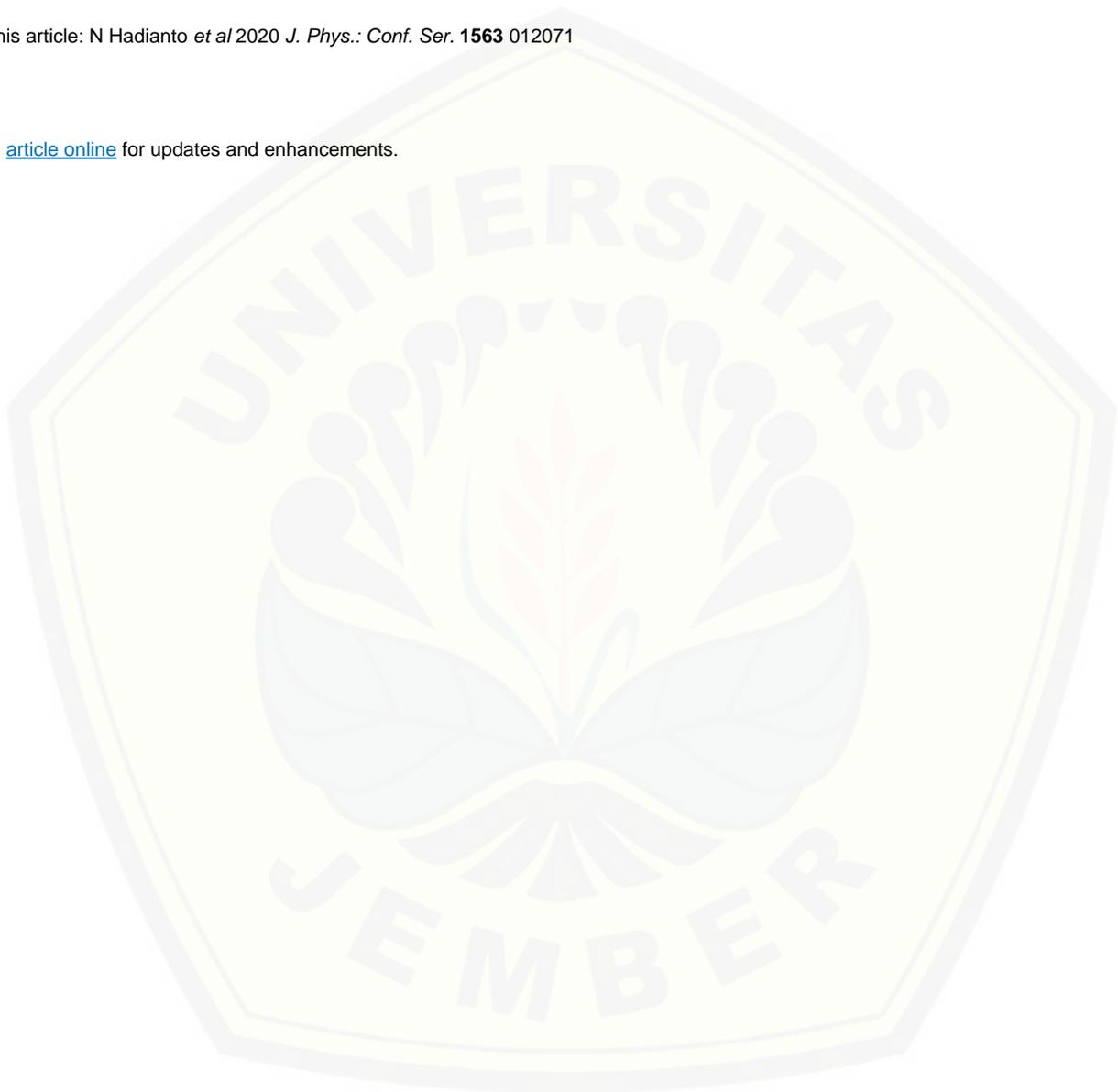


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## The implementation of lesson study as a tool to improve the students' higher order thinking skill on trigonometric material regarding creative thinking skill

