Profile of Students' Inquiry Ability Variation on Heat Transfer

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Abstract

This study is conducted to investigate the improvement of inquiry ability variation of students after applying inquiry learning model in 30 Junior High School, Makassar. Inquiry variation is amount of counseling intensity or guidance that is given by teacher in a learning. Inquiry variation can be seen based on five inquiry essential features such as applying question, deciding and collecting relevant evidence, making explanation based on the evidence, connecting the explanation with scientific references and communicate it. This research uses documentation study method. The sample of the research are 74 students of seventh grade that are taken by using random class sampling technique. Data collection technique uses observation sheet of inquiry ability variation. The data processing technique uses descriptive method. Data analysis result shows the improvement in five inquiry essential characteristics. It can be seen in the comparison between the first and the last meeting. In the first meeting, all of the inquiry essential characteristics were given by teacher, while in the last meeting, students can do the characteristics by themselves. However, it is only one characteristic that still need guidance from teacher like essential characteristic in deciding and collecting relevant evidence. The result of the study shows that the application of inquiry learning model can help students in improving inquiry ability variation that is better than the using of conventional learning model.

Keywords: *Inquiry Learning Model, Inquiry Ability Variation, Heat and Transfer*

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INTRODUCTION

Scientist, Policy maker and teacher agree that science learning have to be conducted through inquiry (Lunetta, et al. 2007). AAAS (1993) and NRC (1996) support science curriculum that involves students actively using inquiry based investigation. The learning have to be changed from memorizing into inquiry base learning where the students are actively involved in looking for the answer. Inquiry base learning leads the students to become scientific learner in arranging knowledge. The main focus of inquiry learning is involving the student in a problem by facing them in investigation, help them in identifying conceptual or methodological problem, and ask them to arrange the ways to solve the problem (Joyce, et al. 2009). Inquiry base learning is based on scientist's ways in investigating the nature, which is looking for the explanation based on the evidence around them. Through the process, student can integrate their new knowledge with previous knowledge, and in its turn, it will help them in building their own concept (NRC, 2000). Inquiry learning is based on a viewpoint where students become the subject and object in learning process and the student have basic ability to develop optimally according to the ability they already have. The teacher's role in inquiry learning are mainly as learning consultant or facilitator. Therefore, Students can do many activity by themselves or in group in solving the problem monitored by teacher. Students are positioned as learning subject (Sagala, 2013).

Inquiry has some vision described by NSES (National Science Education Standards) which is purposed in various ways that is conducted by scientist, such as investigating nature phenomena, then explain it based on evidence that is collected through data collection. Furthermore, inquiry is purposed on students activity in developing a knowledge and their understanding about scientific ideas, which is in this case, the understanding about how scientist learns variety of nature phenomenons. In conducting inquiry learning, there are things that have to be done by students through the application of certain learning strategy. Science learning has something that has to be investigated by the students by developing their scientific ideas. In relating students with the activity that is based on inquiry process, NSES mentions some things that have to be understood by students. First, understanding the science concept; second, the appreciation of "how we know" and "what we know in science", third, understanding the nature of science, and fourth, developing certain abilities that are needed to be the independent inquiry subject in science (Bybee, 2004)

National Research Council (2000) asserts that inquiry as "a state of mind" means as a basic thought. Inquiry needs new pattern of thinking, develop thinking habit, especially through hands-on activity, not practice standard in the class. Therefore, inquiry learning is designed advancely so the teacher's role is only to facilitate the students in practicing and learning the inquiry as well as think critically toward the evidence or solution of a problem. Inquiry learning is designed not only as learning through investigation in laboratory but also how build a knowledge thoroughly about science. Therefore, the purpose of inquiry learning is to offer a framework or structured learning, thus the students have thorough knowledge in connecting a problem and students have high motivation in learning.

The inquiry approach has been reported to enable the training of students' thinking and practical skills (Fakayaode, 2014; Stout, 2016: Sedwick, 2018), critical thinking (Asyari, 2016; Boleng, 2017; Zubaidah, 2017), and make reasoning (Putra, 2016). The application of a multilevel inquiry approach can have a positive influence on learning outcomes, practical skills and attitudes (Anwar, 2019).

