The students’ mathematical concept understanding ability through cooperative learning type jigsaw assisted visual media

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Abstract. The purpose of this research is to compare the students mathematical concept understanding ability taught using jigsaw assisted by visual media and conventional learning. It used quantitative with experimental approach as the research method. The populations of the research were the students of Class VIII SMP Negeri 2 Ciniru, academic year 2016/2017, which were consisting of four classes, Class VIII A, VIII B, VIII C and VIII D. The sample taken purposive. The analysis data used normality test, homogeneity test and t-test. The obtained result was the mathematical concept understanding of the students taught by cooperative learning Jigsaw assisted visual media was better than those taught by conventional learning.

1. Introduction
The learning process of mathematics has progressed worldwide from memorizing sets of recognized facts, skills, and algorithms to directing on children’s active construction of meaning and mathematics as sense-making and meaningful learning [1]. Activity that a balance and connection between conceptual understanding and computational skill required for students to develop fluency in mathematics [2]. So, in the learning process of mathematics students must have the understanding of the material concept, because concept is the basis for higher mental processes to formulate the generalization principle.

Concept understanding in learning process of mathematics namely mathematical concept understanding ability, it is a very important and must-have ability of students. Mathematical understanding as involving the building up of the conceptual ‘context’ or ‘structure’ mentioned above [3]. The construction theory, notation, contrast and variation, and connectivity states that learning mathematics is to learn about the concepts and structures of mathematics contained in the materials studied and to search for relationships between the concepts and the structures [4].

Through conceptual understanding, students can comprehend comprehensively and more easily remember the material. Understanding concepts is the ability to understand something, transforming information into meaningful forms. Understanding the concept is the competence shown by the students in performing the procedure (algorithm) in a flexible, correct, efficient and precise. In the process of learning the role of teachers as facilitator and motivators are very important. Teachers must have a strategy so that students can learn effectively and efficiently by the expected goals. One of the efforts that must be done by the teacher is to apply the proper learning model and by the materials or concepts that taught.
One of the learning models that suit the needs of the students is jigsaw type cooperative learning. Cooperative learning can help allow each student more responsible in learning. Through cooperative learning model, we can develop students' ability to test their own ideas and understanding. Jigsaw designed to increase students' learning responsibilities on their self and others as well. Students not only learn the material provided, but they must also be ready to share and explain it to other groups [5]. The jigsaw technique is manifested when each student takes responsibility for learning their groups, the students divided into two groups as the origin group and the expert group [6].

The process of learning mathematics requires the media in the process of learning in the classroom. The use of instructional media in the classroom can help students understand the information conveyed by the teacher. One of the media used is visual media presented through power point. This medium used to ease the understanding of the concept of flat side 3D geometry. Visual media make learning math more interesting and fun. There are several visual learning theories one of the theory of image perception, which in essence considers that the teaching information contained in the picture can help students understand the material [7].

2. Experimental Method
This research used the quantitative with experimental approach. The research design used was pretest-posttest control and experimental group design [8]. This study involves two groups, namely the experimental group and the control group. The experimental group was used cooperative learning model type jigsaw assisted visual media, while the control group was used conventional learning.

The populations of the research were the students of Class VIII SMP Negeri 2 Ciniru, academic year 2016/2017 which were consisting of four classes, Class VIII A, VIII B, VIII C and VIII D. The samples were taken purposively, class VIII C and VIII D represent as sampling.

The quantitative data instrument used in this research is a test of mathematical concept understanding ability that is according to Badan Standar Nasional Pendidikan (BSNP), is a National Education Standards Agency in Indonesia, indicators of mathematical concept understanding ability: 1) Redefining a concept; 2) Classifying objects according to certain characteristics; 3) Give examples and non-examples of concepts; 4) Present the concept in various forms of mathematical representation; 5) constructs enough requirements or enough conceptual requirements.; 6) use, utilize and select certain steps or operations; 7) Applying the concept or problem-solving algorithm [9]. The analysis data used normality test, homogeneity test and t-test.

