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SCIENCE LEARNING BY USING GUIDED INQUIRY APPROACH THROUGH EXPERIMENT AND DEMONSTRATION METHOD VIEWED FROM STUDENTS' SCIENTIFIC ATTITUDES

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Abstract

The objectives of the research were to identify whether or not (1) the difference of learning science by using guided inquiry approach through experiment and demonstration method viewed from students' scientific attitudes toward students' achievement; (2) the difference between students having high scientific attitudes and those having low scientific attitudes toward students' achievement; (3) the interaction between learning methods and students' scientific attitudes toward students' achievement. Related to the objective of the research, the writer used quasi experimental method with factorial design of 2 x 2. The research was conducted at SMP N 14 Surakarta. The population in this research was all of the eighth grade students of SMP N 14 Surakarta in the academic year 2011/2012 consisting of 6 classes. The sampling of the research was cluster random sampling. The samples consisted of two group, VIIIB as experiment I taught by experiment method and VIIID as experiment II taught by demonstration method. In collecting the data, the writer used test, questionnaire, and observation techniques. As a requirement for the data analysis, firstly the data had to be tested using Kolmogorov-Smirnov through Lilliefors formula in order to test the normality and Levene formula in order to test the homogeneity. The data analysis in this research was two ways anava and the following test was Scheffe'. The result of the research showed that: (1) there was no impact of guided inquiry usage through experiment and demonstration method toward students' achievement; (2) there was an impact of high and low of scientific attitude toward students' achievement; (3) there was interaction between guided inquiry usage through both method and scientific attitude toward students' achievement affective domain but there was no impact in cognitive one.

Key words: guided inquiry, experiment, demonstration, scientific attitude

INTRODUCTION

Indonesian law about national education system that says, "Pendidikan Nasional berfungsi mengembangkan kemampuan dan membentuk watak serta peradaban bangsa yang bermartabat dalam rangka mencerdaskan kehidupan bangsa, bertujuan untuk berkembangnya potensi peserta didik agar menjadi manusia yang beriman dan bertaqwa kepada Tuhan Yang Maha Esa, berakhlak mulia, sehat, berilmu, cakap, kreatif, mandiri, dan menjadi warga negara yang demokratis serta bertanggungjawab." Based on the law education should have gotten serious attention from citizen.

United Nations Development Program (UNDP) in 2014 showed that Indonesia placed 108 in a rank of 187 countries in human development index in the world. That number indicates that Indonesia still has low quality of education. Seeing this fact, education should have gotten serious treatment for improving its quality. There are many ways to improve our education quality. One of them is through formal education at school. Teacher is one factor which has

important role to conduct learning process at school. Teacher as a designer and a person who directly involved in learning process must be able to design an active, creative and joyful learning process so that every student has chances to build and find their identity through it. Teacher also has a role to help student in order to reach optimal achievement and give learning experience that involves mental and physical process.

Learning process which is done by students is a key of success (Dimyati and Mudjiono, 2006: 236). In fact, there are some teachers who conduct unplanned and undirected learning process. National Science Educational Standard (NSES) (1996) said that, learning science is an active process. Learning science is something student to do, not something that is done to them. Science learning process give chances students to describe object and phenomena, ask questions, get knowledge, construct explanation from natural phenomena, test explanation, and communicate to others. So, science is obtained through processes by using scientific methods and giving chances students to get learning experiences such as reading, discussion, experiment, make conclusion, and observe natural phenomena that make student active. But, there is school which conduct learning proves without involving student to be active to learn science.

In order to choose a learning approach and method, it is important to notice the characteristics of the material. So, teachers are forbidden to select carelessly. Sound is a topic that is used in this research. It is chosen because in the previous academic year, the average mark just 62,54. Sound as a topic can be observed directly through experiment and also daily phenomena. Based on that characteristic of the topic, experiment and demonstration methods will be used. By using that, students will be involved in discovering concept. Scientific attitudes are required in discovery and inquiry. Thus, students will be active to discover science concept to get experience of learning. This is parallel with discovery learning theory by J.S. Bruner.

