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Differences Ability of Visual Thinking Representation Mathematic and Student Learning Independence Between Student Who are Given an Open Ended Approach and Jigsaw Type Cooperative Model MTS Lab UIN SU Medan

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Abstract

The purpose of this research is (1) To know the difference of visual thinking ability between students who are given open-ended learning with students who are given cooperative learning jigsaw type (2) To know the difference of learning independence between students who are given open-ended learning with students who are given Jigsaw type cooperative learning. This type of research is quasi experiment. The population of this research is all students of class VII of MTsS Laboratory of UIN SU Medan. The sample of this research is, Class VII-1 (37 students) taught by Jigsaw Cooperative type and VII-2 class (37 students) taught with Open Ended Approach. The instrument used consisted of the test of visual thinking representation ability and student self study independence questionnaire. Analysis performed using ANAVA.

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The results showed that: (1) There is a significant influence on visual thinking ability of students were taught by given open-ended learning with students who are given cooperative learning jigsaw type. (2) There is a significant influence of student were taught learning independence between students who are given open-ended learning with students who are given Jigsaw type cooperative learning.

Keywords: Open-Ended Approach; Jigsaw Type Cooperative Model; Ability of Visual Thinking Representation; Student Learning Independence.

1. Introduction

One of the lessons that should be in every level of education is math. Both from kindergarten, elementary, junior high school, even college even though studying mathematics. That's because mathematics can train high-level thinking and practice problem-solving skills. However, because Mathematics is a science that has a tendency of deductive, axiomatic and abstract (facts, concepts and principles), then this is what causes mathematics to be a lesson that is considered difficult and become one of the subjects that are feared by students. Until now the quality of mathematics education in Indonesia is still lagging compared to education in many other countries in the world.

This is evident from the achievements of Indonesian representatives in international events such as IMO (International Mathematics Olympiade) in which Indonesia generally only ranks last. As quoted by TIMSS, an international survey of mathematics and science achievement of Junior High School Grade VII, published by the Ministry of Education and Culture shows that the score achieved by Indonesia is still below the average. The 2003 TIMSS study results, Indonesia ranked 35th out of 46 participating countries with an average score of 411, while the international average score is 467. The 2007 TIMSS study results, Indonesia ranks 36th out of 49 participating countries with an average score at the international average score of 500. At TIMSS 2011, Indonesia ranked 38th out of 42 participating countries with an average score of 386, while the international average score is 500.

NCTM states that the mathematical skills that students must possess that are summarized in process standards include Problem Solving, Reasoning and Proof, Connection, Communication, and Representation). The process standards are collectively the basic skills and understanding that the 21st century students desperately need [6]. (Together, the standards describe the basic skills and understandings that students will need to function effectively in the first twenty-first century). One form of representation that must be owned by students is the ability to represent visual thinking. With this ability, students can describe in their minds, what to do, to solve problems in mathematics. Reveals the role of visual thinking in problem solving that is: (1) Visual Thinking makes it easy to understand complex issues. (2) By visualizing a complex problem, it becomes easier to communicate & more to build that communication. In addition to the ability to represent visual visual mathematics, the affective aspect is also very important in learning mathematics. One important affective aspect is learning independence [5].

According to the observation of researchers at school many students who, when given a problem by the teacher, immediately resigned and gave up that they do not know how to work. Although there are some students who

know, but still they are still asking what they will do next. And this is an example of students' lack of independence in solving problems. Based on the above description the authors are interested to conduct research with the title: " Differences Ability Representation of Visual Thinking Mathematics and Independence of Learning Between Students Who give Open-Ended Learning and Learning jigsaw Class VII MtsS Laboratory UIN SU Medan". Based on the description of the background, it can be identified that the problems in this study are as follows: (1) Students' mathematics learning outcomes are still low (2) The ability of student visual representation is still low. (c) Student self-reliance is still low (d) Implementation of mathematics learning done by teacher so far less relevant with characteristic and purpose of learning mathematics. Based on the background of the problem, problem identification, then the problems studied can be formulated as follows: (1) Is there any difference in visual thinking ability ability between students who are given Open-Ended learning with students who are given jigsaw learning? (2) Is there any difference in learning independence between students who are given Open-Ended learning with students who are given jigsaw learning.

In accordance with the formulation of the above problem, the purpose of this study are as follows: (1) To determine the difference of visual representation ability of thinking between students who were given open-ended learning with students who were given jigsaw learning. (2) To know the difference of learning independence between students who are given open-ended learning with students who are given jigsaw learning.