According to Chiapetta (1976), Inquiry learning is very useful in a development process; first, fundamental understanding about a concept, fact, principal, laws and theory; second, the ability that push people in collecting knowledge and understanding about nature phenomenon, ketiga, provide disposition to fiind the answer and testing the validation of a statement.; fourth, develop a positive attitude toward science; and five, gathering meanings about characteristics of science.

The inquiry application in science learning need to be conducted collectively and involve educator in various levels, on top of that inquiry does not have to be consider only as a method, approachment or learning model, but also has to be viewed and applied as an ability that needs to be developed (Rustamam, 2005). According to NRC (2000), There are two patterns of inquiry; 1) inquiry as a process in understanding the content, where the students have the chance to build the concept; 2) inquiry as a skill and ability.

The teaching approachment and instructional materials that use inquiry fully including five inquiry essential characteristics. Based on National Research Council (2000), the five essential characteristics are: (1) students bond with scientific questiens; (2) students prioritised the evidence that make students develop and evaluate the explanation of scientific questions; (3) students arrange the explanation based on evidence to answer scientific question; (4) students evaluate the explanation that lead to alternative explanations, especially that reflect scientific understanding; and (5) students communicate and give assessment toward the given explanation.

Inquiry base learning has various of detailed guidance that are given by teacher. There are variety of amount of structure, guidance, and counseling that is given by teacher related to inquiry. National Research Council (2000) states that teaching learning process of inquiry happens on some levels or types. Those levels or types are: 1) more teacher-directed means inquiry learning is applied by using question guide that is provided by teachers and the procedures are given in each steps, while students conduct an investigation with tools and materials provided. The purpose of the investigation is to find out some phenomenons that had been found previously (a confirmation activity). 2) less teacher-directed means that the inquiry learning is conducted using guidance in form of questions lead from the teacher. Teacher suggests tools and materials that can be used, as well as guide the students in conducting the investigation (guided inquiry). 3) student centered means this type of inquiry learning gives a chance to students to arrange question based on observation result and decide independently tools and materials according their needs. In this learning, teacher's role is only as a facilitator in learning process (open inquiry).

NRC (2000) states that there are various of students inquiry skills based on five inquiry essential characteristics. This variety gives insight for teacher about some relevant activity conducted by student for each inquiry essentials. The variety of students activity for inquiry essential are: 1) Appying question means that students asking question, selecting question, elaborate the question given by teacher, and students are given question by teacher. 2) decide relevant evidence and gather it means students decide things that can be evidence and gather it. Students are guided to collect the data, given the data and asked to analyze it. Moreover, students are given the data and ways to analyze it. 3) arrange explanation from the evidence means students make explanation after gathering the data. Students is guided to make explanation from the data, ways to make explanation, and given explanation from the evidence. 4) connecting explanation with science means students testing other sources and relate it with explanation, guided to the science resource, and given the connection of the explanation. 5) Communicate means students communicates the explanation, trained in developing communication, provided with guidence to communicate, and given steps and procedures to communicate the explanation. The result of the research shows that inquiry learning model can improve variety of inquiry skills based on inquiry essential characteristics (Forbes, 2011; Sutman, 2008).

METHOD

Research method that is used in this research is documentation study. Population in this research is seventh grade students of 30 Junior High School, Makassar, South Sulawesi with 9 class in total. The sampling technique that is used in this research is simple random sampling. Simple random sampling technique is a sample selection technique from random class population without changing the class or making new class. The collected random sample are two class, experimental class and control class. Both classes are differenciate into 1) inquiry learning model class (VII.2) and conventional learning class (VII.3). Observation sheet of inquiry skills variety is used to view many guidance or teacher's participation that is attained by student in each steps of learning. The observation sheet format is in form of check list, thus the researcher can give checklist mark on the variety of students inquiry skills in every steps of learning. The observation of students inquiry ability variety based on five inquiry essential characteristics are; applying question, deciding and collecting relevant evidence, making explanation from the evidence, connecting explanation with scientific knowledge, and communicating. Each inquiry essential characteristics consist of four variations, except the fourth characteristic which has only three variations.

Based on technical implementation, the observation in this research is not conducted straightly which is the observation that is observed through mediator like technically or by using certain tool. This observation is conducted

by observing the result of students activity of video recording during the learning process. This is purposed to make the observation be more objective because the researcher can observe repeatedly the video.

The data of inquiry ability variety observation result is carried out by using description of each learning steps in every meetings. The description of inquiry ability variation shows some leads or guidance that is given by teacher to students in each steps of learning. The observation is conducted based on video recording result that is collected from four meeting of learning process. Inquiry ability variation is described based on five inquiry essential characteriatics.

