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Understanding of mathematical concepts through cooperative learning, and learning styles

Virgana
Postgraduate Universitas Indraprasta PGRI Jakarta, Indonesia

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ABSTRACT

The results of the mathematics learning of junior high school students have not been satisfactory. This is due to the low understanding of students' mathematical concepts. The purpose of this research is to identify the influence of cooperative learning model and learning style towards the understanding of the mathematical concepts of Junior High School students. The method is factorial experiments with 2 x 3 and sample of the study is 60 students of 8th grade junior high school. The analysis results of variance (ANOVA) indicate the following: the use of cooperative learning model of type Student Team Achievement Division influenced the understanding of the mathematical concepts significantly, there is an significant influence of the learning style towards an understanding of mathematical concepts, and there is also a significant influence of the interaction of cooperative learning model of type Student Team Achievement Division and learning style towards the understanding of mathematical concepts. So it can be concluded that the cooperative learning model can improve understanding of students' mathematical concepts and learning styles is a individual differences of learning students in absorbing mathematics subject matter. We hope that this study can be beneficial for further research to improve student's achievements in mathematics.

Corresponding Author:

Virgana,
Postgraduate,
Universitas Indraprasta PGRI,
Jalan Nangka No 58c Tanjung Barat, Jakarta Selatan, Indonesia.
Email: virganaunindra@gmail.com

1. INTRODUCTION

The low understanding of students' mathematical concepts is influenced by internal factors and external factors. The internal factors include: interest, motivation, basic abilities, and cognitive abilities. External factors include educators, learning strategies used by teachers in teaching, curriculum, facilities and the environment [1]. Errors of students in answering the questions of the mathematics still occurs in the student's tasks in constructing mathematical concept. The dominant factor affecting the results of the students in mathematics is the mastery of math concepts [2]. The type of error that are done by learners in solving problems of mathematical concepts in the national exam is at 30, 54% [3]. Ruswati et al [4] conducted a research on the results of mathematical tests in junior high schools in Bandung, within three aspects of errors namely conceptual errors, procedural errors and technical errors with the result of 39.9%, 43.3%, and 13.6% [4] Learning model that can be used as a solution to the problem is the cooperative learning model of Student Teams Achievement Division (STAD). Moreover, STAD also creates supportive learning and continuous interaction that explicitly strengthens the students to learn in the social constructivist paradigm [5].

Cooperative learning has been widely proven to have great impact on human development as it is crucial to the improvement of cognitive and affect outcome, process skill, and values [6]. And the positive

impact of cooperative learning has an effect that extends beyond the classroom into professional participant and personal lives. [7]. The selected learning model in this research is a model of cooperative learning Type STAD by considering the type of learning style of the learners, there are many ways students to learn, some students prefer teachers to explain the material by writing everything on the board, there are also students who like the lecture method, and some prefer learning through discussion by forming small groups. Whatever the student's learning style is, it is the best way to absorb the subject matter. This diversity must be understood by a teacher in managing class in his school, namely how to choose a learning model that is in accordance with the subject matter that will be given to students. It is in accordance with the opinion of Aissaoui: Due to personality and environmental factors, each student has his own preferred ways of learning, for example, when doing an experiment, some students can understand by following verbal instructions, while others have to physically practice the experiment themselves. These differences in students' learning styles should be considered by the educational systems to enhance the learning process [8].

The Understanding of Mathematical Concept support the cognitive thinking process of the learners. So they are able to master math concepts in order to identify and solve mathematical problems. There are structures (concepts) and relations in mathematics which is a structural system [9]. Students who master the mathematical concept are able to identify and solve some new and more challenging mathematical problems. In addition, when children understand a concept, the will be able to generalize an object in different learning situation by using the mastered concepts [10]. And the level of understanding that someone owned about something is closely related to mental construction in his minds [11].

