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THE EFFECT OF INQUIRY TRAINING MODELS BASED ON LECTORA AND FORMAL THINKING ABILITY TOWARD PHYSICS STUDENTS ACHIEVEMENT

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Abstract - This paper presents the results of research the use of lectora multimedia as innovation in science education teaching and learning when combined with inquiry training instructional models and formal thinking ability toward students achievement in Harapan Senior High School Academic Year 2014/2015 in the measurement material. The research aims : (1) to explain the students achievement who applied inquiry training instructional models based on lectora multimedia better than conventional instructional models, (2) to explain the students achievement who have high formal thinking ability better than students who have low formal thinking ability, (3) to explain the interaction between inquiry training instructional models based on lectora multimedia and formal thinking ability toward students achievement. The instruments used in this research are formal thinking ability instrument consist of 10 questions and student achievement instrument consist of 20 questions stated valid and reliable. To test the hypothesis used analysis of variance two tails (2 x 2 factorial design) with a significant level $\alpha = 0.05$. The results of research are : (1) the students achievement who applied inquiry training instructional models based on lectora multimedia better than conventional instructional models; (2) the students achievement who have a high formal thinking ability better than students who have low formal thinking ability, (3) there was interaction between inquiry training learning models based on lectora multimedia and formal thinking ability toward students achievement.

Keywords: inquiry training, formal thinking ability, lectora, conventional.

1. INTRODUCTION

The 21st century is the century of science and technology, therefore we are faced with a situation where science and technology is changing and evolving very rapidly. To deal with these changes very rapidly then the required human resources (HR), which has high competitiveness, creative, reliable and quality to be able to handle the various possible solutions to a problem and change. But the expected demands of human resources does not match the reality. According to the data version of the UNDP Human Development Report in 2013, level HDI (Human Development Index) of Indonesia is on ranked 121 of 187 countries. Meanwhile the results of votes Trends in International Mathematics and Science Study (TIMSS), an international study which is held every four years in order to know the development of the ability of science to students in various countries, in 2011 put Indonesia level 38 from 42 countries. This indicates that the quality of human resources and the ability of Mathematics and Science students in Indonesia is still far below the average of other countries.

Omosewo (1999) stated the several factors that causes low students achievement: the limited number of professionally trained teachers, inadequate laboratory facilities, poor background of science students are currently learning ability in middle level. Various efforts have been made by the government to find solution of low learning outcomes such as by changes in the curriculum, facilities and infrastructure, improving the quality of teachers, and the renewal of the learning process. But has not shown results satisfactory because until now the results of studying physics in high school students is still low. This indicates that these efforts have not been able to improve student learning outcomes. Students still have not been able to apply the concepts well understood form of knowledge, skills and attitudes in a real situation.

Based on preliminary study in Harapan High School performed in Medan, data showed the average value of class X student from the second semester of 2011/2012 was 53.62, year of 2012/2013 was 56.86 and years of 2013/2014 was 62.14 . The average value is still below minimum completeness criteria (KKM) where the KKM 's is 75.00. It makes a lot of students have to undertake remedial program to increase their value. In addition, based the results of a questionnaire distributed to

40 students found that as many as 70.0 % of students do not like physics, 12.5 % stated that physics was mediocre and only 17.5 % of students stating liked physics. This is due to the many formulas that further highlight the form of a physics equation rather than the concept should be applied. As a result, students difficulties in resolving issues related to science.

In the use of computer technology, as much as 100 % of the students understand how to operate a computer program for as many as 95 % of students have a computer/notebook at home and the rest understand computer programs because there are subjects computer in their school and also played notebook from their friends who sometimes bring notebook to school. Then many students who also have a ipad or tablet. However, the use of multimedia is also rare because many teachers do not understand how to create a formula or equations using the equation on toolsbar. In fact, teachers are the spearhead that affect the quality of the learning in class. Students also lacked confidence in his friends to shows the results of the experiments conducted so that 100 % of students never presented the results of his work in front of their friends. This is what makes unheard of scientific debate among students.