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**Abstract.** The development of lesson study-based learning tool where students are able to involve directly in the learning so it is expected to improve their creative thinking skill. This research aimed at developing lesson study-based learning tool to help the students improve their creative thinking skill at SMK Darussalam in Trigonometry material validly, practically and effectively. This research used Plomp development model research design consisting of 3 phases covering: (i) Preliminary Research, (ii) Prototyping Phase and (iii) Assessment Phase. This research was the learning tool development research and experimental research by using Quasi Experimental Design method and Non-equivalent Post-test Only Control Group Design. In this research, the sampling technique used was simple random sampling. Out of 7 population classes, 2 sample classes were selected namely class X TKJ 1 as the experimental class which was given the treatment by using teaching material development and class X TKJ 2 as the control class by using direct learning. The data analysis technique used descriptive analysis to test the validity, practicality and effectivity as well as through mix method analysis to analyze the results of the students' learning achievement between the experimental and control classes. The results of this research revealed that: in the pre-test phase, from the experimental class, there were 3 students who belonged to L4 level, 1 student from the control class and in the post-test phase, from the experimental class, there were 8 students who were at L4 and only 1 student from the control class. With a significance of  $[t=1.15$  and  $df = 61$ ,  $p>0.05]$  in the pre-test phase and the value of  $[t=4.04$  and  $df = 61$ ,  $p<0.05]$  in the post-test phase and in the regression test, the values of  $t_{count}$  was 4.649 and  $t_{table}$  in degrees of freedom  $(df) = N - 2 = 33 - 2 = 31$  with a significance of 95% as much as 1.196 with a determination of  $t_{count} > t_{table}$  ( $8.296 > 1.196$ ) therefore  $H_0$  was accepted and  $H_a$  was rejected with a provision that there was a significant influence of lesson study method on the students' creative thinking skill.

### 1. Introduction

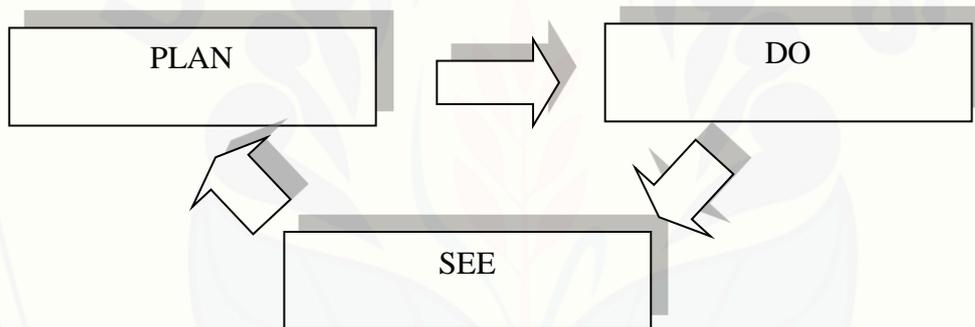
One of educational problems which becomes the first priority to be solved immediately is the problem of the students' thinking skill, particularly the students' higher order thinking quality. The improvement quality of education cannot be done only by repairing the curriculum, adding the learning books and providing the laboratory in schools. The education quality is the micro problem of education which is related to the students' understanding, teacher readiness, school readiness in supporting the learning process by providing the facilities needed and the participation of supporting society for education in the area accompanied by the management arrangement. In this modern era required a competition in every aspect, by the development of everything rapidly such as information and communication technology in every aspect of life [2][8]. The rapid Development of Knowledge and Technology requires students as the educational subject and next generation of nation to think critically, creatively, carefully and logically. Therefore, it needs efforts to improve the students'