Cooperative Learning Model is a model of learning in which the learners are devided into small groups. The principle that should be held in a cooperative learning model is that all member of the group must have a heterogeneous ability level (high, medium, and low). Cooperative learning has been well documented in the educational research as a successful pedagogy to improve students' academic achievement [12]. In cooperative learning there is a model system where 4 to 6 persons learning, studying and working in small groups collaboratively so it can stimulate learners to be more passionate in learning. The learners are grouped heterogeneous so that interactions between learners are more active and opinions of the learners are more various [13]. Cooperative learning, learners play an active role in solving the problems given by the teachers, in this case the teacher directs and controls the class activity such as monitor the state of the group of learners, and provide directions if learners have difficulties [14].

Student Teams Achievement Division is a model of cooperative learning in which learners are grouped into small groups called the team. After the teacher gives a presentation of the subject matter then the learners are given a test for first score then, individual score are combined into a team scores. The next step is that the learners discuss the subject matter of the previous task in groups with the control and guidance of the teacher. On the cooperative learning model of this type though learners are tested individually, learners stay spurred to work together to improve performance for the achievements of his team.Planning and designing the cooperative learning model (STAD) involves the steps in presentation of the lesson, which enhances cognitive development. Then in small group activities, social skills are promoted by members staying together and developing good interpersonal relationships. This enhances development of the affective area, forming good behaviors, required characteristics, and self-esteem [15]. Cooperative learning steps of type STAD consists of conveying the purpose and motivation, break-out group, teacher's presentations, learning activities within the team, quiz (evaluation), and team achievement award. Cooperative learning STAD is a simple learning method, made easy for students to follow it [16].

Jigsaw is a particular learning model to enhance the sense of responsibility of self-learners towards their learning situations and towards the situation of the members of the study group. Students in the jigsaw classes expressed significantly, more self-confident and liked school better when tested objectively. Behavioral data supported these self-report measures. Students in jigsaw classes were absent less frequently, intermingled more in the cafeteria and in the school yard and performed better in exams. The mechanism of the learning model Jigsaw is, after formation of the groups, every group member is given the task to be studied that the material become his or her responsibility and every member of the group must teach the material to other members within the group. Students team up in heterogeneous groups of interdependence, which consists of up to 6 members. Students with the same topic from different groups joined in the group of experts helping each other to understand the topic. After that students go back to their original group and teach what has been learned to the members of his previous group [17]. On the model of cooperative learning like Jigsaw, the type of dependency between the learners is very high, because each learner in cooperative learning model is a member of two groups, namely original groups (home group) and expert groups. Original group consist of heterogeneous members [16].

Learning Style is a characteristic way of learning that someone has in studying something that can affect the results of the learning [18, 19]. Furthermore [20] point out that humans have different learning ways, some can assimilate knowledge in a better way when received auditory, visually or through another

sense. Then that learning styles are typically bipolar entities (for example reflective versus impulsive, random versus sequential), representing two extremes of a wide continuum; However, where a learner falls on the continuum is value becomes neutral because each has its own extreme potential advantages and disadvantages. There are three modalities (type) in a learning style that is visual, auditory, and kinesthetic [21]

The purpose of this research is to know the influence of cooperative learning model towards students' understanding of mathematical concepts, the influence of learning style towards students' understanding of mathematical concepts, and the influence of interaction models of cooperative learning and learning style students' towards the understanding of mathematical concepts.

2. RESEARCH METHOD

The method in this research is experimental (Quasy experiment) and two-way ANOVA test analysis, with a factorial design 2 x 3 of the experimental treatment methods by level. The procedure is done on this experiment, such as teachers teach materials of mathematics in school using cooperative learning method involving two groups of sample, i.e. the group of experimental and control group. Experimental group is a group of learners in teaching and learning activities using cooperative learning method of Student Team Achievement Division (STAD), and the control group is the group of learners who use type approach Jigsaw. The analysis used in this study is a two-way ANOVA with variable treatment (model learning) and variable attributes (learning style).

Sample for this research are 60 students of grade 8th in SMP Budi Luhur Tangerang City who are selected randomly, and then the sample is divided two groups, namely as the experimental class and as the control class Experimental group is given a learning model cooperative STAD then they are devided in 3 (three) categories of learners based on the types of learning styles, visual, auditory and kinesthetic, as well as the control group given model cooperative learning, Jigsaw is divided in 3 (three) categories of learners based on the types of learning styles, visual, auditory, and kinesthetic. Data collection techniques for learning styles are done through questionnaires with the Likert scale method, while for understanding mathematical concepts with material:Calculation of the surface area and the volume of the cube, prism and beam, pyramide with objective tests 20 of multiple choice questions. Research design can be seen in Table 1.