Teachers should also consider the different of formal reasoning from each students. This can be performed well when information about the formal reasoning of students already owned a teacher. This statement supported by a research conducted by Amien (in Eka, 2005) showed that formal thinking can be measured on secondary high school students. Through the class (and by age) there is a significant increase in terms of how the 15 year olds have a level think formal higher than children aged 14 years. It was also found differences in terms of gender, place of residence (urban and rural), and the education level of the family. The urban environment and the family environment that parents have higher education more stimulating children in developing formal reasoning.

According to Piaget in (Corebima, 2013), the development of formal reasoning is essential to understand the concepts for conceptual knowledge because it is a constructive process and reasoning is a necessary tool in the process. Furthermore, Piaget in Day (1981) stated that a child formal operational level is able to construct and concluded a hypothesis against certain phenomena and incorporate systematically a set of elements to create every possible combination and control the variables. This opinion is relevant to the purpose of inquiry learning model training. According Suchman (2007) inquiry can be applied in various ways such as observing nature, estimates the condition that would happen, manipulate variables, analyze the situation and give a statement. In addition, through research conducted by Ali (in Eka, 2005) found that the formal thinking ability positively correlated with the formal achievement either individually or in together, though do the control of the creativity variable and achievement motivation. This suggestion show that the ability to think formal consistently positively correlated with the results achievement. It also means if students has high formal thinking ability, it will increase achievement of the students.

To repair the quality of processes and achievement of the students need a serious effort, one of them by applying the inquiry training learning which this learning can help to understand the concepts and solve problems in learning. According to Joyce, et al (2003) this learning is focused on the students' ability to observe, collate the data, understand the information, forming concepts, using symbols of verbal and nonverbal and solve the problems. The views of these research results also indicates that the inquiry training is proven to improve students achievement. According to Pandey, et al (2011) the inquiry training is more effective than learning by using conventional learning. Similar statement also delivered by Khalid & Azeem (2012) which states that the inquiry training that given by the teachers can help achievement of the students where students can formulate and test their ideas, draw conclusions and pass on their knowledge in a collaborative learning environment.

Learn by using inquiry training model can also be applied using multimedia technology. According Gillani (2010) the development of web and hypermedia make opinions on inquiry learning training can be implemented by using technology in different conditions. According to Hayati (2013) stated there is significant effect by using inquiry training based on multimedia toward student achievement. In addition, research that conducted by Nurhafni (2010) stated the achievement taught using multimedia more higher than the achievement taught without using multimedia. The results of the same research also showed by Fatmi (2013) which states that there is significant effect of using multimedia in inquiry toward studens achievement.

According Ismaniati (2010) the process and learning resources that can be designed and developed by learning technology based on student characteristics and is based with learning theories can definitely will become more qualified because the learning process of each student will gets

optimum services according to their characteristics. So that students will be more active, more fun and easier to learn. Based on the description of the background issues and the above theory, the formulation of the problem in this research: (1) the result of compare students learning outcomes when use inquiry training intructional models than use conventional instructional models in Harapan Senior High School Academic Year 2014/2015 in the measurement material ? (2) the result of student who have high formal thinking ability with students who have low formal thinking ability in Harapan Senior High School Academic Year 2014/2015 in the measurement material? (3) the interaction between inquiry training instructional models based on multimedia lectora and formal thinking ability toward students achievement in Harapan Senior High School Academic Year 2014/2015 in the measurement material?

The purpose of this study: (1) to determine students achievement that more better between using inquiry training instructional models based on lectora multimedia compared with students using conventional instructional models in Harapan Senior High School Academic Year 2014/2015 in the measurement material, (2) to determine students achievement that more better between student who have high formal thinking ability with students who have low formal thinking ability in Harapan Senior High School Academic Year 2014/2015 in the measurement material, (3) to determine the interaction between inquiry training instructional models based on multimedia lectora and formal thinking ability toward students achievement in Harapan Senior High School Academic Year 2014/2015 in the measurement material.

2. METHOD

This research was conducted in Harapan Senior High School of Medan grade X in first periode (first semester) on September Academic Year 2014/2015. The population in this study consist of all the students grade X in Harapan Senior High School of Medan. The sample in this study divide by two class, namely control class and experimental class. The study involved two classes given a different treatment, for class control using conventional instructional models and experimental class using inquiry learning instructional models based on lectora multimedia. Research design is ANOVA 2 x 2. To test the hypothesis of this research used analysis techniques data by analysis of variance (ANOVA) two tails (2 x 2 factorial design) with a significant level $\alpha = 0.05$ or 5%.