2. Literature Review

2.1. Ability of Visual Mathematical Thinking Representation

Visualizations used in mathematics learning can be a powerful tool for exploring mathematical problems and to give meaning to mathematical concepts and relationships [10]. Visualization is the process of image formation (mental, or with paper and pencil or with the aid of technology) visualization as a skill, product and way of interpreting, reflection of diagrams, depictions in our minds. visualization Has an important role in understanding the problem, guiding problem-solving methods and influencing mental structure significantly [2].

Visualization is an act whereby an individual person forms a strong relationship between the internal construct of something accessible through the senses. The ability to visualize what can not be seen directly is an important skill in mathematics and science [2]. Visual Thinking or Visual Thinking is an intellectual process of intuitive and visual imagination ideas, whether in mental imagery or through images. It represents knowledge in the form of an idea structure, the flow of ideas can be as drawings, diagrams, model explanations, paintings that are arranged great ideas and simple settlement. Visual thinking is art. While in STEM (Science, Technology, Engineering, and Mathematic) also expect students to have the ability to visual thinking [16]. Principles and Standards of Mathematics such as, students should be visualized, visualization as a tool for problem solving and also have an important role to be able to represent and interpret mathematical ideas and problems in visual form, including graphs, sketches, and diagrams [6].

2.2. Student Learning Independence

Learning independence is a constructive and active process in which students define goals in learning, and try to

monitor, regulate and control cognition, motivation and behavior with guided and constrained by objectives and contextual characteristics in the environment [8]. Learning independence is a mechanism to help explain the differences in success among students in terms of improving achievement [12]. Student self-reliance indicators [13] include learning initiatives, diagnosing learning needs, establishing learning objectives or goals, monitoring, managing, controlling learning, viewing difficulties as a challenge, utilizing and locating relevant sources, selecting and implementing learning strategies, evaluating Process and learning outcomes and self efficacy [3]

Independent learning can be interpreted as an active learning activity, driven by the intention to master a competency to overcome a problem and built with the provision of knowledge or competencies that have been owned [1]. Learning independence is one of the most important behaviors in teaching and learning. Independence is the ability to perform activities or daily tasks in accordance with the stages of development and capacity [5]. Through independence learners are able to learn with their own initiative, with or without the help of others.

Learning independence there are several terms to show the independence of learning, among others: "independent learning, self directed learning, autonomous learning, self instruction, self access, self study, self education, out- Class learning, self-planned learning " [7]. From some of these terms, independent learning and self directed learning is a process in which individuals take initiative with or help others in diagnosing learning needs, identifying learning resources, formulating learning objectives, identifying learning resources, owning and implementing learning strategies, and evaluating learning outcomes.

2.3. Open Ended Approach

One approach to learning based on constructivism is an open-ended approach. The Open-Ended Approach is one of the first mathematical education innovation attempts by Japanese mathematicians Shigeru Shimada, Toshio Sawada, Yoshiko Yashimoto and Kenichi Shibuya. Viewed from the strategy of how the subject matter is delivered, in principle the open-ended approach is the same as the problem-based learning that is a learning approach which in the process begins by giving a problem to the students.

In the open-ended approach the student acts as a center in the learning process, so the knowledge is constructed by the students themselves. For that purpose, this approach requires students to actively learn, either in large groups or small groups. Learning with an open-ended approach presents a problem that has various solutions / settlement methods [13]. This approach allows students the freedom to express answers. Thus, students have the opportunity to acquire knowledge or experience of discovering, recognizing, and solving problems with several techniques. Given opportunities like this, the way students learn can be trained well. In addition to the use of a wide range of open issues, this approach can enhance the flexibility of students' math capacities [14].

By providing a situation of problems whose solution can not only be presented in one way, students gain experience in discovering new things by combining all the knowledge, skills, and mathematical thinking that students have in their previous lessons. Students then analyze problem and problem-solving methods through a

problem-solving process in one way and then discuss and evaluate variations of completion methods that can be developed and presented by classmates. In one version of the open-ended approach, the discovery of the problem also plays a very important role as the problems found by students who are related but different from the problems that have been resolved in the past [14]. The use of problems that allow students to come up with multiple solutions is a special key in mathematics learning related to the development of students' representation and student strategy flexibility.

Table 1: Syntax of Learning with Open-Ended Approach.