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thinking skill, one of them is the implementation of lesson study as the learning method. Lesson Study is the collaboration between teachers in arranging the lesson plan as well as the research lesson, the implementation of learning in class accompanied by observation and reflection. By Lesson Study, teachers can widely improve their performances and professionalism which later can improve the quality of learning and produce the high quality students. The focus and attention on the effort to improve the creative thinking skill in mathematics is rare or has never been developed. In fact, this skill is really needed so the students can have the skills of gaining, managing and utilizing information to survive in life in the situation which is always changing, uncertain and competitive. Creative thinking skill is the skill to give new ideas which can be implemented to solve problems. Creative thinking skill requires to be developed by the students because it has a lot of benefits, including creative thinking can manifest itself, because self-realization is the main need in human's life. Maslow emphasizes in the investigation of human need system, aspect of high creative thinking skill is the manifestations of human which function fully in their self-realization.

According to Baba [1], lesson study referred to a process done by teachers which progressively tried to improve their learning method through the cooperation with other teachers, while Sukirman [7] said that lesson study as the model of fostering the teaching profession through the learning examination collaboratively and continuously based on the collegiality principles and mutual learning to build the learning community. Lesson study is done in three phases namely Plan (planning), Do (implementing) and See (reflecting) continuously. In other words, LS is a way to improve the education quality that never ends (continuous improvement). The scheme of lesson study is shown on the following figure:



**Figure 1.** Scheme of Lesson Study Activities

The phase process of lesson study was also given by Stigler and Hiebert [1]. They explained three main phases of lesson study process, namely preparation/plan, study lesson and review session. Preparation phase consisted of 3 activities including problem identification, class planning and consideration of class. Study lesson phase consisted of class implementation and implementation of class based on reconsideration. While review session consisted of class evaluation and review of results.

These phases are the cycles which were schematically described as follows:

**Preparation** Problem identification, Class Planning and Reconsideration of Class. **Study Lesson** Class Implementation and Implementation of Class Based on Reconsideration. **Review Session** Class Evaluation and Review of Results, Evaluation and Review and Sharing of results

Thinking process is an experience of processing problems to gain and determine new ideas as the answers of the problems faced. To solve the problems faced as efforts to reach the goals need creative skill. According to Umam [8] thinking skill was activities of reasoning reflectively, critically and creatively which were oriented to an intellectual process that involved conceptualizing, applying, analyzing, assessing the collected information (synthesis) or resulted from observation, experience, reflection, communication, as the basic of a belief (trust) and action. Based on Kratwohl [9] in a revision of Bloom's Taxonomy: an overview – Theory into Practice stated that indicators to assess the higher order thinking skills covering 3 levels, as follows: analysis level, evaluation level and creating level and 3 levels below it were low skills. The expected problem solving is problem solving which is involving and exercising creativity [3][4]. Creative thinking can be defined as a whole set of cognitive

activities which are used by individuals according to objects, certain problems and conditions, or types of business against certain events and problems based on individual capacity [6].

**Table 1.** Components of creative thinking skill in problem solving according to silver

Aspect	Problem Solving
<b>Fluency</b>	Students are able to solve problems with various solution interpretations and answers
<b>Flexibility</b>	Students finish (or state or justify) in one way, then with another way students discuss various solving method
<b>Novelty</b>	Students check how solving method or answers (statement or justification), then make another different method

Creative thinking was defined as a thinking-process whose characteristics covered fluency, flexibility, originality and elaboration [6]. Anggreini [4] pointed out that creativity or creative thinking was operationally formulated as a process reflected on fluency, flexibility and originality in thinking. Creative thinking was the ability to see or think about extraordinary, unusual things, combining unrelated information and popping out new solutions or ideas that also showed fluency, flexibility, flexibility, originality in thinking and elaboration. According to Nazula [6], 5 levels of creative thinking involved level 4 (very creative), level 3 (creative), level 2 (quite creative), level 1 (less creative) and level 0 (not creative). The characteristics of each level of creative thinking skill are shown on table 2.2

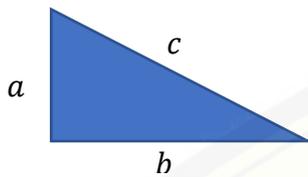
**Table 2.** The Characteristics of Creative Thinking Level

