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Implementation of Structured Inquiry Based Model Learning Toward Students' Understanding of Geometry

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Abstract

The purpose this study is implementation a structured inquiry learning model in instruction geometry. The model used is a model with a quasi-experimental study amounted to two classes of samples selected from the population of the ten classes with cluster random sampling technique. Data collection tool consists of a test item questionnaire understanding of geometry and geometric perception of students towards learning using interactive learning technology. Post test data analysis begins with understanding the concept of geometry such analysis prerequisite test for normality test using Kolmogorov-Smirnov test and homogeneity test data using Levene test. Two mean difference test used was Kruskal Wallis k-independent samples of assisted program SPSS version 16. The results showed that students' understanding of the concept of geometry which acquire learning with structured inquiry model is significantly higher than the understanding of the concept of students who received conventional learning. Understanding the concept of geometry students with interactive learning technology is better than the understanding of the concept of students with conventional learning. There is a positive interaction between the applications of structured inquiry learning model by using interactive learning technology for students' understanding of the concept of geometry.

Key words: Inquiry Model structure; Understanding concepts; Geometry; Interactive learning technology

Introduction

Geometry is a part of mathematics which deals with the relationship between points, lines, angles, and wake field space (P4TK Matematika, 2008). Travers et all (1987) states that: "Geometry is the study of the relationships Among points, lines, angles, surfaces, and solids ". There are two kinds of knowledge in geometry is flat geometry and the geometry of space. At the high school mathematics curriculum in grade 10 will explain about learning the geometry of space. Builds space on its basis derived from concrete objects to make the process of abstraction and idealization (Nola. R, 2005). Abstraction is the process of attention and determine the nature, attributes, or special characteristics that are important in a geometrical object. Idealization is a process considers everything from concrete objects that ideal. In other words look a solid object that is equal to the actual shape (Paivio. A, 2013).

Johnson and Rising (1972) states that: "Mathematics is a creation of the human mind, concerned primarily with ideas, processes, and reasoning." Which means that mathematics is a creation of the human mind which is essentially related to ideas, processes , and reasoning. As stated before, the process of idealization and abstraction from concrete objects, humans develop knowledge that relates to the real objects are given special names cube. In the learning process, the high school students who are still in the stage of concrete operations (based on Piaget opinion) is very difficult to catch the nature or particular characteristics of the cube, as he has 6 pieces of square-shaped field side. Therefore, approaches and learning strategy rests on the notion that understanding a concept or self-constructed knowledge (constructed) by the students. This means, a formula, a concept or principle in the geometry of space, should be rediscovered by students under the guidance of teachers (guided reinvention). Conditioned learning students to rediscover, making them accustomed to investigate and find something, and it will also be useful in other fields as well as in everyday of life.

Based on interviews with a number of high school mathematics teachers in the Province Kepulauan Riau , that there are several factors as causes of students' learning difficulties in understanding the concepts of geometry. Among these are (1) the number of concepts that are abstract geometry; (2) learning model geometry applied was based on the assumption that knowledge can be transferred intact from the mind of the teacher to the student's mind; (3) the evaluation system, the teacher just focus on the assessment of the results of formative and

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summative examinations; (4) quizzes with feedback from students rarely implemented in learning mathematics; (5) students who take geometry learning situation varies greatly with different cognitive abilities. They differ in terms of learning preferences, prior knowledge, intelligence, motivation, learning pace and in the other case.

According Santyasa (2007), "To improve the quality of the processes and outcomes of learning, the learning experts have suggested the use structured inquiry learning paradigm for teaching and learning activities in the classroom". With the changes in the learning paradigm change center (focus) learning from a teacher-centered learning to student-centered learning. In other words, when teaching in the classroom, teachers should strive to create a learning environment that can be students learning, to encourage students to learn, or provide an opportunity for students to participate actively construct concepts learned. Conditions of learning which make students only receive materials from teachers, notes, and memorize it should be changed to the new knowledge search, looking through the guidance (structured inquiry), find knowledge actively so as to increase understanding of not only the memory of it (Paivio, A, 2013). There are several models of learning which is based on the paradigm of constructivism, in the search for new knowledge and build such a model of PBL (Problem Based Learning), CTL (Contextual Teaching and Learning), inquiry training models, conceptual change learning model, and the model group investigation. "But learning model in accordance with the characteristics of the learning material and the character of the students in the class should provide a greater contribution to the development of student learning" (Santyasa, 2007).