No.	Learning Phase	Learning Activity
1	Presenting problems	Providing open problems to students, so that students get the opportunity to do things freely as they wish.
2	OOrganizational learning	Teachers direct students to foster the idea's originality, creativity, high cognitive, critical, communication-interaction, sharing, openness, and socialization.
3	Observe and record student responses	Teachers should prepare or write down a list of anticipated student responses to the problem. So that students can express their ideas or thoughts as an effort to direct and help students solve problems in accordance with the way his ability.
4	Guidance and direction	Teachers provide guidance and direction to the students to improvise developing methods, ways, or approaches that vary in obtaining answers so that student answers vary
5	Make a conclusion	Students are asked to explain the process of reaching that answer

2.4. Model of Jigsaw Cooperative Learning

The jigsaw type cooperative learning model was developed and piloted by Elliot Aronson and his colleagues at the University of Texas. The technique of teaching jigsaw was developed by Aronson et.al as the method of Cooperative Learning. Basically, in this model the teacher divides a large unit of information into smaller components. Furthermore, the teacher divides the students into cooperative learning groups consisting of four students so that each member is responsible for the mastery of each component / subtopic assigned by the teacher as well as possible. Students from each of the same groups formed another group of two or three people.

After reading and studying the material, "experts" from different groups gather to discuss the same topics from other groups until they become the "experts" conceptualized by what they learn. Then go back to the original group to teach the topic they are mastering to a group of friends. Last was given another test or assessment on all given topics. These students work together to complete their cooperative tasks in: (1) learning and becoming experts in the sub-section of its parts; (2) plan how to teach the sub-section to the original group members. After that, the students return to their respective groups as "experts" in their subtopics and teach important information in the subtopic to their friends. Experts in other subtopics also act similarly. So that all students are responsible

for showing their mastery of all material assigned by the teacher. Thus, each student in the group must master the topic as a whole.

Supporting Learning Theory Taking into account the sequence of activities that exist in the learning through advocacy approach with open-ended problem presentation, there are at least three underlying learning theories. The three learning theories are: (1) Jean Piaget's learning theory with his constructivism view, (2) Jerome J. Bruner's learning theory, mainly related to the proposition of composition, contrast and diversity, and attribution; (3) Robert M. Gagne's learning theory, with a series of verbal and problem-solving. And (4) Theory of Learning Vygotsky

a. Jean Piaget's Theory of Learning with Constructivism Views

Jean Piaget conducts research begun to his own son and western children. From his research, came the theory of learning "theory of human mental development". The word "mental" in his theory is also called "intellectual" or "cognitive". The theory he encounters concerns the readiness of the child to be able to learn, which depends on the stage of intellectual development from birth to adulthood, and also equipped with the characteristics of each stage of intellectual development. According to him also, a child will more quickly enter the stage of intellectual development is higher if he is rich in experience.

Here are three basic arguments of Piaget, Intellectual development occurs through successive stages of the same sequence, The stages are defined as clusters of mental operations (sorting, sequencing, grouping, hypothesis making, conclusions) showing the existence of intellectual behavior. The motion through these stages is accomplished by the equilibration of the development process that describes the interaction between experience (assimilation) and the cognitive structure that arises (accommodation). Assimilation is the absorption of new information into the mind. Whereas accommodation is rearranging the thought structure because of new information, so that the information has a place. In the assimilation process does not produce changes in schemata, but only support the growth of schemata in quantity. While in the process of accommodation produce changes in the schemata in quality.

According to Piaget, knowledge is not acquired passively by a person but through action. In fact, the child's cognitive development depends on how far they are actively manipulating and interacting with their environment. So according to him, at a certain stage the way and ability of children who construct knowledge vary based on intellectual maturity [13]. In this study, cognitive children developed with the obligation to solve open-ended problems in mathematics well and correctly through the process of debate. With this approach it is expected that children have a good intellectual maturity and precise.

b. The Learning Theory of Jerome J. Bruner with His Four Theorems

Jerome J. Bruner in his theory states that learning mathematics will be more successful if the learning process is directed to the concepts or structures covered in the subject matter taught, in addition to the related relationship between concepts and structures. In this way, it is expected that students will understand the material that must be mastered. Meanwhile, that materials that have a particular pattern or structure will be more easily understood

and remembered children.

In this study each concept on the subject matter of the function studied in detail. Each concept is discussed in detail and packed in an open-ended problem. In the learning process, students are given the widest possible freedom to argue, question, criticize the opinions of other students, and propose ideas or ideas, so that students indirectly build their own mathematical concepts in mind. In addition, in the learning process through advocacy approaches by presenting open-ended problems, students are given the opportunity to give contrasting or contrasting opinions, ideas or ideas with other students, enabling students to better understand the concepts being studied by having a variety of examples.