Table 1. Research design

Learning style	Cooperative Learning		Sum
	STAD (A_1)	Jigsaw (A_2)	($\sum$ B)
Visual (B_1)	A1B1	A2B1	$\sum B_1$
Auditorial (B_2)	A1B2	A2B2	$\sum B_2$
Kinesthetic (B_3)	A2B3	A2B3	$\sum B_3$
$\sum$ A	$\sum A_1$	$\sum A_2$	A x B

Notes:
A_1: a group of students with STAD
A_2: a group of students with a Jigsaw
B_1: a group of students with a visual learning style
B_2: a group of students with auditorial learning style
B_3: a group of students with a kinesthetic learning style

3. RESULTS AND ANALYSIS

In doing this research, a data analysis prerequisite test is performed i.e. data normality test and the test of its homogeneity variant population. The data was tested with norm One-Sample Kolmogorov-Smirnov Test with SPSS provide value significance on the lines of asymptote all values (0.326, 0.832, 0.946, 0.714, 0.486, 0.404, 0.474, 0.189, 0.374, 0.870, and 0.703) have > 0.05. Thus it was concluded that all groups of data in this study comes from a normal population.

Test results of its homogeneity against three groups of data (A + B + A * B) obtained the value of sig value meaning 0.694 > 0.05. Then it can be inferred that the concept of mathematics mastery score data from three groups of data has variance the same population or in other words the data derived from the treatment of the whole group of population homogeneity. The results of the Calculation of its homogeneity Test Variance Test Using Levene's population with degrees of Significance (= 0.05) as seen at Table 2.

Table 2. Levene's test of equality of error variances[a]

Dependent variable: Y

F	df1	df2	Sig.
.608	5	54	.694

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + A + B + A * B

This research was conducted with the test analysis techniques with the help of two ways ANOVA program SPSS, results as in Table 3.

Table 3. Tests, of between-subjects effects

Dependent variable: Y

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	6723.333[a]	5	1344.667	10.448	.000
Intercept	258526.767	1	258719.667	2010.250	.000
A	4681.667	1	4671.667	36.376	.000
B	1075.823	2	542.917	4.218	.020
A * B	955.823	2	467.917	3.713	.031
Error	6940.000	54	129.704		
Total	271390.000	60			
Corrected Total	13673.343	59			
R Squared = .492 (Adjusted R Squared = .445)					

First results of the research: The influence of cooperative learning model towards students' understanding of mathematical concepts, 8th grade Junior Budi Luhur Tangerang City. Based on the results of testing on the table Test of Between-Subject Effects in the Table 3 which, notes that value of the p-value for category A (cooperative learning Model) is 0000 (< 0.05), it means there is a significant difference towards mastery of math concepts on learning by using learning model cooperative STAD and Jigsaw. So we can conclude that there is a significant influence of cooperative learning model towards students' understanding of mathematical concepts of 8th grade Junior Budi Luhur Tangerang City. It is characterized by a value of cooperative learning model for sig 0.000 < 0.05 thus it can be concluded that there is a significant influence of cooperative learning model towards mastery of math concepts, especially if the learning model cooperation uses type STAD yield greater learning than with the type of Jigsaw. This is supported by the mean gain score mastery math concepts with cooperative learning model type STAD 76.17 is higher than on the use of cooperative learning model type Jigsaw 56.83. The results of this study showed that the use of cooperative learning model plays an important role to the mastering of mathematical concepts. Based on cooperative learning experimental step type STAD that consists of conveying the purpose and motivation, break-out group, presentations from teachers, learning activities within the team, quiz (evaluation), and appreciation of the achievements of the team. Cooperative learning of type STAD will produce a better understanding of the concept if students are given additional learning time. The research conducted by Sari and Putu (2015) with MSTAD on algebra learning material, proven a good student's result by providing time extension modification. The class that gets MSTAD (class C) has a better achievement than the class with STAD method (class B) and method of lectures (class A), even though the learning device is the same. This is because students have more discussion time so that all material can be completed correctly and some misunderstandings about a particular material can be corrected immediately, then the value of the post test between the control class (STAD) and experimental classes (MSTAD) differ significantly (tcount-to < .01 (41) =-2.702) [22]. The addition of the time in a given learning need further considered, given the density of the target achievement of the curriculum should be given to the student needs to be submitted should be on schedule. Therefore this research tailored to the number of hours of instruction in accordance with the schedule of lessons without any addition of lessons.