Levels of Creative Thinking Skill	Characteristics
Level 4 (Very Creative)	The students are able to solve problems by providing more than one solution and developing other ways to solve it. <b>Reach the aspects of elaboration, originality, flexibility and fluency</b>
Level 3 (Creative)	The students are able to solve problems by providing more than one solution, but they cannot develop any other ways to solve them. One solution is new. <b>Reach the aspects of originality and fluency</b>
Level 2 (Quite Creative)	The students are capable in solving the problems with more than one solution and developing the other ways to solve the problems but they provide the same way as the others do. <b>Reach the aspects of flexibility and fluency</b>
Level 1 (Less Creative)	The students are able to solve problems with one different solution but are not able to fulfill the aspects of fluency and flexibility <b>Reach the aspect of originality</b>
Level 0 (Not Creative)	The students are unable to solve the problems with more than one solution and develop the other solution to solve them. They also cannot get the new solution. <b>Do not reach the aspects of elaboration, originality, flexibility and fluency</b>

The studies of trigonometry as a branch of mathematics, separated from astronomy was first delivered by Nashiruddin al-Tusi (1201-1274), through his book entitled Treatise on the quadrilateral. The book, in fact, shows six comparisons of trigonometry through right triangle

**Trigonometry Material**

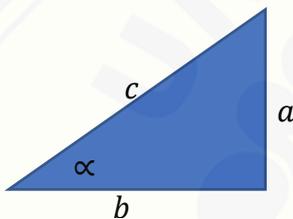
1. Right Triangle



$$\begin{aligned}
 1. c^2 &= a^2 + b^2 \\
 2. a^2 &= c^2 - b^2 \\
 3. b^2 &= c^2 - a^2
 \end{aligned}$$

**Figure 2.** Right Triangel

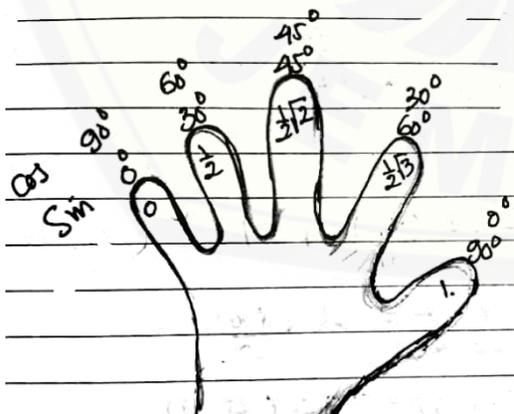
2. Basic Definition of Trigonometry



**Figure 3.** Right Triangel

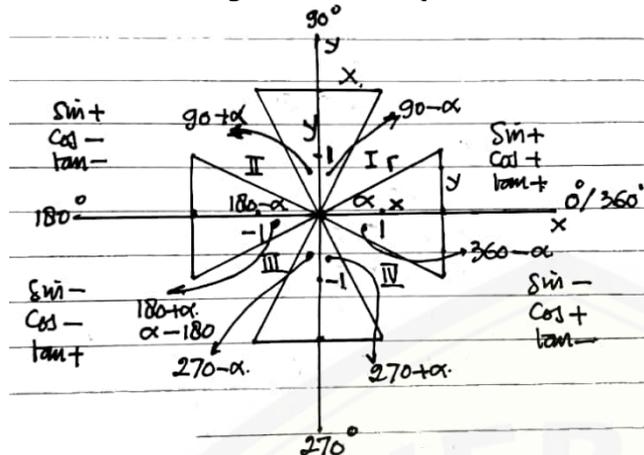
$$\begin{aligned}
 1. \sin \alpha &= \frac{\text{opposite side}}{\text{hypotenuse side}} = \frac{\text{opposite}}{\text{hypotenuse}} \\
 &= \frac{DE}{MI} = \frac{a}{c} \\
 2. \cos \alpha &= \frac{\text{adjacent side}}{\text{hypotenuse side}} = \frac{\text{adjacent}}{\text{hypotenuse}} \\
 &= \frac{SA}{MI} = \frac{b}{c} \\
 3. \tan \alpha &= \frac{\text{opposite side}}{\text{adjacent side}} = \frac{\text{opposite}}{\text{adjacent}} = \frac{DE}{SA} = \frac{a}{b} \\
 4. \tan \alpha &= \frac{\sin \alpha}{\cos \alpha} = \frac{\frac{a}{c}}{\frac{b}{c}} = \frac{a}{c} \times \frac{c}{b} = \frac{a}{b}
 \end{aligned}$$