In the process of debate conducted at the time of learning, students in giving criticism of the settlement of other students submitted, not on the concept alone, but the criticism was directed at the way of writing the right mathematical notation. Thus, students gradually learn to use appropriate mathematical notation. Each of the concepts in the subject matter of the function is endeavored in relation to everyday life or with other mathematical concepts. Through such attribution students have the possibility to be able to build logical relationships between concepts, as a way to be able to provide strong and relevant arguments. Four important propositions in mathematics learning, the four propositions are: (1) postulate proposition, (2) postulate notation, (3) argument of contrast and diversity, and (4) association argument. From the description above, it appears that every proposition proposed by Bruner is closely related to learning through an advocacy approach with an open-ended problem presentation [9].

c. Robert M. Gagne's Theory of Learning with Verbal Rounds and Problem Solving

According to Gagne, in learning mathematics there are two objects that can be obtained students, namely direct objects and indirect objects. Direct objects of facts, skills, concepts, and rules. While the indirect object of the ability to investigate and solve problems, self-study, be positive about mathematics, and know how to learn. learning can be grouped into eight types of learning: gesture learning, response stimulus, motion sequencing, verbal sequencing, discrimination, concept formation, rule formation, and problem solving. Five of the eight types of learning put forward by Gagne are closely related to this research, namely: (1) a series of verbals; (2) to differentiate; (3) concept formation; (4) establishment of rules; And (5) math problem solving.

d. Theory of Learning Vygotsky

Vygotsky is also in line with Piaget's developmental theory which believes that intellectual development occurs when individuals face new challenges and experiences, and to solve emerging problems. In an effort to gain an understanding, the individual concerned tries to relate a new experience to the experience it has had and then builds a new understanding. Vygotsky in his theory emphasizes the interaction of individuals with others is the most important factor that encourages a person's cognitive development. The point is that students in completing the task of learning can not own. So here the teacher organizes and provides a learning environment, organizes the tasks that must be done students, and provide support so that each student can develop optimally.

3. Research Methods

Population in this research is all students of class VII at MTsS Laboratory of UIN SU Medan. Selected class VII SMP because: (1) Already able to think concretely. (2) Have enough experience in learning. (3) As a coaching ability of visual thinking representation mathematically. (4) Expected to be independent in learning. Prior to hypothesis testing, the prerequisite analysis test is done that is normality and homogeneity test. To know the difference of visual representation ability of mathematical thinking and student learning independence between students who were given an open ended approach and jigsaw type cooperative learning on square and rectangular material was done with ANAVA test. This analysis technique is used to know the difference of visual representation ability of mathematical thinking and student learning independence between students who are given an open ended approach and jigsaw type cooperative learning. Instruments used in this research is a test of visual representation ability of mathematical thinking and questionnaire student self-reliance.

4. Results and Discussion

Before performing hypothesis test with ANAVA test analysis toward final test result of student need to test data requirement include test requirement analysis of normality and homogeneity from distribution of data obtained.

1. Normality Test

Based on a random sample, we tested the null hypothesis that the sample came from a normally distributed population and the counter-hypothesis that the population is not normally distributed. If sig value > 0,05, then Ho accepted If sig value <0,05, Then Ho rejected.

Table 2: Summary of normality analysis results from each group

Group	L_o	Sig Value	Conclusion
KRVT Experiments 1	0.315	0.05	H_o : Accepted, Normal
KRVT Experiments 2	0,055	0.05	H_o : Accepted, Normal
KBS Experiments 1	0.631	0.05	H_o : Accepted, Normal
KBS Experiments 2	0,510	0.05	H_o : Accepted, Normal

2. Homogeneity Test

Homogeneity test is the test whether or not the two or more distribution variables. Criteria for homogeneity testing by using Levene test that is if: The sig value > 0.05, Then Ho is accepted, which means the sample data has homogenity variance. The sig value < 0.05, Then Ho is rejected, which means the sample data has no homogenity variance.

Table 3: Test of Homogenity

Group	L_o	Sig Value	Conclusion
Representation Ability of Visual Thinking	0,902	0,05	Homogen
Student Learning Independence	0,805	0,05	Homogen

Based on the results of homogeneity test analysis can be concluded that, all groups of samples come from populations that have homogeneous variance.