Second results of the research: The influence of learning style of students toward mastery of mathematical concepts of grade 8th Junior Budi Luhur Tangerang city is based on the results of testing on the table Test of Between-Subject Effects in the Table 4 which is presented the results of the hypothesis proposed researchers. From the table, note the value of the p-value for category A (cooperative learning Model) is 0.020 (< 0.05), it means there is a significant difference in learning style students toward mastery of mathematical concepts. So it can be concluded that there is a significant influence of learning style students toward mastery of mathematics learners grade 8th Junior High School Budi Luhur Tangerang City. In total there are significant effects seen with standard of significant learning styles towards mastery of the

mathematical concept of 0.020 (< 0.05) learners with different backgrounds like that have a visual learning style, auditory or kinesthetic in this study was able to increase mastery of mathematics. Average students who have a learning style Auditory outweigh the Visual and kinesthetic learners, who have a kinesthetic learning, style on second-order and visual the third-order. However, the difference in learning style does not affect the ability of learners in mastering the concepts of mathematics significantly [23]. Research on learning style towards mathematics learning outcomes was carried out by Bosman and Schulze [24]. The results of learning mathematics by using constructivist teaching found that high achievers in Mathematics made use of the auditory, visual, and kinaesthetic. Furthermore, a positive learning environment in the Mathematics class is important, with competent teachers who are helpful and empathetic. To support visual and kinaesthetic learning styles, teachers need to be creative in their use of visual media and in ways learners can handle physical objects to benefit their learning. In addition, auditory learners benefit from interaction with patient teachers who give detailed explanations, and who provide them with numerous examples to aid mathematical insight. Multi-modal teaching could contribute significantly to enable learners to study individually at home, thereby increasing their study time [24].

Third results of the research: influence of cooperative learning Model of interaction and learning style students towards mastery of mathematical concepts of grade 8th Junior Budi Luhur Tangerang City based on the test results in Table 4 Test of Between-Subject, which is a table presenting the main results of the proposed hypotheses the researcher. From the table, note the value of the p-value for category A (cooperative learning Model) was 0.031 (< 0.05), it means there is a significant difference in learning style students toward mastery of mathematical concepts. So it can be concluded there is a significant influence of cooperative learning Model of interaction and learning style students toward mastery of mathematics learner's grade 8th Junior Budi Luhur Tangerang City. Based on the third result research of significance influence, and then carried out further trials in the form of a test Post Hoc or Tukey test on a variable. Then Tukey test calculation results with SPSS 22 can be seen in Table 4.

Table 4 Post hoc or test with Tukey score math mastery dependent variable: The mastery of math concepts

Tukey HSD						
(I) Post hoc	(J) Post hoc	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-5.5500	4.69929	.329	-18.0585	4.5585
	3.00	-10.2500	4.69929	.083	-21.5585	1.0585
2.00	1.00	6.7500	4.69929	.329	-4.5585	18.0585
	3.00	-3.5000	4.69929	.738	-14.8085	7.8085
3.00	1.00	8.2500	4.69929	.083	-1.0585	21.5585
	2.00	3.2500	4.69929	.738	-7.8085	14.8085

Based on observed means.
The error term is Mean Square (Error) = 220.833.