Therefore, the concepts in the learning material a lot of abstract geometry in this case it is realized that there needs to be related to the daily life of students, as well as the situation of students of different cognitive abilities, so in this study used a model of structured inquiry-based learning approach. Inquiry structured approach used in this study is expected to help students improve their understanding of the concept of geometry. In addition, structured inquiry approach is also expected to develop intellectual thinking skills and other skills such as asking questions and finding answers originated skills of their curiosity. Thus they will be familiar such as rigorous science, diligent, objective, respect the opinions of others and creative (Joyce, B.et.al, 2000).

Structured inquiry model is a model that promotes the involvement of learners actively and creatively in the search for, examine, formulate concepts and principles of geometry and to encourage students to develop intellectually and skill in solving the problem. In the structured inquiry model student-centered learning, so that students can actively participating in the learning process. According to Sanjaya (2009), the main objective of the strategy is the development of inquiry structured thinking skills-oriented learning process. Criteria for success of the learning process by using the inquiry model structure is not determined by the understanding of the learning material but the extent to which students are active search for and find something. Structured inquiry model emphasizes on the development of cognitive, affective and psychomotor balanced manner so that through this model of learning more meaningful.

In relation to learning goemetry, students are directed to formulate a hypothesis, perform experiments related to the learning material geometry and make conclusions to answer the hypothesis. In studying and developing the science needs to be supported by students' attitudes in students. Student attitudes related to skill groups in the field of the requirements for the learning process. So in essence the attitude of students is a tendency or impulse to behave and thinking in accordance with the model expected.

The attitude of students consists of curiosity (curiosity), flexibility (flexibility), critical reflection (critical student attitudes), and honest. Students who have high student attitudes will have fluency in thinking that they will be motivated to excel and have a strong commitment to achieve success in learning. In studying the geometry of the learning material presented by the use of structured inquiry model, students' attitudes are very influential in the learning process. Frequent case is the lack of a critical attitude and less eager students in learning mathematics, students' attitudes like this are not expected to arise in the implementation of learning in the classroom or laboratory. Thus, in the present study attitudes students need to be a review.

Based on the description set forth above, the research by applying the model structured inquiry which can increase students' understanding of the concept becomes better and higher so that student achievement in learning material geometry for the better. The main problem in this study is whether the use of structured inquiry learning model can further enhance the students' understanding of the concept than the use of conventional learning models in terms of attitudes and perceptions of students in the geometry learning material. The purpose of research to determine the ratio of students who are given understanding of the concept of learning by inquiry model and conventional structured, knowing students' perception of the interaction between the application of the learning model with an attitude of students in learning geometry.

Methodology

This research includes quasi-experimental research with pretest and posttest quasi design. Data analysis was performed to obtain the increased understanding of the concept in terms of attitudes and perceptions of students. In this study, subjects were given further treatment was measured as a result of the treatment. In experimental models, researchers are free to determine the design of experiments (Arikunto, 2006). This study used a factorial design as shown in Table 1 below:

Table 1. Factorial Research Design

		Learning Model	
		Inquiry Model structure (X1)	Conventional (X2)
Attitudes and perceptions of students	High (Y1)	(X1Y1)	(X2Y1)
	Low (Y2)	(X1Y2)	(X2Y2)

Table 1 is a factorial design study to see the effect and interaction learning model, students 'attitudes and perceptions of students' understanding of concepts in geometry material. Learning model that compared the structured inquiry model (X1) and conventional (X2). Students' attitudes and perceptions of students categorized into high (Y1) and low (Y2). Samples were SMAN 3 Tanjungpinang who are following the lesson material geometry. The sample was selected 2 class from a population of 10 class with cluster random sampling technique (Suparno, 2007). The number of samples included in this study were 58 people consisting of 29 people experimental class and 29 people control class. There are two types of instruments that are used to retrieve data that research; 1) test understanding of concepts shaped geometry multiple choice (multiple choice) questions numbered 20 held at the end of the test, and 2) a questionnaire attitudes and perceptions of students who are 20 questions to categorize the students who have the attitudes and perceptions of students of high and low.