Learning science is an active process. Learning science is something students do, not something that is done to them (NSES, 1996). Students describe objects and events, ask question, get knowledge, construct explanation, conclude information, and communicate to others in it. Based on Permendiknas Number 23 2006, learning science has many purposes, such as: by learning science students will have curiosity, positive feeling appear from students, students are able to relate science with natural phenomena in daily life, improve scientific attitude, etc. Topics on science for secondary school consist of: living thing, matter and its characteristics, energy, and universe. In secondary school the implementation of science is integrated science, but the implementation in SMP N 14 Surakarta the learning process among physics, biology and chemistry is still separated.

Inquiry is an approach that chosen in this research. Inquiry is one of approach that often used in science. Teaching science by inquiry involves teaching students the science processes and skill used by scientists to learn about world and helping the students apply these skills involved learning science (J.W. Mc Bride et al., 2004). In inquiry, teachers give opportunity to expand students' skill and scientific attitude in learning process. "A guided inquiry-based approach allows for scaffolding of new scientific concepts with the learner's existing mental model" (Trundle, 2009). In a guided inquiry approach the instruvtor provides the problem and encourages students to work out to resolve it (Trowbridge dan Bybee, 1986). In this research, the inquiry approach is referred to as guided inquiry by using these phases: 1) engagement; 2) exploration; 3) explanation and communication; 4) extension; 5) evaluation.

Science learning process through experiment and demonstration methods can be conducted both in a real laboratory and virtual laboratory. Real laboratory is certain place with real materials for experiment. If the materials aren't available it may use virtual laboratory which use animation or others. Many schools have had complete facilities but they haven't used it optimally. The learning process do not used what the school has to support the learning process so sometimes they can't get the best result.

At some schools there are some teachers who teach using traditional methods by lecturing. Teachers just give explanation to students and the students just hear what the teacher explained. This fact indicated that many teachers haven't made interactive and innovative learning process in the classroom. Many students haven't given facility to improve their skill. It exaggerate that students still got knowledge as a theory so the improvement of scientific attitudes are still limited. So by using inquiry through experiment and demonstration methods are expected can help students to overcome these problems and make learning process more meaningful.

Students' achievement can be influenced by two factors, that are; external and internal factors. Internal factor is factor derived from students, for examples gender, study habits, peer influence, attitude toward science. Family factors (educational attainment of parents, occupation of parents, family income, and parent's learning support) and school factors (physical facilities and library service) are exampels of external factors (Noemu Mangaoang, 2013). But, in fact there are some teachers who do not give notice the students' internal factors.

Scientific attitude is one of internal factor that influence students' achievement in science learning process. Every student has different scientific attitude because each students has different interest for some subjects. The metal state, more or less enduring, representing a tendency to react favorably or unfavorably toward science is scientific attitude. The scientific attitude investigates for a certain scientific act or thought (Islam A and Farooq, 2012). There are many scientific attitudes, such as: curiosity, rationality, willingness to suspend judgment, open mindedness, critical mindedness, objectivity, honesty, discipline, humility, etc. Nowadays, scientific attitudes of people disappear. For instant, discipline that one of important aspect should have been own by students are infant. Many students disobey the rule at school, etc. Actually, discipline is a way to improve their personality and their temptation (Rachmawati, 2011:1). Through good scientific attitudes, hopefully students are able to better result, but teachers seldom give big attention for this term.

RESEARCH METHOD

This research was conducted in SMP Negeri 14 Surakarta. The try out was conducted in SMP Negeri 16 Surakarta. The population in this research was all of the eighth grade students of SMP N 14 Surakarta in the academic year 2011/2012 consisting of 6 classes. The sampling of the research was cluster random sampling. The samples consisted of two group, VIIIB as experiment I taught by experiment method and VIIID as experiment II taught by demonstration method. In collecting the data, the writer used test for students' cognitive achievement, questionnaire for students' scientific attitudes and students' affective achievement, and observation techniques for additin insrument. As a requirement for the data analysis, firstly the data had to be tested using Kolmogorov-Smirnov through Lilliefors formula in order to test the normality and Levene formula in order to test the homogeneity. The data analysis in this research was two ways anava and the following test was Scheffe'.

