

Argument-based science inquiry (ABSI) models to improved capability of scientific argumentation

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Abstract. The purpose of this study was to developed argument-based science inquiry (ABSI) models to improved capability of scientific argumentation. The method used was Descriptive Research. The instruments of data collection used in this study were observation sheet, teachers structured questions, form of interview, scientific argumentation test. This study was conducted in junior high schools plus An-Naba Sukabumi with 25 seventh-grade students. The average results of students answers have the ability to argumentation at first level and only a few have the ability to argument at second level and one of the ways to improve student argumentation was experiment. One learning model that can be applied to improve students' argumentation is argument-based science inquiry (ABSI). The application of ABSI in enhancing the argumentation skills is in the research stage.

1. Introduction

The development of cumulative knowledge through science and technology is growing very rapidly in Indonesia, and now the country begins to emphasize science-based science learning. Science literacy includes skills to understand and communicate scientific ideas, as well as the ability to make informed decisions. Such skills can only be developed through meaningful reading, communicative writing, and argumentation in teaching science [1-3]. One of the goals of science learning in the 2013 curriculum is so that students have the competence to develop reasoning skills in thinking inductive and deductive analysis using the concepts and principles of science to explain various natural events and solve problems both qualitatively and quantitatively [4]. The purpose of science education is not only in mastering scientific concepts, but also in learning how to engage in scientific discourse. To achieve the implementation of scientific discourse, students must have the ability to argue in their learning to train students to get used to arguing [5].

The ability of scientific argumentation is very important to be trained in science learning so that students have logical reasons, clear views and rational explanations about things learned. In addition, the ability of scientific argumentation can equip students to provide an explanation of scientific phenomena that occur in everyday life based on scientific theories / concepts [6]. Argument-based science learning activities will encourage students to be involved in providing evidence, data, and valid theory to support opinions about a problem [7]. The ability to debate is one of the main goals of science learning because student's who study science must know the scientific explanation of natural phenomena, use them to solve problems and be able to understand other findings they get. Science

learning involving scientific argumentation does not occur naturally, but must be carefully planned. The focus and learning model must be adjusted and the teacher must be able to direct students how to build and support knowledge through arguments and assess and respond to statements or arguments put forward by others. The main problem in this case is that not all teachers are able to accommodate and carry out science learning like this. The teacher must design learning that gives students the opportunity to learn how to explain data, assess the relevance or adequacy of evidence, support statements, respond to statements or debate and revise statements based on feedback or new evidence obtained. In other words the teacher makes every effort to help students learn and adopt the same criteria that are used by true scientists in gaining scientific knowledge [8-10]. Based on the results of observations that we conducted at An-Naba Sukabumi Middle School, it shows that the average score in science lessons is still below the KKM, which is 65 to 70. Likewise with students' argumentation skills, the science subject teachers felt at the school were still low. This is related to mastery of the concept of students who have not reached the average. So that students find it difficult to build the ability of scientific argumentation.

The learning that can facilitate this is Argument-Based Science Inquiry (ABSI). This ABSI learning can train students to debate based on practical scientific investigation activities. This ABSI learning has been used in many countries including the United States, Korea and Turkey. Because ABSI learning has two main components, namely debating and investigating [11,12]. ABSI learning is a learning model of argumentation that integrates science inquiry into learning. ABSI Learning provides opportunities for students to conduct inquiry activities in inquiry, providing opportunities for small group discussions and class discussions so students are trained to argue which arguments are based on the results of scientific inquiry activities. In other words ABSI learning can facilitate investigation activities and build student arguments. Argument-based inquiry involves students in the inquiry process that results in understanding and explanation supported by relevant evidence [12]. being involved in the argumentation process, students can also master the concept better because knowledge about the context of the topics discussed requires students to understand content better. In order for students to be able to master the concept through scientific arguments in science learning, students should be given the opportunity to acquire and find concepts through a series of learning activities that emphasize direct learning experience so that the knowledge possessed by students is the result of the students' own construction.