3. Special Angles



**Figure 4.** The Special Angles on Fingers

4. The Value of Angles on various quadrants



- X-axis is as benchmark
- If the angle is more than 360, it will return to normal/first one
- If Y-axis as benchmark, the value will be reversed on quadrant

Figure 5. The Special Angles on Various Quadrants

2. Methodology

The research entitled "The Implementation of lesson study as a tool to improve the students' higher order thinking skills on trigonometric material regarding creative thinking skill" was a research with mixed method. Johnson and Cristensen [5] explained the definition of mixed research. "Research that involves the mixing of quantitative and qualitative approaches". Creswell in Sugiono then pointed out that the definition of mixed method research is "an approach to inquiry that combines or a philosophical assumption of the use of quantitative and qualitative approaches, and a mixture of both used in a research". A mixed research method is an approach in research that combines or links quantitative and qualitative research methods. Creswell [2] clarifies that there are two main models of mixed methods namely sequential model (mixed sequential), and concurrent model (mixed combinations). There are two sequential models, namely the sequential explanatory model and the sequential exploratory model. There are two concurrent models, namely, concurrent triangulation model (balanced mixed quantitative and qualitative) and concurrent embedded (reinforcement/second method strengthens the first method).

Quantitative research used an experimental research model with pre-test and post-test.

Table 3. The experimental research model with pretest and posttest

Class	pre test	treatment	post test
Experiment	R1	X	R2
Control	R1	—	R2

In qualitative research, the data sources used were student worksheets, observations and interviews. From the three sources the qualitative data triangulation was carried out, to further validate the tested data, qualitative and quantitative data triangulation was conducted.

3. Results and Discussion

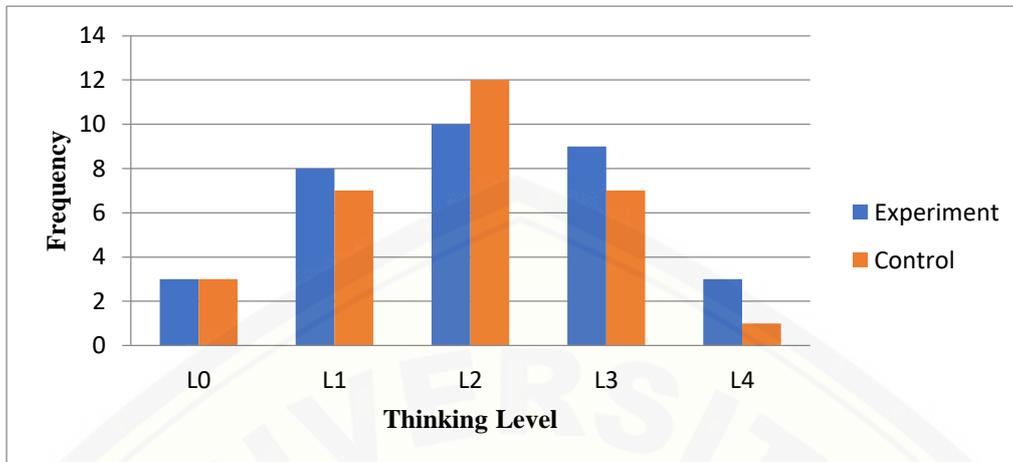
The research subjects were 63 university students who were tested for their thinking ability.

