding ability of students taught using the CTL learning model is better than that of conventional learning. Thus, it can be concluded that the Contextual Teaching and Learning (CTL) learning model is effective on students' mathematical relational understanding abilities.

Keywords:
Contextual Teaching and Learning, relational understanding ability, mathematics learning

INTRODUCTION

Understanding is the ability of students to master, absorb, and apply the material in the learning. Someone who understands mathematics can use it in everyday life or in math problems themselves. Two types of understanding, namely instrumental understanding and relational understanding (John A, V. de W., Jennifer M, B.-W., Jonathan W & S, 2013; Skemp, 1978). Instrumental understanding is an understanding of separate concepts and the ability of students who only memorize formulas. At the same time, Relational understanding is the ability to deduce specific rules or procedures from more general mathematical relationship, and formal understanding is the ability to connect mathematical symbolism and notation with relevant mathematical ideas and to combine these ideas into chains of logical reasoning(Minarni et al., 2016). There are benefits of relational understanding in learning mathematics (Utomo, 2019), namely: (1). Provide opportunities for students to solve more complex problems (2) easy to remember and understand mathematical concepts (3) easy to achieve learning objectives (4) create original ideas.

Students' low ability to understand mathematics causes a lack of relational understanding, so this ability is still relatively low; most students only memorize concepts and apply examples of questions given by the teacher (Malinda & Sylviana Zanthy, 2017). Students can develop ideas to solve problems in mathematics, so this understanding must be owned by students (Utomo & Huda, 2020). The importance of relational understanding is as follows: (1) Easy to adapt to new problems. (2) Easy to remember. (3) Relational Understanding is more effective as a goal. (4) Relational schemes are central to the quality of knowledge (Riyani et al., 2017).

Mathematical relational understanding is the ability of students to solve mathematical problems using specific procedures from the results of combining concepts and explaining why using these procedures (Sariningsih, 2014). The indicators of relational understanding are: (1) the ability to apply concepts in various forms of mathematical representation (2) the ability to clarify objects based on whether or not the requirements that form a concept are met (3) the ability to relate various mathematical concepts (Skemp, 1978). in another reference it is stated that the indicators of relational understanding are: (1) students can anticipate the results of the implementation of the procedure without having to do so and they can anticipate relationships expected results with results from other procedures; (2) students can identify when it is best to use procedure; (3) students can carry out all procedures or selected step in the procedure; (4) students understand the reasons why a procedure works Overall, students know the motivation or reason for key steps in the procedure; (5) students can symbolically or graphically verify truth or the reasonableness of the results recognized in the procedure without repeating procedure; (6) students can make connections within and within all representations: symbolic, graphic, and numerical (Anwar et al., 2016; Glass & Kim, 2011). Relational understanding is able to develop four things, including: (1) developing a correct understanding of mathematical concepts; (2) train students to usually see the problem as a whole; (3) develop skills in using mathematical principles and concepts; (4) develop inductive abilities (Napaphun, 2012). The low ability of relational understanding is also caused by the learning model used by teachers in ongoing learning, namely conventional, where learning is teacher-centered and there are few opportunities for teachers to carry out innovative learning.

Such a situation is not conducive to the learning process of mathematics. This situation implies that the selection of learning models is very important to grow the ability to understand mathematics (Novitasari, 2016; Santoso, 2017; Wulandari & Rakhmawati, 2019). Wilson revealed that the mathematical understanding ability of students in Indonesia is in a low category. This is based on the report on the evaluation results of TIMSS (The Trends of Mathematical and Science Studies) in 1999, 2003, and 2007 (Fajriah & Suji Santoso, 2014). The results of an interview with one of the teachers in the field of mathematics in class VIII of SMP N 2 Prambanan also revealed that students' mathematical understanding was still low, so student learning outcomes decreased.