3. RESULTS AND DISCUSSION

3.1. Results

Description of the data on the results of this study consists of scores of cognitive achievement and formal thinking skills. Pretest score with using inquiry training instructional models based on lectora in the experiment class obtained the average value 5,10 and conventional instructional models obtained the average value 4,97. Testing by using SPSS 20.0 with samples free *t* test. Then both the data were tested for normality and homogenety in advance. The normality test are shown in Table 1.

Table 1. The normality test

		Kolmogorov – Smirnov[a]			Shapiro -Wilk		
PRETEST	CLASS	Statistics	df	Sig.	Statistics	df	Sig.
	CONTROL	0.143	30	0.122	0.959	30	0.290
	EXPERIMENT	0.140	30	0.136	0.958	30	0.269

Based on *kolmogrof-Smirnov*[a] obtained value the significance of the results of experiment class is 0.122. These results indicate that *kolmogrof-Smirnov*[a] greater than 0.05, then data on the experiment class is normal distributed. The significant value of classroom learning outcomes Control of 0.136. These results show that *kolmogrof-Smirnov*[a] greater than 0.05, then the data on the control class is normal distributed. Test for equality of variance and the average the value pretest is done with a Test of Homogenety of Variance using SPSS 20.0 with the test results in Table 2.

Table 2. Test of variance homogenety

		Levene Statistic	df1	df2	Sig.
Pretes	Based on Mean	0.113	1	58	0.738
	Based on Median	0.079	1	58	0.779
	Based on Median and with adjusted df	0.079	1	57.71	0.779
	Based on trimmed mean	0.106	1	58	0.746

The test results are contained in Table 2. shows the value of F for the pre-test learning outcomes with significance 0.113 < 0.738 (F table = 4.12 , α = 0.05). Based on the results, the value of F < F table and significant count greater than α = 0.05, so data can be concluded pretest data of control class and experimental class have the same variance or homogeneous. Formal thinking ability tests given the control class (conventional) and class experiment (inquiry training) can be seen in Table 3 .

Table 3. Data of formal thinking ability control and experiment classroom

Control Class (Conventional)		Experiment Class (Inquiry Training)	
Score	N	Score	N
3	2	4	1
4	2	5	4
5	4	6	8
6	4	7	3
7	6	8	10
8	7	9	4
9	5	Sum	30
Sum	30		

By using SPSS 20.0, the data formal thinking ability of two classes then grouped into 2 groups each groups of high (score interval 8 – 10) and low (score interval 0 – 7) seen in Table 4.

Table 4. Distribution of formal thinking group high and low based on interval

Group	Score Interval	Summary	
		Conv.	IT
High	8 – 10	12	14
Low	0 – 7	18	16

The average result of students achievement by using conventional instructional models for the students who have high formal thinking ability obtained 11.67 and student who have low formal thinking ability obtained 12, 28, whereas average results by using inquiry training instructional models based on lectora multimedia for groups of students who have high formal thinking ability obtained 16,42 and for groups of students who have low formal thinking ability obtained 11.56. The data presented in Table 5.

Based on Table 7, the calculations based on the significantly models obtained significant results 0.00 and this significantly smaller than α = 0.05. So there are significant differences in students achievement between using inquiry training instructional models based on lectora multimedia compared with students who used the conventional instructional models in Harapan Senior High School Academic Year 2014/2015.

The calculations based on the significantly formal thinking obtained 0.00 and this significantly smaller than α = 0.05. Then there are differences students achievement between students who have high formal thinking skills with students who have low formal thinking ability in Harapan Senior High School Academic Year 2014/2015. The calculations based on In a significant models* derived formal thinking obtained 0.00 and this significantly smaller than the significant α = 0.05.