Table 4. Research Subject

Sample	n = 63
Experiment	33
Control	30
Gender	Male 30
	Female 33

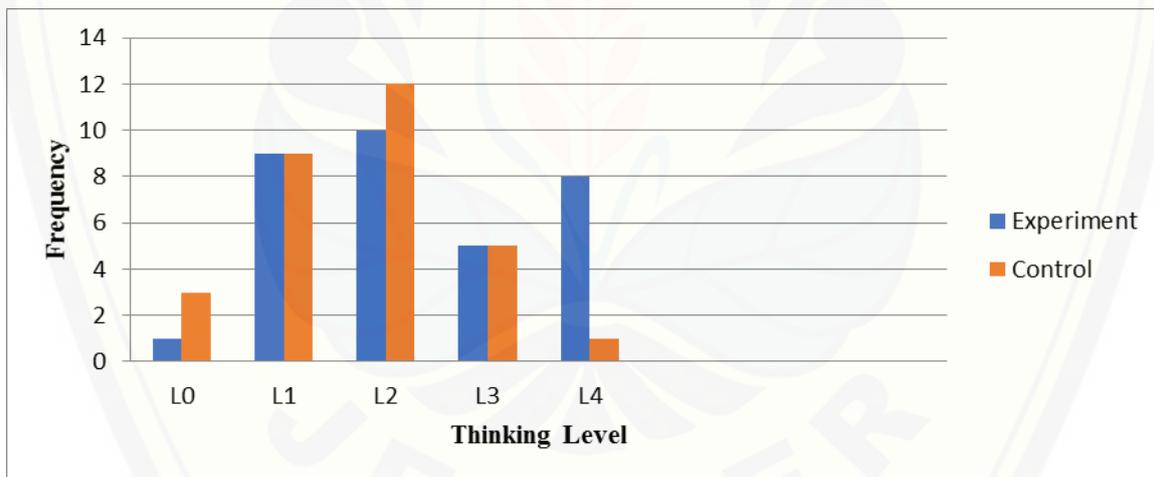
From the 63 students who were tested in the pre-test (Diagram 1) for the experimental class there were 3 students at the L0 level, 8 students at the L1 level, 10 students at the L2 level, 9 students at the

L3 level, and 3 students at the L4 level. For the control class there were 3 students at L0 level, 7 students at L1 level, 12 students at L2 level, 7 students at L3 level, and 1 student at L4 level.



**Diagram 1.** Analysis of learning achievements in pre-test

From the 63 students who were tested at the post test (Diagram 2) for the experimental class there were 1 student at L0 level, 9 L1 level students, 10 L2 level students, 5 L3 level students, and 8 students at L4 level. For the control class there were 3 students at L0 level, 9 L1 level students, 12 L2 level students, 5 L3 level students, and 1 student at L4 level.



**Diagram 2.** Analysis of learning achievements in post test

In the quantitative analysis stage, this research used two tests, namely the difference test of learning achievements of the pre and post tests and the test of the influence of the questionnaire data and the post test results. The difference test was done through 3 stages namely homogeneity test, normality test and difference test (independent sample t test). The test of the influence used a validation test and questionnaire data reliability. After the data were said to be valid and reliable, homogeneity test was carried out. After the data were known to have the same variant, performed a regression test, a regression equation test, a correlation coefficient test and a coefficient of determination test.

Homogeneity test was performed to find out whether the data were homogeneous or not. Based on table 1.5 for homogeneity test, the obtained sig. value was 0.06. Since the significance was greater than 0.05, thus the pre-test data had homogeneous variants and from homogeneity test of post-test obtained a sig value. As much as 0.063. Since the significance was greater than 0.05, the post test data had homogeneous variants and the independent t test could be continued at a later stage.