2. Method

The method used in this research is descriptive method. Descriptive method is a method that does not provide treatment, manipulation, or changes in the independent variable, but describes the condition as it is. Descriptive research aims to describe the characteristics of a systematic and accurate population or about a particular field [13]. This research was conducted to obtain information about the learning model applied by the teacher and to know the ability of scientific argumentation of students in science subjects in junior high school. The research was conducted at SMP Plus An Naba Sukabumi. The problems studied are focused on the learning model applied by the teacher and the ability of students' scientific argumentation. Data collection uses observation, teacher structured questions, scientific argumentation test and interviews. The answers from the teacher will be analyzed qualitatively so that the description of the learning model that is often used by the teacher and the scientific argumentation skills of junior high school students can be known. This research will be the basis for my thesis which will examine the application of inquiry-based science learning arguments (ABSI) in improving the ability of scientific argumentation of middle school students. In this article, I also explained the learning stages of ABSI to provide an overview of how ABSI can improve students' scientific argumentation skills.

3. Result and Discussion

3.1. The Learning Model Used by Teacher and Student's Scientific Argumentation Skills

The science learning activities in SMP Plus AnNaba Sukabumi refer to the learning model that is in accordance with the 2013 curriculum. According to the results of observations that we made to science

teachers in SMP Plus AnNaba Sukabumi already uses learning models. The aim is to shape scientific behavior in students. In the implementation of learning in class VII, the teacher stated that the learning model used was Problem based Learning. In accordance with Permendikbud No. 103 of 2014, in the 2013 Curriculum there were three main learning models that were suggested to be able to shape scientific behavior, social behavior and develop a sense of curiosity. The three models are: Problem Based Learning, Project Based Learning, Discovery / Inquiry Learning. Based on the teacher's answers to structured questions, information was obtained that the science teacher in the junior high school had used all three learning models in science learning, adapted to the material of the science they were going to teach.

Based on our interviews with 2 science teachers at SMP Plus AnNaba Sukabumi related to the ability of students' scientific argumentation in the learning process, according to the teacher the scientific arguments of students are still lacking. According to them because of several things including lack of interest in reading from students so often students only get information or learning material from the teacher (teacher-centered). The second reason is because there are some students who are shy so they are afraid to be laughed at by their other friends when expressing their opinions. The third reason is the lack of internet facilities and LCD injectors in schools so that computer-based learning in schools is rather difficult to implement, so students cannot be forced to search for information through the internet when learning takes place.

The ability of argumentation is measured using essay test with a problems based on reality to improved ability of argumentation. The students are given a test on the topic of changes in temperature, acid rain, air pollution in industrial areas so that it can be related to daily life and are given questions about responses, causes and impacts as well as solutions to overcome them. The average results of students answers have the ability to argumentation at first level and only a few have the ability to argument at second level. First level which means the arguments contains only claims and at second level which menas the arguments containing claims and data. There are 3 levels of argumentation, at the third level namely arguments that contain claims, data, warrant, and backing or assumptions.

Argumentation is the main goal of science education that involves students in complex scientific practices to build and students who get science learning must be able to present accurate statements, communicate them to others convincingly, respond to other people's arguments and compare various arguments logically [7, 14]. The scientific argument serves to present and overcome the gap between ideas and evidence through valid statements. An assessment of the quality of argumentation refers to Toulmin's Argument Pattern (TAP). TAP is considered to be able to improve the quality of argumentation in the classroom through searching, responding to differences and taking attitudes so that scientific communication in the classroom is more effective and minimizes student misconceptions [14]. Toulmin said that an argument is obtained from a series of interrelated sentences and based on a statement that is believed to be true, namely claim (C), with data (D) that has been tested, and connected via warrant (W) and reinforced with backings (B). arguments are opposed in rebuttals (R), or counter-arguments that present facts that are contrary to data, warrant or backings, thus proving that the statement is true. Qualifiers (Q) show the strength of the conclusions obtained and how they can be applied and valid. Theoretically, the complex ability of argumentation covers all elements in TAP, but in practice it is found that many students experience difficulties in achieving all of these aspects in their entirety. From a Toulmin perspective, arguments include claims, data that support claims, justifications that provide a connection between data and claims, backing that reinforces objections that indicate circumstances in which claims will not be true.