The Contextual Teaching and Learning (CTL) learning model is a learning process in which students experience and apply the material being taught related to real problems, thus making learning meaningful and fun (Nurdyansyah & Fahyuni, 2016; Shanti et al., 2018). Contextual learning is one alternative learning that can reduce verbalism and theoretical. In addition, this learning can improve understanding comprehensively through connecting the meaning or intent of the knowledge students learn with direct experience in real life (Kadir, 2013). There are eight main components in CTL learning, according to Johnson (Cholifah et al., 2021) including (1) Independent Learning, (2) Making meaningful connections, (3) Doing meaningful work, (4) Working together. The CTL learning model motivates students to connect the knowledge gained and its application in their lives as family members, as citizens, and later in the workforce. Students find meaning in learning activities, try to achieve learning goals, and build on the knowledge they already have(Shanti et al., 2018). In contextual learning, students can find material according to their own experiences to form students' relational understanding abilities (Razi, 2018; Sariningsih, 2014). CTL is characterized by seven main principles, namely 1) Constructivism, namely the process of building new knowledge based on experience. 2) Inquiry, namely the learning process based on search and discovery through a systematic thinking process; 3) Questioning, namely the process where the teacher explores student information through questions; 4) Learning Community, namely by developing a learning community through group learning; 5) Modeling, namely the learning process as an example to show something that can be imitated by every student; 6) Reflection is a process in which students deposit what they have just learned as a new knowledge structure which is an enrichment or revision of previous knowledge; and 7) Authentic Assessment, namely the process by the teacher to collect information about student learning progress (Nurdyansyah & Fahyuni, 2016). In this study, it is stated that the relationship between the CTL learning model that is applied in learning is able to improve students' mathematical relational understanding abilities.

METHODS

This study uses a Quasi-Experiment type (quasi-experimental) with a quantitative approach. This study used two groups, namely the experimental and control groups, to determine the level of students' relational understanding skills using the Contextual Teaching and Learning model before and after treatment. The design used in this study was non-equivalent control group design. The population in this study were all students of class VIII SMP N 2 Prambanan, Yogyakarta, Indonesia which consisted of four classes, namely class VIII A, VIII B, VIII C, and VIII D with a total of 115 students. While the sample of this research is class VIII A as control class and class VIII B as experimental class with a total of 57 students who have heterogeneous abilities, which were selected by purposive sampling technique. This study uses the conventional learning class as the control group and the treatment class using the CTL model as the experimental group. In simple terms, the design of this study is described as follows:

Table 1. The design of this study

Class	Prettest	Treatment	Posttest
Experiment Class	O_1	X	O_2
Control Class	O_3	Y	O_4

Note:

O1 : Prettest experimental group

O2 : Posttest experimental group

O3 : Prettest Control group

O4 : Posttest Control group

X : Treatment using the CTL learning model

Y : Treatment using conventional learning model

To determine the effectiveness of the CTL learning model on the ability to understand mathematical relational using the test. right-hand t-test.

RESULT AND DISCUSSION

After doing the research, the pretest and post-test results of students' mathematical relational understanding abilities in the experimental and control classes can be seen in table 1. The following;

Table 2. Pretest and Post Test Result Data of students' mathematical relational understanding ability

Descriptive statistics	Control Class		Experiment Class	
	pretest	posttest	pretest	posttest
min	83	83	83	92
max	36	36	36	39
means	54,928	63,25	55,931	70,103
Standard Deviation	12,216	14,064	13,794	14,755

Table 1. above shows the average value (mean) of the pretest in the experimental class 55.931 and the control class 54.928, while the post-test average value of the experimental class is 70.103 and the control class is 63.25. The results showed that both classes experienced an increase after being given treatment. The increase in the score of the experimental class after the implementation of the Contextual Teaching and Learning learning model was 14.17 and the increase in the score of the control class was 8.32 so it could be interpreted that the result of increasing the score of the experimental class was higher than the control class. The data distribution shows that the control class has increased by 1.848, while the experimental class has increased by 0.961. In other words, the control class experienced a higher increase in data distribution than the experimental class, although the standard deviation value of the experimental class was higher than the control class.

Then, the normality and homogeneity tests were carried out for the pretest and post-test data in both classes (experimental and control classes). The pretest and post-test normality tests in both classes with a significance level of 5% showed that both were normally distributed.