Instruments tested then further analyzed the data selected are good questions to be used in research. Analysis instruments include test validity, level of difficulty, distinguishing, and reliability of the instrument. Test conducted research about the validity of using the product moment correlation formula (Arifin, 2009). Level of difficulty, distinguishing features and reliability problems were analyzed using the equation proposed by Arikunto (2006). Questions used in the study have valid criteria with high reliability.
Prior to determine differences in learning outcomes of students who were given learning with structured inquiry model and conventional learning model, first tested the ability of the students in the class early experimental and control classes. If the initial ability of students in the two classes together, the study design did not use pretest and posttest design but simply use the posttest-only design. The same initial Capability impact on treatment outcome illustrates the differences of learning outcomes only due to the difference in treatment in applying the learning model. Initial capability data taken from the tests earlier learning material. The results of the initial test students' abilities in the experimental classes and control classes can be seen in Table 2 below:

Table 2. Initial student capability test results

Statistics	Value
df	51.000
T stat	0.2313
P(T<=t) two tail	0.7852
T critical two tail	2.0322

Based on Table 2, note that the p-value of 0.7852 and is greater than the 0.05 significance level research. It shows that there are differences in average ability students between classes beginning the experimental and control classes before being given treatment in both classes. Thus, the research design used to see the effect of the application of learning models to the students' understanding of concepts in this study using a posttest-only control design. Research data processing begins with the test requirements analysis in the form of normality and homogeneity test data. Normality test aims to determine whether the data taken from the population that is normally distributed or not normal. The test is performed using SPSS version 17 with choice test test used is the Kolmogorov-Smirnov. While the data homogeneity test was conducted to determine whether the two sets of data are homogeneous or inhomogeneous. Homogeneity test using the Levene test programming are also processed using SPSS version 17.
Testing the significance of differences between the mean level of conceptual understanding between the experimental group and the control group performed statistically. Prerequisite test results analysis show that there is not normally distributed data or homogeneous so that the statistics used are non-parametric statistical

test and the two mean difference used was Kruskal Wallis k-independent samples. Two mean difference test was performed using SPSS version 17.

Results

Data were described on the application of inquiry learning model structure on learning materials goemetri include; test data on the students' understanding of concepts goemetri material, and data attitudes and perceptions of students. Then performed a comparative analysis of students' understanding of concepts taught with structured inquiry learning model with the conventional model by considering the attitude of the students. Description of student understanding concepts in geometry Matter Data acquisition value students' understanding of the concept of the geometry of the experimental class and control classes are presented in Table 3.

Table 3. Description of value understanding conceptual geometry

	Experiment Class	Control Class
Number (N)	29.00	29.00
Max Value	85.50	71.70
Min Value	65.10	49.80
The mean of value	78.62	65.21
Standard Deviation	7.39	7.19

Based on Table 3, it can be seen that the average value of students 'understanding of geometric concepts in the experimental class at 78.62 while the average value of students' understanding of geometric concepts in control class is 65.21. This shows that the average value of students 'understanding of geometric concepts in experimental class is higher than average value of students' understanding of the concept of geometry on the control class. The maximum value of understanding the concept of three-dimensional geometry of students in the experimental class (85.50) is higher than the maximum value of understanding the concept of three-dimensional geometry in the control class (71.70). Judging from the standard deviation, the standard deviation of the data on the students 'understanding of the concept of the experimental class (7.39) is not much different than the standard deviation of the data on the students' understanding of the concept of class control (7,19). It shows that the students 'understanding of data distribution in the experimental class with the same homogeneous distribution of the data on the students' understanding of the concept of the control class.

Description of attitudes and perceptions of students data acquisition attitude scores of students students students in experimental classes and control classes were taken before treatment is given. Indicators include the students' attitudes and perceptions; rigor, discipline, creativity, expression / ideas, attitudes curious, critical and responsible. Description student attitudes students score data are presented in Table 4.

Table 4. Data description of attitudes and perceptions of students' scores

	Experiment Class	Control Class
Number (N)	29.00	29.00
Max Value	105.00	86.00
Min Value	76.00	63.00
The mean of value	91.12	74.52
Standard Deviation	8.09	8.73

In Table 4 it can be seen that the average scores of students in the classroom student attitudes experimental/ structured inquiry model (91.12) is higher than the average scores of students at grade student attitude control / conventional model (74.52). Maximum score students' attitudes of students who were given structured inquiry model (105.00) is higher than the maximum score attitudes students taught with the conventional model (86.00). Likewise with the second lowest value of different classes namely 76.00 (class of structured inquiry model) and 63.00 (class experimental model). The standard deviation of the experimental class / structured inquiry model (8.09) is lower than the standard deviation of the control class/ conventional model (8.73). These results suggest students are more likely to have such a good student attitudes more thoroughly, more critical in the classroom learning with structured inquiry model than in a conventional classroom.

