The Effect of Cooperative Learning Models and Logical Thinking Ability to The Result of Learning Mathematics of Grade Eight Students

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Abstract
This study was aimed at finding out the effect of cooperative learning models and logical thinking ability to the result of learning mathematics. This study used a quasi-experimental research design. The populations consisted of 144 grade eight students in Trisakti 1 Junior High School Medan. The sample consisted of 72 students that were divided into two groups. The instruments used were mathematic test and logical thinking ability questionnaire. The data which analyzed in this research was the value of mathematics learning outcomes from cognitive domain. The data was analyzed using Two-Way technique: analysis of variance (ANOVA). The result of the research are as follow: (1) The difference in the results of learning mathematics between student who are taught by Jigsaw cooperative learning model and the results of learning mathematics students who are taught by STAD cooperative learning model, (2) The difference in the results of learning mathematics between students who have high logical ability (HL) and low logical thinking ability (LL), (3) the interaction between cooperative learning models and the logical thinking ability on mathematics learning outcomes.
Keywords: learning model, ability of logical thinking, mathematics learning.

I.   INTRODUCTION

Mathematics comes from the Latin "mathenein" or "mathema" which means "learned" or "was learned". The logic in the Big Indonesian Dictionary (KBBI) means knowledge of reasoning rules or logical thinking [1]. Of the two definitions, it appears that mathematics and logic/logical thinking are very closely related in everyone's life. According to BSNP (2007) the definition of mathematics is divided into four namely: (a) mathematics as a pattern and relationship search activity, (b) mathematics as creativity that requires imagination, intuition and discovery, (c) mathematics as problem solving and (d) mathematics as a communication tool. [2]

Mathematical material in schools by NCTM is formulated in content and process standards. Content standards include numerical and numerical operations, algebra, geometry, measurement, analysis and probability data, while process standards include problem solving, reasoning, communications, connections, and representation. To achieve that goal requires an innovative mathematics teacher so that it can design and implement quality learning process, so that the learning of mathematics can develop logical thinking ability which will help to find solutions to problems related to math and daily life problems.

Innovative teachers will select the appropriate learning models in school learning. Joyce and Weil (2016) stated that there are five components in each learning models: syntax, social, reaction principles, support systems, and the impact of direct and companion learning. [3]. These illustrate clearly how a teacher should design instructional steps according to the model chosen to teach the subject matter. One of the interesting learning models in the learning process of mathematics is cooperative learning model Jigsaw and Students Teams Achievement Division. (STAD).

Slavin (2005) through his research states that the use of cooperative learning can improve students achievement, improve good relationships between groups, acceptance of classmates with poor performance and increased self-esteem. He insisted that "each team can ensure that every high, average, and low achieving students is equally challenged to do the best and the contribution of all team members is rewarded". [4]. Student interaction in the cooperative learning model provides an opportunity for students to learn from each other through the deepening of the material, the discussion, even through the conflicts so that the understanding of each member of the group on the material studied sharper. Slavin (2005) stated *"Cooperative learning refers to a variety of teaching methods in which students work small groups to help another learn academic content. In cooperative classrooms, students are expected to help each other, to discuss and argue with each other to assess each other's current knowledge and fill in gaps in each other's understanding. Cooperative work rarely replaces teacher instruction, but rather replaces individual seatwork, individual study and individual drill. When properly organized, students in cooperative groups work with each other to make certain that everyone in the group has mastered the concepts being taught".* [5].

Jigsaw's cooperative learning model has positive implications for the students as they can increase their sense of responsibility for their own learning and the learning of others. They are trained in public speaking and opinion, co-operatively co-operated with a group of experts assigned to share the subject matter they hold to their peers, friends in the original group.

The steps of STAD cooperative learning model consist of five: class presentations, teams, quizzes, individual progress scores and team recognition. These five steps are expected to increase individual students' skills, enhance group skills, develop positive attitudes toward peers without resentment and compete healthy.

Significant urgency and significance in Jigsaw and STAD cooperative learning models is the ability of group members to carry out the steps of a predetermined learning model. If students and teachers can focus on the process steps of both cooperative learning models that are determined, then the achievement of learning experiences that really develop students' logical thinking ability will be realized. The experience of working together, responsible for group progress requires logic that can shape the student into a person who values himself and others at once. In this context, cooperative learning model can be used as one of the supporters to achieve 21st century skills, namely cultural literacy and global awareness, collaborative and cooperative skills and creativity.[6] Curriculum 2013 target oriented to critical thinking skills, collaboration, communication, creative and innovation and high order thinking skill (HOTS).