3. Result and Discussion
3.1 Result
This research is collect pre-test and post-test scores of mathematical concept understanding ability. Pre-test score analysis purpose to know the mathematical concept understanding ability in two classes before treated. Post-test scores analysis purpose to know the mathematical concept understanding ability in two classes after treated.

| Mathematical concept understanding | Sig. Test for normality | Sig. homogeneity test | Mean | Sig. 2-tailed Test Difference of Two Mean |
|-----------------------------------|-------------------------|-----------------------|------|------------------------------------------|
| Experiment class                  | 0.199                   | 0.450                 | 33.92| 0.910                                    |
| Control class                     | 0.071                   |                       | 33.56|                                          |

Based on table 1, the result of the data normality test pre-test scores of the students’ mathematical concept understanding ability had shown that both probability score more than 0.05. It can concluded that the sample in both groups is normally distributed. For the variance homogeneity test is show that data were homogeneous. The result of significanation test of pre-test using the t-test is show probability
score (sig.) is less than $\alpha = 0.05$, it can concluded that there are not difference between the mathematical concept understanding ability students in both group samples before the treated.

Table 2. The results of statistical of posttest scores mathematical concept understanding.

| Mathematical concept understanding | Sig. Test for normality | Sig. homogeneity test | Mean | Sig. 2-tailed Test Difference of Two Mean |
|-----------------------------------|-------------------------|-----------------------|------|------------------------------------------|
| Experiment class                  | 0.419                   | 0.244                 | 87.48| 0.002                                    |
| Control class                     | 0.184                   |                       | 80.00|                                          |

Based on table 2, the result of the data normality test post-test scores of the students’ mathematical concept understanding ability had shown that both probability score more than 0.05. It can concluded that the sample in both groups is normally distributed. For the variance homogeneity test is show that data were homogeneous. The result of signification test of pre-test using the t-test is show probability score (sig.) is

$$0.002 < 0.025 \left( \frac{\alpha}{2} \right),$$

it can concluded that the mathematical concept understanding of the students taught by cooperative learning Jigsaw assisted visual media was better than those taught by conventional learning.

The learning process of 3D Geometry Flat Sides by cooperative learning Jigsaw type assisted visual media and by conventional learning, we can see in the figure 1 and figure 2.

**Figure 1.** Learning activity in cooperative learning jigsaw type assisted visual media.

**Figure 2.** Learning activity in conventional class.

Figure 1 is student’s activities in the classroom using cooperative learning model type jigsaw. Based on the observation we can see that by using cooperative learning model type jigsaw can make students active by doing various activities to master the subject completely. In learning process students explain the material to other students, listen to explain friends actively, give question and answer between students and teachers, discuss with other students, responds to questions and arguments.

In addition, at the learning process also use the visual media as a tool to provide materials “3D Geometry flat side”. The visual media is very helpful for students to classify objects according to certain traits (by the concept) and make it easier for students to give examples of the concept of 3D Geometry flat side. The more active students in learning then the students' understanding are increasing. Jamidar [10] stated that implement cooperative learning model jigsaw can foster students' interest to learn mathematics.

Figure 2 is a student's learning activities in the conventional class the student is just sitting and listening to the teacher explaining. Students are less active, still embarrassed to ask, students' courage to express opinions is still lacking. The students just listen and record what is delivered by the teacher, so that less efficient learning process. Hamzah and Muhlisarini [11] stated that the lecture method is less efficient because it contradicts the teaching method which should invite learners actively in their interaction with the teacher.
3.2 Discussion

Based on the analysis of post-test data, it can be seen that the average score of mathematical concepts understanding ability of students in experimental class learning using cooperative learning model type jigsaw assisted visual media is higher than the control class whose using conventional learning. It is because in cooperative learning type Jigsaw assisted visual media provides opportunity for students to cooperate, to exchange ideas with each other and help each other in completing the task given by the teacher.

From the cooperation built by fellow students, the tasks can discussed and finished, so that student ability to understand the concept learning materials is better. Students are able to put their ideas well, it will be easier to communicate the materials that become expert to the group of origin and can solve the problem in a systematic order. Maode [12] stated that jigsaw learning is design to increase students responsible themselves and others in learning, students not only learn the material provided but also the students must ready to share and explain the material to other students.

Based on the percentage of achievement of concept understanding indicators in the experimental class and control class after being given treatment, post-test result is different on both groups sample.

Figure 3. Student’s answer experimental class.  
Figure 4. Student's answer control class.

Question number 2 is a problem of indicator 1 that is Redefining a concept. The student in the experimental class, can answer the question correctly and solve the problem with the right steps, the student can redefine the cube volume formula and calculate the volume. The student in control class can answer the question correctly, but the student just write the cube volume formula without redefine the cube volume.

