Original Research Article

Analysis of Students' Mathematical Reasoning Capabilities with the Constructivism Approach Through the Mobile Learning System

ABSTRACT

Aims: To analyze the mathematical reasoning ability of mathematics education students.
Study design: Qualitative research with a descriptive approach.
Place and Duration of Study: The population of all students of mathematics education 3rd semester of Bung Hatta University who took geometry courses totaling 25 students.
Methodology: This research is a qualitative research with a descriptive approach. Researchers directly measure the mathematical reasoning ability of students in mathematics education study programs. Judging from the research subjects, the population of all students of mathematics education 3rd semester of Bung Hatta University who took geometry courses totaling 25 students.
Results: From the analysis results obtained mathematical reasoning ability achievement for indicators of student ability in presenting mathematical statements verbally, in writing, pictures, and diagrams shown by problem number 1 is 74% (Good Category). Indicators of the ability to do mathematical manipulation shown in questions number 2, and 5 are 41% (Fair Category), and 42% (Fair Category). And indicators of student ability to conclude, compile evidence, provide comments, or evidence of some of the solutions shown by questions number 3 and 4 are 67% (Good Category) and 58% (Fair Category).
Conclusion: The conclusion of this research is to be able to find out the category of mathematical reasoning of the 3rd semester students of the Bung Hatta University Mathematics Education Study Program.

Keywords: Analysis, mathematical reasoning ability, constructivism approach

1. INTRODUCTION

The purpose of learning mathematics one of them is to practice the ability to reason and think students in concluding, and be able to express their opinions with confidence to solve the problems at hand. Principles and Standards for School Mathematics 2000 revealed that there are five process skills that students need to have through mathematics learning, namely: (1) problem solving; (2) reasoning and proof; (3) communication; (4) connections; and (5) representation [1]. These process skills include high-level mathematical thinking that must be developed in the process of learning mathematics. Based on its type, mathematical thinking is classified into five main competencies namely mathematical understanding, problem-solving, mathematical reasoning, mathematical connections, and mathematical communication. The ability measured in this study is the mathematical reasoning ability of students. Mathematical reasoning abilities are needed early through classroom learning so that students can solve problems and apply mathematical concepts. Although mathematical reasoning is an ability that must be possessed by students, in reality, the field still exists learning that causes low mathematics learning achievement [2]. The ability of students to connect between mathematical concepts and objects, can result in the ability of students' reasoning towards concepts to be broader and deeper. This was also confirmed in the National Council of Teachers of Mathematics NCTM, which states that if students can connect mathematical ideas, then their reasoning will be deeper and more durable [1].

The importance of reasoning ability in mathematics learning was stated by Mullis, et al., which

states that learning that emphasizes more on reasoning and problem-solving activities is very closely related to high student achievement [3]. According to Rainer and Matthews students who have progressed in learning are students who have high levels of communication skills and reasoning abilities [4].

The term mathematical reasoning or commonly known as mathematical reasoning in some literature is called mathematical reasoning. Brodie states that, " Mathematical reasoning is reasoning about and with the object of mathematics" [5]. The statement can be interpreted that mathematical reasoning is reasoning about mathematical objects.

Turmudi says that the ability of mathematical reasoning is a brain habit as well as other habits that must be developed consistently using a variety of contexts, knowing reasoning and proof are fundamental aspects in mathematics [6]. With mathematical reasoning, students can submit allegations and then compile evidence and manipulate mathematical problems and draw conclusions correctly and correctly.

Indicators of reasoning include: drawing logical conclusions, giving explanations using models, facts, properties, and relationships, estimating answers and process solutions, using patterns and relationships to analyze mathematical situations, drawing analogies, and generalizing, constructing and testing conjectures, giving opponents example (counterexamples), follow the rules of inference, check the validity of the argument, make the argument valid, and to develop direct evidence, indirect and using mathematical induction [7].

According to Suharman, someone who can reason means to have abilities that include:

a. Unique ability to see problems or situations and how to solve them.

b. Having a good ability in solving problems.

c. Have the ability to think logically.

d. Being able to distinguish properly between responses or incorrect answers correctly.

e. Able to apply knowledge to specific problems.

f. Able to put existing information and theories into a new perspective.

g. Able to store large amounts of information in his memory.

h. Able to recognize and understand the differences and similarities between various things. [8]

In the process, logical reasoning is an activity to dig up information and translate it to conclude a solution. Along with this, Galotti explains that logical reasoning is an attempt to transform the information provided to obtain a conclusion [9]. In other words, logical reasoning is reasoning following the rules of logic. Logical thinking and reasoning is very necessary in every aspect of daily life, because logical reasoning is a supporter of the success of an action, especially in making decisions. This is certainly very much needed by everyone in carrying out their lives. Therefore the study of reasoning ability should get more attention at every level of education, especially in Higher Education. Because in Higher Education are students who are adult human beings who already can reason logically. Given the learning patterns that require students to think and act independently.

Based on the results of observations and interviews conducted, information was obtained that the lecture process was not optimal enough, students still had difficulty in completing math problems given. Students also still have difficulty in connecting between objects and concepts in determining what formula will be used if faced with questions related to proof. This shows that there are still many Mathematics Education students who have low reasoning abilities.

Based on these descriptions, this research is very important to obtain data as a consideration in the development of mathematics learning. This data will describe the extent of the reasoning ability of mathematics education students after learning.

2. METHODOLOGY

This research is a qualitative research with a descriptive approach. Researchers directly measure the mathematical reasoning ability of students in mathematics education study programs. Judging from the research subjects, the population of all students of mathematics education 3rd semester of Bung Hatta University who took geometry courses totaling 25 students.