The results of research, such as Ataman Karacop (2017) [7], Shan-Ying Chu (2014) concluded that Jigsaw cooperative learning model is an effective learning model can be selected because it can improve student learning achievement. [8]. Today, it is increasingly recognized that one important element in critical thinking and mathematical reasoning is logic. (Wheeler, 1995) Education becomes one of the indicators that determine the welfare of one's life. Education will progress if the ability to think logically developed. Karl Albrecht states that training in logical thinking encourages learners to think for themselves, question hypotheses, develop alternative hypotheses, and test these hypotheses against known facts. [9]

Based on the above explanation, it is necessary to examine and analyze (1) the difference between the mathematics learning outcomes of students who are taught by cooperative learning model Jigsaw with STAD cooperative learning model (2) the difference between the students' mathematics learning outcomes that have high logical thinking and students have low logical thinking ability, (3) interaction between cooperative learning model with logical thinking ability of student that influence student learning result of mathematics.

II. METHOD
Participants
The subject of the research is the eight grade students Trisakti 1 Medan in the academic year 2017/2018. The population consists of 144 and the sample consists of 72 students.
Design
This study uses quasi-experimental design.
Instrument
A logical thinking ability test by psychologist.
The learning outcomes were measured by mathematical problems with the material of *Operation and Algebraic Focalization Factor.*
Data analysis technique in this research use Two-way ANOVA

III.   RESULT AND DISCUSSIONS
a. Results
The sample in this research is divided into two groups namely Jigsaw cooperative learning model and STAD cooperative learning model. Each group was divided into two groups based on the results of the logical thinking ability test; groups of students who have high logical thinking ability and group of students who have low logical thinking ability.

The result is obtained from the mathematics test of students who learn by using cooperative learning model Jigsaw and STAD cooperative learning model. The result shows that the average value taught by Jigsaw cooperative learning model is higher than STAD cooperative learning model. The results of the tests are shown in table I.

TABLE I. The Value of Mathematics Learning Outcomes

Kooperative Learning Models	Logic Thingking Ability	Mean	Std.deviation	N
Jigsaw	HL	83,56	6,88	16
	LL	65,65	9,42	20
	Total	73,61	12,59	36
STAD	HL	71,36	8,88	14
	LL	65,73	8,69	22
	Total	67,92	9,60	36
Total	HL	77,87	10,65	30
	LL	65,69	8,62	42

From the two groups of learning models, it can be seen that the average learning outcomes of the Jigsaw

cooperative learning model group is 73.61 and the mean of STAD cooperative learning model is 67.92. The average score of students with high logical thinking ability (HL) was 77.87 and the average score of students with low logical thinking (LL) was 65.69. For both models of learning, the average mathematics learning outcomes of students with high logical thinking ability is higher than the average mathematics learning outcomes of students with low logical thinking.

To find the interaction between cooperative learning model and logical thinking ability on student learning achievement, two-way test (ANOVA) was used. The results are presented in table II below:

TABLE II. The Result of Analysis Two-way Anova

Source of Variation	df	SS	MS	F_{hitung}	F_{tabel}= 0,05
Learning Models (A)	1	583,68	583,68	6,56	
Logical Thinking Ability (B)	1	2.594,54	2.594,54	29,14	4.00
Interaction	1	528,70	528,70	5,94	
Error	68		89,03	-	
Total	71	3.706,92	3l795,95		

TABLE III. The Result of Analysis Two-way Anova using SPSS16

| Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3718.807[a]	3	1239.602	13.835	.000
Intercept	357173.149	1	357173.149	3986.378	.000
Model	606.168	1	583.68	6.565	.011
Logika	2429.314	1	2594.544	29.113	.000
Model * Logika	694.205	1	528.705	5.948	.007
Error	6092.693	68	89.598		
Total	370212.000	72			
Corrected Total	9811.500	71			

a. R Squared = .379 (Adjusted R Squared = .352)

From the analysis Two-ways ANOVAva, it can be explained that:

The first hypothesis is to examine the effect of cooperative learning model on mathematics learning outcomes. Based on data analysis show that F_{count} > F_{table}; 13,835 > 4.00, the null hypothesis is rejected so that it can be interpreted there is a difference between the mathematics learning result of the students taught using cooperative learning model Jigsaw with STAD cooperative learning model.

The second hypothesis in this study is the effect of students' logical thinking ability on mathematics learning outcomes. Based on data analysis show that F_{count} > F_{table}; 6,565 > 4,00, the null hypothesis is rejected so that there can be a difference between the students' mathematics learning outcomes that have high logical thinking (HL) and students with low logical thinking (LL).