The average percentage of experimental class is 60.4%, higher than the control class whose average percentage was 52.4%. This is due to the effect of cooperative learning model of jigsaw type when discussion with the student's origin group, student mention the formulas volume of 3D geometry flat side.

Figure 5. Student’s answer experimental class.

Figure 6. Student's answer control class.

Question number 1 is a problem of indicator 2, that classifying objects agree certain characteristics. The students in experimental class, can classify the object / image, then explain exactly why the image is a beam. The student in the control class, answer incorrect because the student can’t classify the object / image a beam.

The average percentage of achievement of experimental class is 73.6%, higher than the control class whose average percentage was 61.2%. This is due to the effect of cooperative learning model of
jigsaw type, the student discussion group of students can differentiate the shape and the elements of the 3D geometry flat side.

Figure 7. Student’s answer experimental class.

Figure 8. Student’s answer control class.

Question number 7 is a problem of indicator 3, that is give examples and non-examples of concepts. The students in the experimental class can answer the problem by showed the images that are the nets, rather than the nets of the 3D Geometry flat side, explaining what nets type 3D Geometry flat side. The students in the control class just write the numbers which are the nets of 3D Geometry flat side. He can’t show any number of figures which are not the nets of 3D Geometry flat side.

The average percentage of experimental class was 69.6%, higher than the control class whose average percentage was 61.2%. This is due to the effect of cooperative learning model of jigsaw type when students discussing with the group of expert, they can distinguish which is the net of 3D Geometry flat side and which is not a net of 3D Geometry flat side.

Figure 9. Student’s answer experimental class.

Figure 10. Student's answer control class.

Question number 3 is a problem of indicator 4, that is presents the concept in the various forms of mathematical representation. The students in experimental class can answer the problem with the right steps and answer the question correctly, student can presents the volume formula is $\frac{2}{5} \times (p \times l \times t)$.

The students in control class did not present the volume formula.

The average percentage of experimental class was 64%, higher than the control class whose average percentage was 59.2%. This is due to the effect of cooperative learning model of jigsaw type, when the students discuss with the students' group of origin, students presented the concept in the various forms of mathematical representation the volume of 3D Geometry flat side to other students in the group of origin.

Figure 11. Student’s answer experimental class.

Figure 12. Student's answer control class.
Question number 4 is a problem of indicator 5, that is constructs enough requirements or enough conceptual requirements. The students in the experimental class can answer the question correctly and answer the question with the right steps. The students in the control class can’t answer the question correctly and can’t answer the question with the right steps.

The average percentage of experiment class achievement was 74%, higher than the control class whose average percentage was 69.2%. This is due to the effect of cooperative learning model of jigsaw type when discussing with expert group or with origin group, student can answer the problem and re-solve the problem related to the volume and surface area of 3D Geometry flat side.

![Figure 13. Student’s answer experimental class.](image1)

![Figure 14. Student's answer control class.](image2)

Question number 5 is a problem of indicator 6 that is use, utilize and select certain steps or operations. The student in the experimental class, can answer the question with the right steps and the answer is correctly. The student in the control class can’t answer the question with the right steps and the answer is incorrectly.

But the average percentage of indicator 6 of student in experiment class and control class are equal, that is 67.6%. This is because during the learning process both in the experimental class and control class when students are given the problem by the indicator 6 of the many student there who can solve the problem and there are still confused solve the problem.

![Figure 15. Student’s answer experimental class.](image3)

![Figure 16. Student's answer control class.](image4)

Question number 6 is a problem of indicator 7 that is Applying the concept or problem-solving algorithm. The student in experimental class can answer the question correctly with the right steps. The student answer from the control class, the student can answer the question correctly, but students do not explain the problem solving steps.

The average percentage of experiment class achievement was 42.8%, higher than the control class whose average percentage was 40.4%. This is due to the effect of cooperative learning model of jigsaw type, during discussion the students are given problem-solving tasks, and explain to the group's friends.

4. Conclusion
Based on the result and discussion, we can concluded that the mathematical concept understanding ability of students taught by cooperative learning type Jigsaw assisted visual media was better than those taught by conventional learning.

Acknowledgments
Thus the Authors can convey about the result of research enclosed in this article. On the occurrence the authors would like to express the appreciation and gratitude to BUDI-ND and LPDP as sponsors
and all the parties that have big impact to the success and accomplishment of this research. The author realizes that this article is far from perfect, therefore constructive criticism and suggestions are desirable for perfect this article. Hopefully this research will be valuable for the reader.

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