Furthermore, the category of attitudes and perceptions of students of high and low on both classes can be seen in Figure 1.

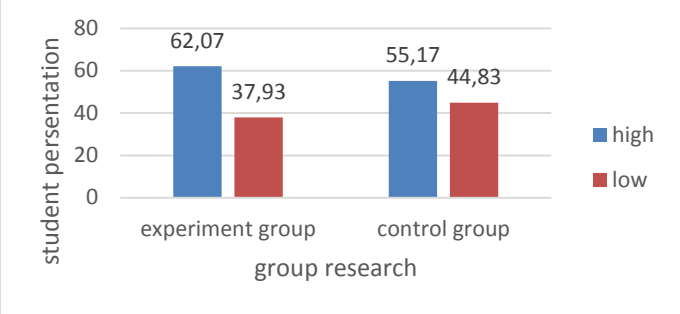

Figure 1. Number of students by category attitude students

In Figure 1, it can be seen that the percentage of students who have high student attitudes in the experimental class 63.03% greater than the percentage of students who have high attitude and perception 55.17% in the control classes. The number of students who have low student attitudes and perceptions of the experimental class as much as 37.93% of the students and the students who have low student perceptions on attitude control class as much as 44.83% of the students.

Description Conceptual Understanding of Geometry Based on Students' Attitudes and Perceptions

The data is reviewed student conceptual understanding than students' attitudes and perceptions of high and low are presented in Table 5.

Table 5. The description of the student conceptual understanding by attitudes and perceptions of students of high and low

	Attitudes and perceptions low	attitudes and perceptions height
Number (N)	34	24
Max Score	88.75	75.65
Score Min	50.51	54.23
The mean score	72.41	69.78
Standard Deviation	0.10	4.20

In Table 5 it can be seen that the average value of understanding the concept of students who have the attitudes and perceptions of students 'high (72.41) is not much different than the average of students' understanding of concepts that have low student attitudes (71.97). However, the maximum value of understanding the concept of students who have high student attitudes (88.75) is higher than the maximum value of understanding the concept of students who have low student attitudes (75.65).

Based on the standard deviation, the distribution of the value of understanding the concept of students with student attitudes and perceptions category height closer to the average value of the class compared with the distribution of the value of understanding the concepts and perceptions of students with categories attitudes and perceptions of students is low. It is shown from the standard deviation scores of students with students 'attitudes and perceptions of high (0.10) is smaller than the standard deviation scores of students with students' attitudes and perceptions of low (4.20).

Prerequisite Test Results Analysis

Test requirements analysis consists of tests of normality and homogeneity test data. Prerequisite test analysis is performed to determine the type of comparative test statistics that will be used. Parametric statistics used in the comparative test if the data is normally distributed and homogeneous, but if the data is not normally distributed or not homogeneous, the statistics used in the comparative test is non-parametric statistics. The data will be statistically tested students' understanding of the concept is the data in terms of attitudes and perceptions of students in the control class and experimental class. Normality test is performed to determine whether the samples come from populations with normal distribution or normal distribution. Normality test data used in this study is Kolmogorof-Smirnov test using SPSS version 17.

Dependent variable data including data entered into the understanding of the concept of the dependent variable list and then the data is free (learning model) and moderator variables (attitudes and perceptions of students) is inserted into the factor list. If the probability value or significance value calculation data is greater than 0.05 (Sig.> 0.05), the data are derived from normally distributed populations, otherwise the value of the probability

or significance value calculation data if it is smaller than 0.05 (Sig. <0.05), the data are derived from populations that are not normally distributed. Summary of the results of the data normality test conceptual understanding based model of learning and attitudes of students who count with the Kolmogorov-Smirnov test are presented in Table 6 and Table 7.

Table 6. Results of normality test data research based on classroom research

Independent variable	Research group	Kolmogorov-Smirnov		
		Statistic	df	Sig.
understanding of concepts	Experiment group	0.225	28	0.002
	Control group	0.310	28	0.000

[α = 5% (0.05)]

Based on the test results data normality (Kolmogorov-Smirnov test) using SPSS version 17 are shown in Table 6 and Table 7, it can be seen that the value of the significance of the data shows all the data were not normally distributed groups. It can be seen from the value of significance (sig) the results of the calculations in the table. Significance calculation of the entire group of data either by grouping class research (Table 6) and by the attitude of the student's perception (Table 7) are all less than 5% significant level (sig. <0.05). It shows that the data are not normally distributed.