The third hypothesis in this study is the interaction between the cooperative learning model and the ability to think logically mathematical learning outcomes. Based on data analysis show that F_{count}t > F_{table}; 5.94 > 4,00, the null hypothesis is rejected so that it can be interpreted there is interaction between cooperative learning model and logical thinking ability to result of learning mathematics.

Fig. 1. The Interaction between learning models and logical thinking ability
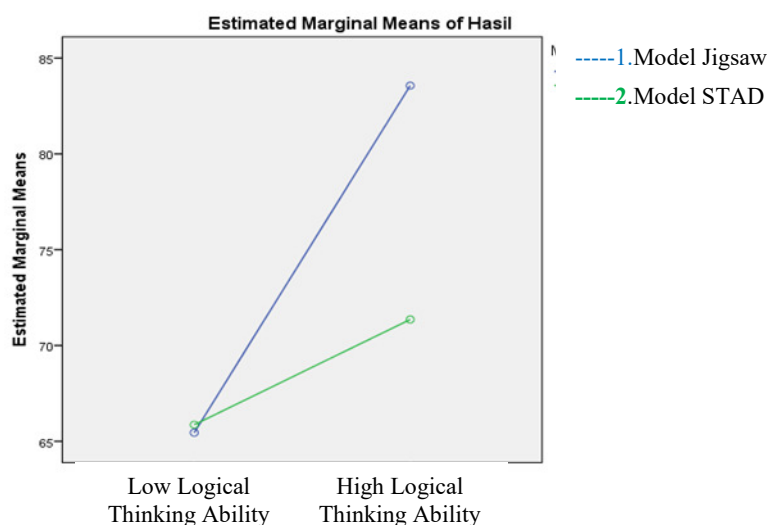
b.   Discussion

The result of the first hypothesis of two-way Anova analysis shows that the application of cooperative learning model of Jigsaw is better than STAD cooperative learning model. Jigsaw's cooperative learning model has improved student learning outcomes significantly. The findings of this study are in line with the findings of previous researchers Ataman Karacop and Emine Hatun Diken (2017) and Shan-Ying Chu (2014) which says Jigsaw cooperative learning model has significantly improved student learning outcomes. This happens because each student in the cooperative learning model group Jigsaw tries to become an expert of the material given to him. The material is not only studied for the students themselves but also to be shared with his friends. The role of the student as an expert mastered the material and increased his confidence to share with his friends.

Jigsaw's cooperative learning model does not automatically make the group members become experts or master the material given to them but is slowly trained to be responsible to his friends. This task can motivate a student to be more serious in learning and respecting others. With the cooperative learning model Jigsaw students are helped to develop his logic of thinking because he has to design his own how the material he understands is shared with a group of friends in a coherent, correct and easily understood group of friends. Students are encouraged to try independently to think and understand independently the subject matter that is important to them. The interaction between students in the group is very possible for students to develop their logical thinking ability.

The second hypothesis results from the two-track Anova analysis: there is a difference between the mathematics learning outcomes of students who have high logical thinking ability with students who have low logical thinking ability. The value of mathematics learning outcomes of students who have high logical thinking ability is significantly better than the value of mathematics learning outcomes of students who have low logical thinking ability. The findings of this research are in line with the findings of previous researchers Selda Bakir & Esra Öztekin-Bicer (2015), suggesting that critical educational environments support creative thinking and enriched cooperative learning activities where students are active to improve logical thinking levels [10]. Akhsanul In'am's research (2016) says that students who have less logical thinking patterns pay less attention to the proper sequence in solving problems and students who have high categories show a logical sequence of thinking. [11].

The result of the third hypothesis of two-way Anova analysis: there is an interaction between cooperative learning model and logical thinking ability on mathematics learning outcomes. Groups of students who have better HL in mathematics learning outcomes than groups of students who have LL for cooperative learning model Jigsaw and Group of students who have better LL in mathematics learning outcomes than HL group of students for STAD cooperative learning model. This suggests there is a significant interaction between the use of cooperative learning models and logical thinking ability on mathematics learning outcomes.

IV.   CONCLUSION

The conclusions of this study are as follows. (1) There is a difference between the learning results of the students learning mathematics by using Jigsaw cooperative learning model with STAD cooperative learning model. The result of learning mathematics that is learned by using Jigsaw cooperative learning model is higher than the result of learning of mathematics study by using STAD cooperative learning model, (2) There is difference between mathematics learning result of students who have high logical thinking ability (HL) in learning mathematics and ability low logical thinking (LL) (3) There is a significant interaction between the use of cooperative learning models and the ability to think logically on mathematics learning outcomes. From the data analysis, it can be concluded that the use of Jigsaw cooperative learning model is more effective for students who have high logical thinking ability.

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