Mathematical reasoning indicators (Table 1.) adopted by Dirjen Dikdasmen No. 506 / C / PP / 2004 (Sadiq, 2014: 51).

1. Present mathematical statements verbally, in writing, drawings, and diagrams,
2. Submitting a conjecture (conjecture),
3. Doing mathematical manipulation,
4. Draw conclusions, compile evidence, provide reasons, or evidence for some solutions,
5. Conclude from statements,
6. Checking the validity of an argument,
7. Finding patterns or properties of mathematical symptoms to make generalizations.

In this case, the researcher took four of the seven indicators above.

Table 1. Distribution Of Question On Mathematical Reasoning Indicators

Mathematical Reasoning Capability Indicator	Aspects observed	Question Number
Present mathematical statements verbally, in writing, drawings, and diagrams	Students can determine what is known in the problem through the given drawing space.	1
Doing mathematical manipulation	a. Students can determine manipulations that are used to solve problems related to the volume of building space.	2
	b. Students can determine the manipulations that are used to solve problems related to the area of the building.	5
Draw conclusions, compile evidence, provide comments, or proof of some solutions	a. Students can determine the right solution to draw conclusions related to the area of the building area.	3
	b. Students can determine the right solution to draw conclusions related to the volume of building space.	4

3. RESULTS AND DISCUSSION

Before analyzing mathematical reasoning abilities, students first follow learning with a constructivist approach using a mobile learning system. The researcher acts as a teacher in this learning. After completing learning with the constructivist approach using a mobile learning system for 4 meetings, students are given a test of mathematical reasoning ability. Indicators of mathematical reasoning measured in this study are: 1) Present mathematical

statements verbally, in writing, drawings, and diagrams; 2) Doing mathematical manipulation ; 3) Draw conclusions, compile evidence, provide comments, or proof of some solutions.

Table 2 Percentage Of Students' Mathematical Reasoning Ability Achievement

Question Number	Many get scores-					Average score	% Achievement	Category
	4	3	2	1	0			
1	8	10	5	2	0	2,96	74	Good
2	0	6	9	5	5	1,64	41	Enough
3	7	9	5	2	2	2,58	67	Good
4	4	8	8	2	3	2,32	58	Enough
5	2	5	6	7	5	1,68	42	Enough

The results of data analysis contained in table 2 show that indicator 1 is the ability of students to present mathematical statements verbally, in writing, pictures, and diagrams shown in question number 1 with an achievement level of 74%, this means that students are good at achieving the first indicator. Although overall students can work on question number one, but there are still mistakes made by some students that there are still some who describe the picture to make a known part of the problem.

The second indicator of the ability to do mathematical manipulation, has 2 aspects that are observed as indicated by question number 2 and number 5. In question number 2 it reaches a level of 41 % meaning that the level of student achievement in working on problem number 2 is in the sufficient category. Whereas in question number 5 the level of achievement was 42 % in the sufficient category. On this indicator, the students have not been able to determine the manipulation used to solve problems associated with the area, and the volume of the room woke up.

While the students' ability to conclude, compile evidence, providing reviews, or evidence against some of the solutions shown by Question 3 by 67% in both categories and Question 4 by 58 % with the category enough. This means that there are still many students who have not been able to provide the right solution of a problem related to the area and volume of building space, so students are also less precise in concluding the solutions they find.

4. CONCLUSION

The achievement of mathematical reasoning ability indicators for students' ability to present mathematical statements verbally, in writing, pictures, and diagrams shown by question number 1 is 74%. Indicators of the ability to do mathematical manipulation shown in questions number 2, and 5 are 41 % and 42 %. And indicators of students' ability to conclude, compile evidence, provide comments, or evidence of some of the solutions shown by questions number 3 and 4 are 67 % and 58 %.

5. REFERENCES

[1] National Council of Teachers of Mathematics (2000). Principles and standards for school mathematics. Reston, VA: National Council of Teachers of Mathematics.

[2] Wahyuni, Ika. & Karimah, Nurul Ikhsan. 2017. Analysis of Mathematical Understanding and Reasoning Ability of Level IV Students on Complex Number System Material in Complex Analysis Courses. National Journal of Mathematics Education. 1 (2): 228-240.

[3] Mullis, et. Al. 2000. TIMSS 1999 : International Mathematics Report. Boston : The International Study Center, Boston College, Lynch School of Education.

[4] Rainer, MW & Matthews, CD (2001). The quandaries of teachers and teacher educators in integrating literacy and mathematics. Language Arts, 78 (4), 357-364.

[5] Brodie, Karin. 2010. Teaching Mathematical Reasoning in Secondary School Classroom. Newyork: Springer.

[6] Turmudi. 2008. Foundations of Philosophy and Mathematical Learning Theory Students in Lessons Mathematics. Doctoral dissertation on PPS IKIP Bandung: No published.

[7] Tria Muharom. 2014. The Effect of Learning with the Cooperative Model Type Student Teams Achievement Division (STAD) Against the Mathematical Reasoning and Communication Capabilities of Students at State Vocational High School in Manonjaya, Tasikmalaya Regency. Journal of Education and Teacher Training, 1 (1): Article 1.

[8] Suharman. 2005. Cognitive Psychology. Surabaya: Heroine.

[9] Jacobs, E. & Roodt, G. 2007. The Development Of a Knowledge Sharing Construct To Predict Turnover Intentions. ASLIB Proceedings. 59 (3) : 229-248.

[10] Sadiq, Fadjar. 2014. Learning Mathematics: How To Improve Student Thinking Ability. Yogyakarta: Graha Ilmu.