Based on test information Table 4, it can be summed up as follows: first, in Group 1 and 2: seen that the Mean Difference of (5.55), meaning that the average difference between groups 1 and 2 in the amount of 5.55. With a value of 0.05 > 0.329 is significance, then it can be taken to mean that the Group 1 and 2 do not differ significantly. Second, on the Group 1 and 3: seen that the Mean Difference of (8.25), meaning that the average difference between groups 1 and 3 in the amount of 8.25. With a value of 0.083 > 0.05 is significance, then it can be interpreted that the groups 1 and 2 are not significantly different, and third, in groups 2 and 3: seen that the Mean Difference of (3.25), meaning that the average difference between groups 2 and 3 (3.25). With a value of 0.083 > 0.783 is significance, then it can be taken to mean that the Group 1 and 2 do not differ significantly. The influence of interactive cooperative learning Model was significant and learning style against the mastery of mathematical concept, characterized by the values of the cooperative learning model for significance and learning style 0.031 < 0.050 and 3.713 F_count>F_table 2.38. Thus Ho denied and H1 is accepted so that it can be concluded there is the influence interaction of cooperative learning model and learning style against the mastery of mathematical concepts.

Cooperative learning model is very helpful in the learning process; in this case the cooperative learning model is highlighted. Based on the results of a descriptive statistical data that groups with cooperative learning model of interaction type STAD against mathematical concepts with auditory learning style has a value of the mean or average of the greatest, and kinesthetic learning style then style visual learning. So it is evident that auditory learning style is very suitable with cooperative learning model in learning. But students who have visual and kinesthetic learning style of interacting with this cooperative learning model, turns out to be the difference in the mean values that are not significant with outrageously

auditory learning style. The learning style with the highest positive correlation with achievement in Mathematics is individual learning.

According to the research conducted by [25], the correlation between visual and auditory learning is significant, positive and medium, likewise for the correlations between kinaesthetic and visual learning, and between group-learning and kinaesthetic learning. This means that the more the learner is able to use one learning style, the more he or she is also able to implement another style [26]. In the discussion of the results of the research, the influence of interactive cooperative learning model and learning style towards the mastery of mathematical concepts is significant, and a calculation based on the results obtained that the model of learning cooperative type STAD is more influential towards mastery of mathematics learners from learning cooperative on the model type of Jigsaw, but the difference in learning styles among the learners do not affect in a significant way. So even though there may be differences in classroom learning style on each learner, but the application of the cooperative learning model type STAD towards mathematical concept can be used as an effort in improving the mastery of math concepts in learning at school, cooperative learning model so that it can be applied to learning other subjects adjusted to the lesson material. Cooperative learning (STAD) when using as instructional strategy has positive effect on students' academic achievement [27]. The value of the sig (0.000) < alpha (0.05) its mean hypothesis about learning model has better learning achievement of mathematics than direct learning. Thus the results of some research learning model type STAD is a suitable model of learning in high school activities, but it's requires time management because of the denseness of the activities in the use of models in this learning process [22].

4. CONCLUSION

Based on experiments in Tangerang City Budi Luhur Junior High School, the use of cooperative learning model STAD is more effective than Jigsaw learning models in understanding the mathematical concepts, because on the learning model cooperative STAD, students have the opportunity to have description material twice, namely through the explanations from the teacher and an explanation from fellow group members during the discussion. Meanwhile, the student differences in learning style has no effect significantly. we can conclude that in improving students ' performances on the mastery of mathematical concepts, it would be more effective if the teacher can select class with proper management, such as the election of the varied learning model that suits the learning materials. Researchers suggest to use Learning model cooperative STAD, because it can mobilize three domain competencies students i.e. comptence of cognitive, of affective, and competence of psychomotoric. Therefore, this research has not been perfect, then more research still needs to be developed, to the implications of the consummation through research that more komporehensif are based on the findings of this research. Last but not least, the writer would like to express deepest gratefulness to God Almighty and say many thanks for the help from all parties in writing this article.

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BIOGRAPHIES OF AUTHORS

Virgana was born in Padang, Indonesia, in September 16, 1955. He recieved the B.A. and S1 degree in educational Mathematics from IKIP Jakarta, Indonesia in 1978 and 1980, the M.A (Master of Arts) degree in special education from State University of Virginia (UVa), Virginia, USA in 1988, and Dr degree in Educational Management from UNJ Jakarta. Associate Profesor in University Indraprasta PGRI Jakarta.