RESULT AND DISCUSSION

Student's inquiry ability variation is amount of counseling intensity that is given by teacher in a learning. The variation can be seen from amount of counseling and guidance given by teacher based on inquiry essential characteristics which are applying question, deciding and collecting relevant evidence, making explanation from the evidence, connecting explanation with scientific knowledge, and communicating.

Based on video analysis result, it is attained that all of the five inquiry essential characteristics are improved. Each inquiry essential characteristics has 4 inquiry variations except the fourth characteristics which has only 3 inquiry variations. The improvement that does not reach highest level are on the second inquiry essential characteristics which is deciding and collecting relevant evidence. The students can only reach the third variation of this characteristics. This is happens because students still experience the difficulty in deciding independently the tools and materials as well as the procedure for collecting the evidence/data.

Inquiry that is applied on the learning process in experimental class is included as full inquiry because inquiry learning that is conducted covers all of the five inquiry essential characteristics (NRC, 2000). Inquiry learning model has various amount of leads and guidances given by teacher, thus if teacher's leads and guidance are oftenly given then the inquiry process can be assumed as closed inquiry. On the contrary, if the students are more independent in deciding every steps of learning, then inquiry process can be assumed as opened inquiry. In developing students inquiry ability and giving more experience to students, opened inquiry learning process is needed. The learning will give the students a bigger portion (student centered) so it will give them the best opportunity for the development of cognitive ability and students scientific thinking ability.

Recapitulation of observation result of experimental class based on inquiry essential characteristics can be seen on the table 1.

Tabel 1. Recapitulation of Observation Result of Inquiry Ability Variation

No	Essential Feature Inquiry	Variation	Meeting to-											
			Group 1				Group 2				Group 3			
			1	2	3	4	1	2	3	4	1	2	3	4
1	Applying question	Learner poses a question				√				√				√
		Learner selects among question			√								√	
		Learner sharpens question provided by teacher		√				√	√			√		
		Learner engages in question provided by teacher	√				√				√			
2	Deciding and collecting relevant evidence	Learner determines what constitutes evidence and collect it												
		Learner directed to collect certain data			√	√				√			√	√
		Learner given data and asked to analyze		√				√	√			√		
		Learner given data and told how to analyze	√				√				√			
3	Making explanation based on the evidence	Leraner formulate s expalanation after summarizing evidence			√	√								√
		Learner guided formulating explanations from evidence		√					√	√			√	
		Learner given possible ways to formulate explanation						√				√		

No	Essential Feature Inquiry	Variation	Meeting to-											
			Group 1				Group 2				Group 3			
			1	2	3	4	1	2	3	4	1	2	3	4
		Learner provided with evidence	√				√				√			
4	Connecting the explanation with scientific references	Learner indenpendently examines other resources and links to explanation			√	√			√	√			√	√
		Learner directed toward sources of scientific knowledge		√				√				√		
		Learner given possible connections	√				√				√			
5	Communication	Learner communicate explanations			√	√			√	√			√	√
		Learner coached in development of communication		√				√				√		
		Learner provided broad guidelines to communication	√				√				√			
		Learner given steps and procedures for communication												

Students inquiry ability variation is analyzed based on the observation result that is collected from four meetings of learning process. The description of Inquiry variation improvement based on all of the five inquiry essential characteristics are:

1. Applying Question

Applying question is the first step of inquiry process. Applying question has a function to invite students' couriosity so they can be motivated in doing investigation. The students are asked to arrange the problem first independently. In this step, one of the important skills is the understanding about the question where the answer is can be found through investigation and question process. The students have to be trained to understand about this step by step and continously. Applying question is very important in inquiry learning model because the main purpose of inquiry is to find the answer of questions through investigation process (Jufri, 2013)

Inquiry variation on essential characteristics of applying question is improved. The improvement can be seen on every meetings where the students can be more independent in deciding and applying question. On the first meeting, students still seems confused in applying question because inquiry learning can be considered as a new way of learning for them, thus they still need to be supported in applying question by the teacher. On the next meeting, it can be seen that teacher's role in giving leads and guidance is decreased. It shows that the students are capable in applying question independently without any leads or guidance from teacher.