Table 4. Normality Test Results from pretest and post-test

Description	X^2count	X^2table	conclusion
Prettest Control Class	4,3345	11,07048	normal
Prettest Experimen Class	4,5699	11,07048	normal
Posttest Control Class	5,4825	11,07048	normal
Posttest Experimen Class	6,795	11,07048	normal

The results of the pretest and post-test homogeneity tests in both classes with a significance level of 5% showed that both were homogeneous.

Table 5. Homogeneity Test Results from pretest and post-test

Class	Fcount	F table	conclusion
Prettest	1,27	1,88	homogen
Posttest	1,1006	1,88	homogen

Furthermore, a t-test was conducted to determine the contextual teaching and learning model's effectiveness on the ability to understand the mathematical relational understanding of class VIII students. With the following hypothesis;

$H_0: \mu_1 \leq \mu_2$: (The average post-test score of students taught using the CTL learning model is less than the same as the post-test score of students taught using conventional models).
$H_1: \mu_1 > \mu_2$ (The average post-test score of students taught using the CTL model is better than that of students taught using conventional models).
Keterangan:
μ_1= Experimental class average
μ_2 = Control class average
The summary of the calculation results of the post-test t-test is presented in the following table:

Table 6. T Test Results posttest

Experimental class average	Control class average	Tcount	T table	conclusion
70,103	63,25	1,79373	1,67	H1 accepted

The summary of the results of the post-test t-test calculation, show that t_count is greater than t_table (1.793>1.6), thus the average post-test score of experimental class is better than the score of control class. Based on the results of the calculation of the data, it can be concluded that the Contextual Teaching and Learning (CTL) learning model is effective in improving the mathematical relational understanding. It can also be seen from the difference in the average post-test score which includes the mathematical relational understanding of the experimental class is 70.103 and the average post-test score for the control class is 63.25.

The high increase in relational understanding ability is influenced by different treatments for the experimental class and the control class. In the experimental class, the treatment of Contextual Teaching and Learning (CTL) learning model is given where students are actively involved in understanding, discovering, and relating material in real life.

Activities in CTL learning that include relational understanding, namely (1) The Connecting stage, In this stage the students relate one concept to another, this is in accordance with the indicator of relational understanding ability, namely the ability to link mathematical concepts. (2) Implementation Stage: students can implement the material they have learned into real life, this stage is in accordance with the indicators of relational understanding, namely the ability to apply concepts in the form of mathematical representations where students can solve problems related to real objects. (3) In the discovery stage, students can find the material that has been studied, It is in accordance with the indicators of relational understanding where the ability to clarify objects is based on whether or not the requirements that form the concept are me. In addition, the application of the approach Contextual can improve ability understanding, because by definition contextual approach is an approach linking learning concepts with students' real life, This is lead to the teaching of mathematics abstract can become concrete, so that students' understanding increases (A.I.Sugandi dan Benard, 2018; Herni Indriastuti & Nani Ratnaningsih, 2019). In contrast to the contextual learning process, the control class with conventional learning models emphasizes teacher dominance in learning so that one-way communication. students feel bored quickly for learn the learning material because in learning it emphasizes more on the lecture method so that the class atmosphere does not increase student activity.

Contextual learning model emphasizes that students make knowledge based on their own experience, this will make it easier for students to understand the material being studied so that learning is more meaningful. This learning process is in accordance with constructivism learning theory which explains that without experience a person cannot form his own knowledge (Abdullah et al., 2019). In addition, the CTL learning model can help improve student learning outcomes because this model focuses more on understanding and emphasizes the experience and development of students' interests in everyday life (Abdullah & Richardo, 2017; Hasibuan, 2014). The Contextual Teaching and Learning (CTL) learning model positively influences students' ability to understand mathematical concepts so that the understanding of concepts applied using the CTL model is better than conventional learning (Brinus et al., 2019).

CONCLUSION

Based on the results of data analysis related to the effectiveness of the Contextual Teaching and Learning (CTL) learning model on the ability to understand mathematical relational understanding of class VIII SMP N 2 Prambanan, it can be concluded that the average value of the experimental class using the CTL model is better than the average post-test value of the control class using conventional learning model. It can be concluded that the Contextual Teaching and Learning (CTL) learning model is effective in improving the ability to understand the mathematical relational understanding of class VIII students of SMP N 2 Prambanan.

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