**Table 5.** Independent sample t-test of pre test

<b>Test of Homogeneity of Variance</b>									
<b>Homogeneity of pre test</b>					<b>Homogeneity of Post test</b>				
Levene					Levene				
Value	Based on Mean	Statistic	df1	df2	Sig.	Statistic	df1	df2	Sig.
		4,174	1	61	,06	3,585	1	61	,063

After the homogeneity test, then the normality test was done. The normality test was carried out to find out whether the data were normally distributed or not, the data were said to be normally distributed when the significance value was 0.05. Based on (Table 6) the significance value of the pre-normality test was  $0.200 > 0.05$  which meant that both variables were normally distributed and the significance value of the normality test of pre-test was  $0.200 \geq 0.05$  which meant that both variables were normally distributed.

**Table 6.** Normality test of the pre test

	<b>Tests of Normality</b>		
	Std. Deviation	Test Statistic	Asymp. Sig. (2-tailed)
<b>Normality of the Pre test</b>	10,45	,117	,200
<b>Normality of the Post test</b>	12,60	,062	,200

Table 7 shows that in the independent t test, the pre-test average score of the experimental class was 72.69 (SD = 10.42), this value was greater than the control class with an average value of 70 (SD = 7.852), and the significance showed the value of  $[t = 1.15 \text{ and } df = 61, p > 0.05]$  which meant that there was no difference at the pre-test. At the independent t test, the post-test average value of the experimental class was 74.27 (SD = 13.02), this value was greater than the control class with an average value of 62.23 (SD = 10.27), and the significance value was  $[t = 4.04 \text{ and } df = 61, p < 0.05]$  which meant that there was a difference at the post test.

**Table 7.** Independent sample t test of pre test  
**Independent Samples Test**

Class	N	Mean	SD	<b>Pre Test</b>			<b>Post Test</b>					
				T	Df	sig(2-tailed)	N	Mean	SD	T	df	sig(2-tailed)
Experiment	33	72,69	10,42	1.15	61	.254	33	74.27	13.02	4.04	61	.000
Control	30	70,0	7,852	1.16	59.02		30	62.23	10.27	4.09	59.8	

This regression test was carried out whether there was an effect of applying the lesson study learning method to the improvement of the ability to think creatively, the hypothesis of the regression test was taken after the normality test, the regression equation test, the linearity regression test, the correlation coefficient test, and the coefficient of determination test. Data normality test was done to find out whether the data were normally distributed or not, based on (table 8) the significance value of the Kolmogorov-Smirnova normality test, significance of the questionnaire lesson study on students' learning achievement was  $0.149 > 0.05$ . Based on both tests, significance value was  $> 0.05$  which meant that the data were normally distributed.

**Table 8.** Regression Normality

Tests of Normality			
	Kolmogorov-Smirnova		
	Std. Deviatio n	Test Statistic	Asymp. Sig. (2-tailed)
Post test results	3,56	,133	,149 <sup>c</sup>

The regression equation test was used to predict how high the dependent value (learning method) was if the independent value (learning outcome) was manipulated. Table 9 showed the regression sought for the value of sig. from the constant value of 0.06 < 0.05, thus the exact regression equation for the two variables was:

$$\bar{y} = 88.235 + 0.408x$$

$\bar{y}$  = Learning outcome

x = Lesson study method

From the equation above, it was obtained that the coefficient of regression was 0.408 which stated that each increase in the use of lesson study learning methods affected the students learning outcome as many as 0.408.

**Table 9.** Regression test

Model	Coefficients				
	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	88,235	3,704		23,821	,000
Lesson Study	,408	,049	,830	8,296	,000

Regression linearity test was used to determine whether the regression equation that had been made was linear or not. Table 1.10 showed the value of  $t_{count}$  on the variable of lesson study was 8,296, on the degree of freedom (df) = N - 2 = 33 - 2 = 31, on the level of confidence 95%, the value of  $t_{table}$  was 1,196. From these results it could be concluded that  $t_{count} > t_{table}$  which meant that there was an effect of the lesson study method on creative thinking skill. Based on the linearity test using ANOVA table, the linearity value (F = 68,822) with a significance value of 0.00 < 0.05 which meant that regression could be used to determine the effect of lesson study method on creative thinking skill.