Table 7. Results of normality test data research based on students' perceptions attitudes

Independent variable	Attitude and perception of student	Kolmogorov-Smirnov		
		Statistic	df	Sig.
understanding of concepts	High	0.172	33	0.035
	low	0.254	23	0.008

[α = 5% (0.05)]

Test of homogeneity in this study conducted to see whether the data dependent variable (understanding concepts) based on the model of learning and attitudes of students in this study are homogeneous or inhomogeneous. Homogeneity test data used in this study is the Levene test based on the average value (based on the mean) data using SPSS version 16. The dependent variable data that is inserted into the understanding of the concept of the dependent variable list and then the data is free (research grade) and moderator variables (attitudes and perceptions of students) is inserted into the factor list. If the probability value or significance value calculation data is greater than 0.05 (Sig.> 0.05) then the data is homogeneous, otherwise the value of the probability or significance value calculation data if it is smaller than 0.05 (Sig. <0.05), then the data is not homogeneous. Summary of test results with the Levene test for normality of data presented in Table 8.

Table 8. Results of homogeneity test data research

Factor List (Independent Variabel)	Dependen List	Levene Test			
		Statistic	df1	df2	Sig.
Group research	Understanding of concept	0.512	1	58	0.873
Attitude and student perseption	Understanding of concept	35.23	1	58	0.000

[α = 0:05 (5%)]

Based on the test results of data homogeneity (Levene test) using SPSS 17 are shown in Table 8, it can be seen that the value of the significance of the data shows that there are several groups of homogeneous data, but there are also sets of data are not homogeneous. It can be seen from the value of significance (sig) the results of the calculations in the table. Homogeneous groups of data based on Table 7 that the data of understanding the concept of class based research group. It can be seen from the value of the significance of these data (the data in the last column of the third row) which has a significance value calculation (sig) larger (.873) from the research significance level (α) used is 0.05. While based on the attitudes and perceptions of students (high and low), the data are not homogeneous understanding of the concept. That is because the empirical significance (0,000) in the last column of the fourth line, is smaller than the significance level of research (α) used is 0.05.

Comparative Test Results Review (Hypothesis)

Test requirements analysis showed that most of the research data berdistribus not normal and homogeneous, so that inter-group comparative test data in This research uses non-parametric statistical Kruskal-Wallis test sample

t-independent. Comparative test performed with SPSS version 17. Prior to the comparative test, it will first discuss the research hypothesis to provide answers while on the formulation of research problems.

a. First hypothesis

H0: there is no difference in the students' understanding of the concept of getting learning with structured inquiry model with understanding the concept of learning by students who received conventional models. Ha: There are differences in the students' understanding of the concept of getting learning with structured inquiry model with understanding the concept of learning by students who received conventional models.

b. Second Hypothesis

H0: there is no difference in students' understanding of concepts that have high student attitudes and the attitudes of students is low. Ha: There are differences in students' understanding of concepts that have high student attitudes and the attitudes of students is low.

c. Third Hypothesis

H0: there is no interaction between learning model with students 'attitudes and perceptions of students understanding concepts. Ha: There is no interaction between learning model with attitude and perception of students understanding of concepts.

Inter-group comparative test data is performed using the Kruskal-Wallis test k-independet sample with SPSS version 16. The zero hypothesis (H0) is accepted if the significance value calculation (sig.) Is greater than the significance level used in this research is α = 5% (0.05). However, null hypothesis (H0) is rejected and the alternative hypothesis (Ha) is accepted if the value of the calculation of significance (sig.) Is smaller than the significance level used in this research is α = 5% (0.05). Summary of the results of the research hypothesis testing using the Kruskal-Wallis test can be seen in Table 9.