2. Deciding and Collecting Relevant Evidence

Deciding and collecting relevant evidence is an essential characteristics of inquiry that has four variation which are students are given the data and way to analyze it, students are given the data and asked to analyze it, students are directed to collect the data, and students decide the data that will be the evidence. This inquiry essential characteristics can be seen on the data collection learning step. On this step, this activity is carried out to decide tools and materials as well as designing and investigate to obtain evidence that can be used to make explanation from given questions. Collecting data can make the student to be skilled in doing hands on, so they will be well trained in doing mental and physical activity. In deciding and collecting evidence, the students are asked to be independent first.

Inquiry variation on essential characteristics of deciding and collecting relevant evidence is improved. The improvement can be seen on the first meeting, which is the students are given the data and ways to analyze it. Meanwhile on the fourth meeting, students are able in deciding and collecting data using leads and guidance from teacher. On the first meeting to the fourth, it can be seen that teacher's role in giving leads and guidance is decreased. It shows that students are able to decide and collect relevant evidence eventhough with leads and guidance from teacher.

3. Making Explanation from the Evidence

Making explanation from the evidence is an activity to find the data pattern that is formed from investigation and making explanation of the relation between the cause and impact between the variables (Sani, 2014). Inquiry essential

characteristics uses explanation from the evidence that can be seen during learning step of data interpretation. Inquiry variation on this characteristics consist of four variations, which are students are given explanation with evidence, students are given ways to make explanation, students are mentored in making explanation from the evidence and students make explanation after collecting the data. In the learning process, students are asked to make explanation independently from the evidence first, then the teacher give the leads and guidance if the students facing difficulty.

Inquiry variation on essential characteristics makes the explanation from the evidence improved. The improvement can be seen on every meetings. Students can be more independent in deciding which question that should be asked. On the first meeting, students still get confused in making explanation because inquiry learning can be considered as a new way of learning for them, thus in making explanation, they still need help from the teacher. On the next meeting, it can be seen that the teacher's role in giving leads and guidances is decreased. It shows that the students are able to make explanation independently without any lead or guidance from the teacher.

4. Connecting explanation with Scientific Knowledge

Connecring explanation with scientific knowledge is an essential characteristics of inquiry that has three variations, which are students are given connection of the explanation, students are led to the scientific knowledge's source and students are asked to check other sources and relate it to the explanation. Inquiry essential characteristics can be seen during learning stage of data interpretation. On this stage, students are asked to connect the arranged explanation with scientific knowledge. Scientific knowledge can be found on the books, internet, or other sources. The purpose in connecting the explanation with scientific knowledge is to find the suppported evidence from the given explanation, to find the suited explanation to answer the given question and to find whether there is any weakness in giving the reason related to the evidence and explanation (NRC, 2000). In connecting explanation with scientific knowledge, students are asked to be independent first.

Inquiry variation on essential characteristics that connect explanation with scientific knowledge is improved. The improvement can be seen on the first meeting when the students were given the relation of explanation. Meanwhile, on the fourth meeting, students are able to check other source and relate it with explanation independently. From the first meeting to the fourth, it can be seen that teacher's role in giving leads and guidance is decreased. It shows that students are able to relate the explanation that they have made with other scientific knowledge's source without any lead or guidance from the teacher.

5. Communication

Communicating is the last stage of inquiry process. Communicating has function to teach the students how to communicate with other scientific society and environment. The most basic activity on this stage is a practice to present nvestigation result or inquiry activity result in form of presentation in the class (Anggraeni, 2005). Inquiry variation of communication characteristics consists of four variation, which are students are given steps and procedures to communicate the explanation, students are given guidence to communicate, students are tought to develop communication, and students communicate the explanation.

Inquiry variation on the characteristics of communication essential is improved. The improvement can be seen on every meetings. Students independently decide way to communicate. On the first meeting, students are given ways to communicate by the teacher. On the second meeting, students are trained to develop communication using leads and guidance from the teacher while in the third and the fourth meeting, students are able to communicate the inquiry result that is done independently.

CONCLUSION

Inquiry ability variation is improved on the students that learn through inquiry learning model. Based on the analysis of inquiry ability variation observation sheet it can be seen that inquiry ability variation on the essential characteristic is improved. It is shown on the first meeting that every inquiry essential characteristics are still given by the teacher, while on the fourth meeting, all of the inquiry essential characteristic can be independently decided by students except on the characteristic of deciding and collecting relevant evidence.

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