3. Hypothesis Testing

The analysis used to test the three hypotheses proposed in this study is the ANAVA test. Briefly presented in the following table. If the value of Fcount > F table then Ho is rejected that there is a difference of visual representation ability of thinking between students who are given Open-Ended learning with students who are given cooperative learning jigsaw type. If the value of F hitung ≤ F tabel then Ho accepted that there is no difference in visual representation ability of thinking between students who were given Open-Ended learning with students who were given cooperative learning jigsaw type. Here is the result of out put anava two-track calculation with the help of SPSS version 19.0 statistic software for hypothesis 1.

Table 4: ANAVA Test Results Visual Ability Representation Thinking Mathematical

Tests of Between-Subjects Effects

Dependent Variable:Nilai

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	487,838[a]	1	487,838	6,038	,000
Intercept	345994,595	1	345994,595	4282,135	,000
Metode_Pembelajaran	487,838	1	487,838	6,038	,000
Error	5817,568	72	80,800		
Total	352300,000	74			
Corrected Total	6305,405	73			

a. R Squared = ,077 (Adjusted R Squared = ,065)

Based on the analysis results obtained F count = 6.038 > F table = 3.57 and with `sig = 0.000, because the significant level is smaller than 0.05, so Ho is rejected and H_1 accepted. It can be concluded that there is a difference of visual representation ability of mathematical thinking between students who are given an open ended approach with students using cooperative type jigsaw learning. Similarly, the first hypothesis. The second

hypothesis also uses the rule Criteria testing can also be seen from the price F is: If the value Fcount > Ftable, then Ho is rejected that there is a difference in learning independence between students who were given open-ended learning with students who were given cooperative learning type Jigsaw. If the value of F hitung ≤ F tabel then Ho accepted that there is no difference in learning independence between students who were given open-ended learning with students who were given cooperative learning jigsaw type. Here are the results of out put anava two-track calculation with the help of software SPSS version 19.0 statistic.

Table 5: ANAVA Test Results Student Learning Independence

Tests of Between-Subjects Effects

Dependent Variable:KEMANDIRIAN

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	115,070[a]	1	115,070	3,812	,000
Intercept	425559,815	1	425559,815	7285,325	,000
KELAS	115,070	1	115,070	3,812	,000
Error	4205,757	72	58,413		
Total	429880,642	74			
Corrected Total	4320,827	73			

a. R Squared = ,027 (Adjusted R Squared = ,013)

Based on the analysis results obtained F count = 3.812 > F table = 3.57 and with sig = 0.000, because the significant level is smaller than 0.05, so Ho is rejected and H1 accepted. So it can be concluded there are differences in student autonomy between the given open ended approach and jigsaw type cooperative learning. The results of research that has been presented in the previous of this sub-researchers will describe and discuss with guided the relevant theories and research which will then be associated with the results of research researchers. In accordance with the focus of research that is "the difference of visual representation ability of thinking and learning independence between students who are given Open-Ended learning with students who are given cooperative type learning jigsaw class VII MTs Laboratory UIN SU Medan" which will be described in two subfokus are: There is a difference in the ability of visual thinking representation between students who are given Open-Ended learning with students who are given cooperative learning type jigsaw. 2) Is there any difference in learning independence between students who are given Open-Ended learning with students who are given cooperative learning type jigsaw

a. Visual Representation Thinking Mathematical Ability Students

The ability to represent visual thinking is a mathematical ability that can be developed in learners. A learner is said to have the ability to represent visual thinking mathematically is the learner who has implied in each of them, develop and be able to identify problems and solve problems through visualization of thinking. Visualization done by the students through the following process when solving mathematical problems (1) Understanding the relationship of spatial elements (spatial) in the problem, 2) Linkage to each other to problem

solving, 3) Construct / build a visual representation (In mind, on paper, or through the use of technological tools), 4) Using visual representations to solve problems, 5) Encoding answers to problems The result of data analysis after treatment and untreated, obtained postet score for visual thinking representation ability in both classes. The mean postes score of visual representation ability of mathematical thinking of students who obtained open ended learning is 70,94 and mean score of postes of visual representation ability of mathematical thinking of students who gain cooperative learning type jigsaw is 65,84. Two way ANAVA calculation results obtained Based on the analysis results obtained F count = 6,038 > F table = 3.40 and with sig = 0.000, because the significant level is smaller than 0.05, so Ho is rejected and H_I accepted.