RESULT AND DISCUSSION

Description of students' achievent can be seen on the table 1 below:

Table 1
Students' Achievement

	Cognitive Domain		Affective Domain	
	Experiment	Demonstration	Experiment	Demonstration
Sum Data	39	40	40	39
Max	89	89	143	145
Min	51	54	90	101
Mean	70,63	69,44	121,28	145
SD	10,34	69,59	13,59	10,59

The hypotesis test of students' achievement can be seen on the table 2 below:

Table 2
Hypothesis Test for Student's Achievement

No	Variable	Cognitive Domain		Affective Domain	
		Sig.	Keuptusan Uji	Sig.	Keuptusan Uji
1.	Method	0.841	H_0 approved	0.829	H_0 approved
2.	Scientific Attitude	0.046	H_0 rejected	0.001	H_0 rejected
3.	Interaction Method * Scientific Attitude	0.981	H_0 approved	0.002	H_0 rejected

Based on the table above, it can be explained as following:

First Hypothesis

The chosen topic in this research is Sound. Material charasteristic of Sound can be learned through direct observation. One of studies that makes students conduct observation is using guided inquiry approach through experiment and demonstration methods. Sound learning by using guided inquiry approach through experiment method gives students opportunities to find the proof of correctness in the theory being learnt. Students are also given opportunities to personally experience or do; follow a process; observe an object; analyze; prove; and personally draw conclusion about an object, a situation, or a process. The advantage of experiment method compared with demonstration method is able to give students full opportunities to expand their ability to find concept or theory being learnt.

Meanwhile, demonstration method is a presentation of learning materials by teacher, either in the form of objects or certain procedures, done directly or using learning media which is able to involve students' participation in achieving the learning objectives. By using demonstration method, students have certain limitations so they can't explore all of their abilities. Students can only pay attention to what is modeled by their teacher. Students' participation in learning has less intensity compared with experiment method that gives bigger opportunity to students to develop themselves. However, the advantage to be gained from demonstration method is more controllable time management which is controlled by teacher.

In this research, it was statitically stated that there was no impact of science learning using guided inquiry approach through experiment and demonstration method on students' learning achievement reviewed from both students' cognitive and affective aspect. This may be caused by various factors. Handy Susanto (2006: 48) and Slameto (2003: 54-72) had similar opinion about factors that affect learning: factors that affect the success of a person in learning process divided into internal and external factors. Internal factors include physical conditions such as physical

limitation and psicologycal conditions such as ability to concentrate and exhaustion factor; whereas external factors include family conditions such as house condition, school factors such as learning method, and community factors. From this statement, it is alleged that learning method is not the only factor that determine students' learning achievement.

Harlen (2004:22) stated that students' limited experiences in learning would affect their learning results. Moreover, Harlen thought that to change learning from traditional to learning through inquiry needed a graduall process so the result could not be observed in relatively short term period. Therefore, it is necessary to conduct an advanced research so that the difference in the impact of the use of both methods in inquiry approach to the students' learning achievement can be seen.

Both learning methods are achieved through guided inquiry method. One of disadvantages of guided inquiry method in (J.W. McBride et. al., 2004) is that the large number of students becomes an obstacle in inquiry learning execution. This is in line with the field condition at the time of research which has about 40 students in the class. This is considered a large number of a study group. Meanwhile, according to the process standard, the maximum number in a study group for secondary school is 32 students. A good study group will enable the learning climate to be condusive and composed so it will affect the students' learning spirits. If the learning climate is discomposed and uncomfortable, it will hinder the learning process in school. A hindered learning process will affect students' learning achievement. So that both methods used in this learning will have no impact in students' learning process.

Judging from the distribution of learning achivement given to both methods, it can be seen that both methods can produce equally good learning achivements compared with the Minimum Completeness Criteria/*Kriteria Ketuntasan Minimum* (KKM) which has been implemented in school. This is in line with Ausubel's meaningful learning theory: for students who learn directly through their experiences, learning will be more meaningful and the knowledge obtained will last longer than if students are not involved directly in their learning.

Second hypothesis

In this research, it was found that there was a significant impact between the students' scientific attitudes on their cognitive and affective learning achievement. This means that students with high scientific attitudes and low scientific attitudes have different learning achievement. This is in line with some studies that found that scientific attitudes have positive corellation to science students' achievement and have role in science learning (Simpson & Oliver, 1990; Lee & Burkam,1996; Papanastasiou & Zembylas, 2004 in Esma Bulus Kirikkaya, 2011). A learning achievement can be achieved not separately from its learning process. According to Wina Sanjaya (2009: 52-57), one of factors that affect learning process is characteristic factor owned by the students. Characteristic factors owned by the student include basic abilities, knowledge, and attitudes. One of those attitudes is scientific attitute.