**Table 10.** Regression Linearity Test

ANOVA Table					
Lesson Study * Post test result	Sum of Squares	Df	Mean Square	F	Sig.
Regression	901,965	1	901,965	68,822	,000 <sup>b</sup>
Residual	406,278	31	13,106		
Total	1308,242	32			

The correlation coefficient test aimed at determining the strength of the relationship between two variables. In table 11 correlation coefficient of 0.830 was obtained and based on the interpretation table of correlation coefficient, 0.830 showed strong correlation in term of the application of lesson study method with students' learning achievements. Coefficient determination, in the form of percentage, was done to measure how big the contribution between the dependent and independent variables was, the coefficient determination (R Square) was 0.689 with moderate level criterion of relationship. This meant that the contribution of the dependent variable (post test results) by the independent variable (lesson study) was 68.9% and the rest 31.1% was explained by other variables.

**Table 11.** Correlation Coefficient Test and Determination Test

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error
1	,830 <sup>a</sup>	,689	,679	3,62018

The regression equation test was used to predict how high the dependent value (learning method) was if the independent value (learning outcome) was manipulated. Table 13 showed the regression sought for the value of sig. from the constant value of  $0.06 < 0.05$ , thus the exact regression equation for two variables was:

$$\bar{y} = 88.235 + 0.408x$$

$\bar{y}$  = Learning Outcome

$x$  = Lesson study method

From the equation above, it was obtained that the coefficient of regression was 0.408 which stated that each increase in the use of lesson study learning methods affected the students' learning achievements as many as 0.408.

Hypothesis test was used to find out the effect of lesson study method on creative thinking skill, the hypothetical provisions were as follows:

$H_0$ : "There was an effect of lesson study method on creative thinking skill"

$H_a$ : "There was no effect of lesson study method on creative thinking skill"

$H_0$  was accepted when  $t_{\text{count}} > t_{\text{table}}$  which meant that there was a significant effect of lesson study method on creative thinking skill and  $H_0$  was rejected when  $t_{\text{count}} < t_{\text{table}}$  which meant that there was no effect of lesson study method on creative thinking skill.

In the regression test table (table 9) the value of  $t_{\text{count}}$  was 4,649 and the value of  $t_{\text{table}}$  at free degrees ( $df$ ) =  $N - 2 = 33 - 2 = 31$  with a significance of 95% as much as 1,196 with the provisions of  $t_{\text{count}} > t_{\text{table}}$  ( $8,296 > 1,196$ ) then  $H_0$  was accepted and  $H_a$  was rejected with the provision that there was a significant effect between the method of lesson study on the skill to think creatively.

#### 4. Conclusion

The distribution of the implementation of lesson study as a tool to improve the students' higher order thinking skill on trigonometric material regarding creative thinking skill show for the experimental class there were 1 student at L0 level, 9 L1 level students, 10 L2 level students, 5 L3 level students, and 8 students at L4 level. For the control class there were 3 students at L0 level, 9 L1 level students, 12 L2 level students, 5 L3 level students, and 1 student at L4 level. the independent t test, the pre-test average score of the experimental class was 72.69 (SD = 10.42), this value was greater than the control class with an average value of 70 (SD = 7.852), and the significance showed the value of [ $t = 1.15$  and  $df = 61$ ,  $p > 0.05$ ], At the independent t test, the post-test average value of the experimental class was 74.27 (SD = 13.02) and the significance value was [ $t = 4.04$  and  $df = 61$ ,  $p < 0.05$ ] which meant that there was a difference at the post test. And In the regression test table (table 12) the value of  $t_{\text{count}}$  was 4,649 and the value of  $t_{\text{table}}$  at free degrees ( $df$ ) =  $N - 2 = 33 - 2 = 31$  with a significance of 95% as much as 1,196 with the provisions of  $t_{\text{count}} > t_{\text{table}}$  ( $8,296 > 1,196$ ) then  $H_0$  was accepted and  $H_a$  was rejected with the provision that there was a significant effect between the method of lesson study on the skill to think creatively.

#### Acknowledgment

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