The experimental class 1 and the experimental class 2 were treated differently so that the visual representation ability of the students' mathematical thinking was higher in one of the experimental classes, where in the experimental class 1 the students started the lesson with a problem, the discussion, and the students expected to solve the problem with various way, in the experimental class 2 is also varied with jigsaw type cooperative model, so that students can more socialize with peers and more relaxed to solve various problems with their friends, but also expected the students can be more active in discussions, both in team of experts and in their respective groups. This is in accordance with piaget learning theory which suggests that "Knowledge is not passively acquired by a person but through action, even a person's cognitive development depends on how far the student is active" [4]. This theory states that learning as an active process so that cognitive students can be more increased. In thesis research shows that the open-ended learning approach is more effective when compared with the approach of expository learning in SLTPN XI Malang on the subject of comparison. The average ability of students using an open-ended learning approach tends to be more equitable [17].

students of SDN Landungsari 01 Dau Malang showed that open-ended learning can motivate students to better understand a proposed problem [9]. Study on grade XI students of SMK Purwakarta Pharmacy shows that there is an increase of reasoning ability and student's mathematical representation of individual and group learning using open ended compared with students whose learning using conventional learning [18]. Researchers can draw a conclusion that there are differences in the ability of mathematical visual thinking representation in the experimental class that is taught with an open ended approach and with cooperative type jigsaw learning.

b. Student Learning Independence

From the research that researchers have done, it can be seen that when students are given a flexible space to work with their friends related to the understanding of learning, then the curiosity and confidence will increase. Coupled with the motivation of teachers about the importance of independence in learning mathematics. In the beginning, students always ask the teacher about the questions given to them. Evidently, when researchers give a matter of pretes, students are trying to answer it themselves, but they are not sure of their answers. So, every time they finish working on the problem then they will come forward to ask the researchers. After the researchers provided the motivation and description of the importance of self-reliance in learning and self-belief, the students began to show the independence of learning slowly. And after the researchers gave a questionnaire of learning independence, they were very eager to complete the questionnaire. And as it turns out, proven after the data were analyzed, the independence of learning from both classes was relatively good.

In line about "Improving Creative Thinking Ability and Self-Reliance Learning of MTsN 2 Medan Students Through open ended learning" from the results of this study can be concluded that students who are taught by open ended can improve the ability of creative thinking and independence learn.

Similarly, research on SMPN 2 Tarogong Kidul class IX, About "Improving Learning Independence and Problem-Solving Ability by Using Open Ended Learning". From the results of this study found that there is an increase in learning independence and problem-solving skills of students taught by the approach of open ended. Open ended learning provides more flexible space for students, so they are more independent in working on the questions.

5. Conclusions

Based on the results of data analysis and research findings during the open-ended approach and cooperative learning type jigsaw with emphasis on the ability of visual thinking representation mathematical and student learning independence, the researchers obtained the following conclusions:

[1]. There is a difference in visual representation skills of mathematical thinking among students who are given open-ended learning with cooperative learning type jigsaw.
[2]. There is a difference of learning independence between students who are given open-ended learning with cooperative type jigsaw learning

6. Suggestions

Research on differences in visual representation ability of mathematical thinking and student learning independence is a teacher effort in improving student achievement. Based on the results of this study, mathematics learning with open-ended approach and cooperative learning type jigsaw well applied to the learning activities of mathematics. For that researchers suggest some of the following:

1. For Math Teachers

a. Open-ended learning and jigsaw type cooperative learning on mathematics learning that emphasizes the ability of visual thinking representation and students' learning independence is very good so it can be used as an alternative to apply innovative mathematics learning especially in teaching rectangular and square material.
b. The resulting learning tools can be used as comparisons for teachers in developing learning tools of mathematics with open-ended approach and cooperative learning of jigsaw type on rectangular and square subject.
c. It is expected that math teachers can create a fun learning atmosphere, giving students the opportunity to express their ideas in their own language and manner, daring to argue so that students will be more confident and creative in solving the problems they face.
d. It is expected that teachers need to add insight about theories of learning and innovative learning models in order to implement them in mathematics learning so that regular learning can be consciously

abandoned as an effort to improve student learning outcomes.

2. To the Related Institution

a. It needs socialization in introducing open-ended learning to teachers and students so that the ability of students, especially the ability of visual thinking representation and learning independence can increase.
b. It is expected that open-ended learning can be used as an alternative in improving students ability, especially visual thinking thinking ability and learning independence on rectangular and square subject so that it can be used as input for school to be developed as an effective learning strategy for other subjects.

3. To Advanced Researchers

a. Can be done further research with open-ended learning in seeing the difference of visual representation ability of thinking and student learning independence to get innovative research result.
b. Design effective learning tools, adjust capability indicators and time allocations to be achieved.

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