Table 5. Statistics of ANOVA

Models	Formal Thinking	Mean	Std. Deviation	N
Conventional	High	11.667	2.309	12
	Low	12.278	1.406	18
	Summary	12.033	1.8096	30
Inquiry Training	High	16.429	1.5549	14
	Low	11.563	1.5903	16
	Summary	13.833	2.914	30
Summary	High	14.231	3.0765	26
	Low	11.941	1.516	34
	Summary	12.933	2.5702	60

The Anova 2x2 design data of the average students achievement against high and low formal thinking ability presented in Table 6.

Table 6. Design of anova data 2x2

Formal Thinking Group	Achievement Average		
	Conventional	Inquiry Training	
High	11.67	16.43	14.23
Low	12.28	11.56	11.94
	12.0	13.8	

Output of ANOVA 2x2 test results of this research can be seen in Table 7.

Table 7. Output calculation of anova 2x2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Models	60.023	1	60.023	20.794	0
Formal Thinking	66.362	1	66.362	22.99	0
Models * Formal Thinking	109.962	1	109.962	38.095	0
a. R Squared = .585 (Adjusted R Squared = .563)					

The interaction between inquiry training instructional models based on multimedia lectora and formal thinking ability toward students achievement in Harapan Senior High School Academic Year 2014/2015 can be seen in Figure 1.

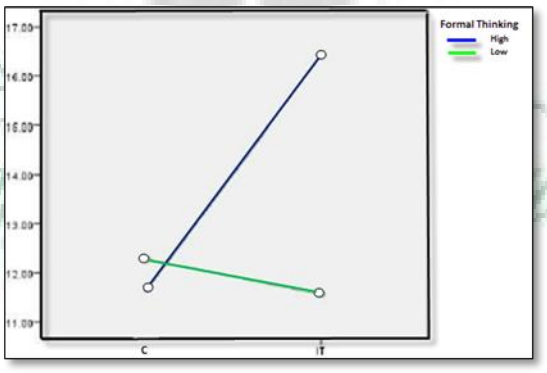

Figure 1. Graph Interaction Model Learning and Thinking Formal

Graph of high formal thinking ability and low formal thinking ability on inquiry training instructional models based lectora multimedia and conventional instructional models intersect at one point. The intersection shows the interaction between both of the models and formal thinking ability toward students achievement.

3.2. Discussion

Learning activities such as questions or problems, formulating hypotheses, collecting and analyzing data and concluded performed by students. Students are active in conducting such experiments to investigate the characteristics of the measuring instrument. Students who presented the problems of measurement able to identify what is the right instrument for measuring an object geometry, how to read the measurement results, identify errors in measurement and formulate a response while on the issues presented. The students carefully to measure the objects and do the measurement results correctly. The data were analyzed by a question and answer in the group. The students also asked to the teacher about the results that they conclude.

In digital era, the development of information technology is fabulous especially in the field of e-learning. It has become a necessity to study independently and quickly manage many knowledges. When lectora multimedia be the basis of the inquiry training instructional models of learning, its impact on learning in the classroom. Lectora supports various common media types including text, images, audio, video, animation, and internet technology even popular file types such as Shockwave, Flash, HTML, Java, Javascript, ASP .NET and Cold Fusion. Lectora become a interactive learning multimedia, and the laboratory can be presented in different condition, namely a computer device. Students become better interact in learning, and the students achievement became better. Theories that support the inquiry training instructional models is Vygotsky's theory. There are two very important concept in Vygotsky's theory, namely Zone of Proximal Development (ZPD) and scaffolding. ZPD is the distance between the actual development level that defined as the ability to solve problems independently with the development level of potential which is defined as the ability to solve problems under adult guidance or in collaboration with peers who have higher capacity.

4. CONCLUSION

Based on the results of research and discussion it can be concluded: 1) There is a difference in student achievement that learn by inquiry training instructional models based on lectora multimedia and conventional instructional models. Students achievement who applied inquiry training instructional models based on lectora multimedia better than conventional instructional models; 2) There is a difference in student achievement that have formal thinking high and low formal thinking ability. The students achievement who have high formal thinking ability better than students who have low formal thinking ability; 3) There is an interaction between the instructional models toward students achievement. Students achievement taught with inquiry training instructional models based on lectora multimedia influenced by formal thinking ability, while students achievement taught by conventional models is not affected by the formal thinking ability.

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