Scientific attitude is an attitude that underlie the science process. Scientific attitude can be considered as values and norms held to bind human in science. These norms are expressed in the form of rules, prohibitions, options, and abilities. These norms and valuse have to be internalized by students and after that, they will familiarize themselves with scientfic habits. Those scientific attitudes are curiousity, honesty, objectifity, criticism, openness, carefulness, etc.

For example, students with high curiousity tend to thirst for new unknown knowledge and try to find the answer about what is not or not yet known. By an effort, a careful student who do his/her task carefully, cautiously, and calmly will be able to minimize errors that may appear in solving any problem. Therefore, students with high and low scientific attitudes will give different effect on their learning achievement. From those reviews above, it can be seen that there are effects of low and high scientific attitudes on students' learning achievement.

Third Hypothesis

In this research, there was no significant mutual effect of scientific attitudes and learning method on cognitive learning achievement. This is in line with Arni Astuti's research that stated that there was no interaction of the use of learning method and students' scientific attitudes on students' learning achievement both cognitively and affectively in learning alkaline and acid solution for the 2nd semester of 11th grade science class in SMA Negeri 1 Surakarta. The effect given by experiment and demonstration methods on cognitive learning achievement was a standalone inluence and did not relate to the scientific attitudes. Vice versa, the effect given by scientific attitudes on cognitive learning achievement was a standalone effect and had no relation with experiment and demonstration methods.

That is to say, a group of students with high scientific attitudes if given treatment through experiment and demonstration methods will give the same effect on learning achievements; the same goes for a group of students with low scientific attitudes, where treatment through experiment and demonstration method will also give the same effect on learning achievements. Similarly in experiment and demonstration method, there is no significant difference of learning achivements between a group of students with high and low scientific attitudes. Those two variables do not produce significant combination effect. Therefore, it can be concluded that there is no interaction between inquiry learning through experiment and demonstration method and students' scientific attitudes on students' learning achievements in cognitive domain.

Students with different categories of scientific attitudes if given treatment with the same method apparently do not give different effect on their learning achievements. This may be caused by external factors that also affect students' learning achievements in school. Outside their school, students get special guidance from private teacher or enroll in certain tutoring agency that can improve students' learning achievement cognitively. Affectively, this can't be done because affective domain of learning achievement relates to students' attitudes towards certain topic that emerge from the students themselves.

Meanwhile, student with the same category of scientific attitudes if given different learning method also do not give significant effect on their cognitive learning achievement. This is not only because there are external factors which can't be controlled by teacher, but also because both methods show almost similar syntax and need scientific attitudes underlying the learning process, so that it allegedly will not will not affect students' learning achievement in cognitive domains. However, it affects the affective domains because experiment method needs higher scientific attitudes than experiment method. Because in experiment method students are given freedom to design observation up to conclude the result, this activity require higher scientific attitudes from students. In demonstration method, students' scientific attitudes do not have significant role because students do not conduct observation themselves. It is done by the teacher instead and students only observe it. Even if they are involved, the intensity is very low. Moreover, affective domain used in this observation does a review on attitudes so the scientitic attitude has strong intersection with affective achievement.

Based on the description above, it can be explained that there is an interaction between the use of guided inquiry approach and students' scientific attitudes on their affective learning achievements in taking science lessons with Sound as the topic. However, there is no interaction between the use of guided inquiry approach and students' scientific attitudes on their cognitive achievement in taking science lessons with Sound as the topic.

CONCLUSION AND SUGGESTION

Conclusion

The result of the research showed that:

1. There was no impact of guided inquiry usage through experiment and demonstration method toward students' achievement;
2. There was an impact of high and low of scientific attitude toward students' achievement;

3. There was interaction between guided inquiry usage through both method and scientific attitude toward students' achievement affective domain but there was no impact in cognitive one.

Suggestion

1. In inquiry learning through experiment and demonstration methods, it need to give attention to students' scientific attitude along the learning process because there are some students who do not involve their selves in it. It needs to do so that the learning process can involve all students by involving students' scientific attitude.
2. The application of inquiry learning through experiment and demonstration methods need serious preparation thus the learning process can be conducted based on lesson planed arranged. For experiment method, though teacher guide the learning proves, teacher should manage the time wisely because not all the students can maintain the time wisely for doing exploration.
3. It will be better if the teacher not only give attention to students' achievement in cognitive and affective domain but also for the phsycomotoric domain.

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