Table 9. Summary of comparative test (Test of hypothesis)

Hypothesis	Kruskal Wallis Chi-Square	df	Asym Sig.
First Hypothesis	35.20	1	0.000
Second Hypothesis	0.737	1	0.445
Third Hypothesis	38.265	3	0.000

Based on the summary of the results of hypothesis testing in Table 9, it is known that the value of the significance of data calculation (Asym sig.) For the first and third hypothesis is smaller than the significance level of 5% (0.05), so the null hypothesis is rejected and the alternative hypothesis is accepted. Whereas in the second hypothesis, the significant value of data calculation (Asym sig.) Is greater than the significance level of 5% (0.05), so the null hypothesis is accepted and the alternative hypothesis is rejected. It can be concluded as follows:

a. There are significant differences between students' understanding of concepts that get structured inquiry learning with understanding the concept of learning by students who received conventional models.
b. There was no significant difference between students' understanding of the concepts that have high student attitudes with low student attitudes.
c. There is interaction between students learning model with an attitude of students Based on the results of comparative tests, the first hypothesis is known that there are differences in students' understanding of concepts significantly the gain learning with structured inquiry model with understanding the concept of learning by students who received conventional models.

When viewed from the mean value of understanding the concept of Table 3, it can be concluded that students gain understanding of the concept of learning with structured inquiry model is better than the students who get the understanding of the concept of learning with the conventional model. Understanding the concept of better student after a given learning with structured inquiry model the impact of the advantages of the application of structured inquiry model. Barlow in Muhibbin (2005) stated that the inquiry-based learning structured more emphasis on the use of the intellectual process of learners in acquiring knowledge by finding and organizing concepts and principles into an order of importance according to the student. Thus, it can be said in the inquiry

process structured student trying to find a concept of knowledge in the learning material by using their intellectual thus more memorable learning for students and last long in the memory. So that more students can make understand the subject matter of geometry and specific learning makes understanding the concept of students in geometry for the better material. The results of this study also found by Nurhayati (2011), which indicates that the application of structured inquiry model can improve student learning outcomes in the material geometry. In addition to the use of models of learning, other things that can affect student learning outcomes are student perceptions dam attitude in the face of math. According Baharuddin in Ulum (2007), "Attitudes and perceptions of students is basically the tendency of individuals to act or behave in solving a problem systematically. Attitudes and perceptions of high student should have an impact on learning outcomes better. Although in this study, the value of understanding the concept of students who have high student attitudes slightly higher or about the same compared to the value of understanding the concept of students who have low student attitudes (Table 5), but these results did not differ significantly. This can be seen from the comparative test in Table 9.

The results also demonstrate the interaction between class learning (structured inquiry model and the conventional model) with the attitudes and perceptions of students (high and low) on the understanding of the concept of the students on the material geometry. In order to understand the interaction of the further analysis by describing the graph in Figure 2.

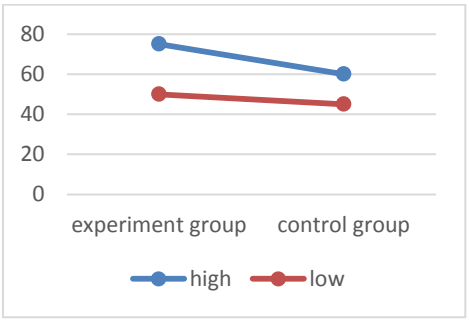

Figure 2. Graph of interaction between students' attitudes and perceptions understanding the concept of students on the learning material geometry

In Figure 2, it can be seen that the average value of the marginal understanding of the concept of geometry students in the experimental class in general higher than the average marginal understanding of the concept of geometry students in the control class. This suggests that learning by using structured inquiry model can improve the understanding of the concept compared to conventional models (lecture and textbook). If the terms of the attitudes and perceptions of students, students 'understanding of concepts is higher in classes taught with structured inquiry model compared to the students' understanding of the concepts that have attitudes and perceptions of students are low.

It shows that, with the attitudes and perceptions of high student students may be able to follow the learning process that uses a structured inquiry model. Attitudes and perceptions of student like curiosity, creative and proactive indispensable in the process of structured inquiry as to understand the learning material geometry. Students who have a high attitude and perception has more high creativity in learning geometry. Just as seen in conventional learning class students who have high student attitudes and perceptions more able to follow the learning compared to students who have a low student attitudes.

Conclusion

Based on research that has been done, it can be concluded that there are differences in understanding of the concept of learning by students who obtain structured inquiry model with understanding the concept of learning by students who received conventional models. When viewed from the mean value, the students gain understanding of the concept of learning with structured inquiry model is better than the understanding of the concept of learning by students who received conventional models in the learning geometry (Bentley, 2012). Understanding the concept of students who have high student attitudes better than the understanding of the concept of students who have a low student perceptions attitude however, mastery of concepts based on high and low students' attitudes did not differ significantly. There is interaction between structured inquiry learning model with attitudes and perceptions of students is higher.

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