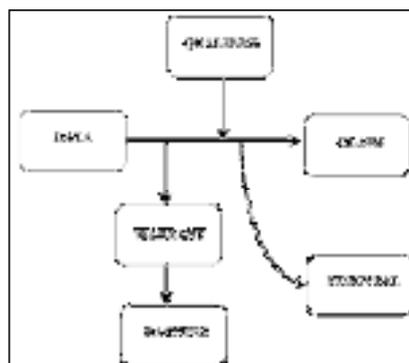


Figure 1. Toulmin's Argument Pattern (TAP)

3.2. Argument-Based Science Inquiry (ABSI)

The argument based science inquiry (ABSI) learning model is a learning model of argumentation that integrates science inquiry into learning. The ABSI model with a science writing heuristic approach is a learning model that seeks to integrate argumentation skills. Science Writing Heuristic (SWH) has been widely used as the argument-based science inquiry (ABSI) approach in many countries including the United States, Korea and Turkey [11]. SWH was originally developed by Key to integrate argument-based inquiry activities, collaborative group work and for writing learning strategies [1]. Arguments and investigations are the two main components underlying the SWH element. ABSI learning has three characteristics namely, 1) inquiry-based practicum learning in groups, 2) students exchange understanding in one group in the form of colliding arguments based on practicum data, and 3) comparing science ideas from the results of group discussions with books or other sources through class discussions and exchanging arguments between groups [15].

The ABSI model consists of 7 stages: generating questions, designing an observation or trial procedure, collecting data, producing evidence, submitting claims relating to the questions raised, contemplating investigations, changing ideas. Steps of the learning model of Science Writing Heuristic (SWH) can be seen in Table 1. [1, 11].

Table 1. Steps of the learning model of Science Writing Heuristic (SWH)

Phase	Activity of Teacher	Activity of Student
Phase 1 <i>Exploration of pre instruction understanding</i>	The teacher begins learning by identifying events for investigation and preparing questions that guide students to answer the problem. Which then identifies the students' initial understanding	Students submit and answer questions about inquiry practicum assignments. Students ask questions that they want to answer and can be answered through practical activities
Phase 2 <i>Participation in laboratory activity</i>	The teacher divides students into small groups. Each group is then directed to design a method (for example, a trial, systematic observation or data analysis) that they can use in collecting data to answer a guiding question	Students design methods (eg experiments, systematic observations or data analysis) and continue each group to collect data. This stage provides opportunities for students to learn how to design and conduct investigations in science.
Phase 3	The teacher directs	Students make tentative

Phase	Activity of Teacher	Activity of Student
<i>Negotiation shape I: writing personal meaning for laboratory activity</i>	students to interpret practical data into data tables and directs students to make temporary claims	arguments based on practicum results data (argumentation guidelines)
Phase 4		
<i>Negotiation shape II: sharing and comparing data interpretations in small groups</i>	The teacher directs students to discussions in their groups regarding strengthening claims based on the data obtained. And encouraged to show evidence of his claim	Students discuss and compare interpretations of data between friends in small groups. Students are asked to submit opinions (claims) to state the meaning of their data, and show proof of their claims, share arguments from their group friends
Phase 5		
<i>Negotiation shape III: comparing science ideas to textbook or other printed resources</i>	The teacher directs students to compare the results of lab work in other forms with textbooks and other sources in the form of class discussions	Students in each group presented the results of their group discussions to compare the results of the data obtained with textbooks, other sources and with the teacher and compared the explanations themselves with explanations that were scientifically accepted in the form of class discussions. This step encourages the conceptual change process and trains strengthening argumentation.
Phase 6		
<i>Negotiation shape IV: individual reflections and writing</i>	The teacher directs students to make lab reports in the form of final arguments from the results of individual class discussions	At this stage the students reflect by writing lab reports in the final argument from the results of individual class discussions (guiding arguments), and reflecting on whether their ideas have changed during laboratory activities.
Phase 7		
<i>Exploration of post instruction understanding</i>	The teacher engages students in strengthening concepts and concludes by making conclusions	Students are actively involved with teachers in strengthening concepts and making conclusions

The strength of the argument-based science inquiry (ABSI) model is to provide opportunities for students to conduct inquiry activities in inquiry, providing opportunities for group discussions and class discussions so students are trained to argue the arguments based on the results of scientific inquiry activities. Learning by using the argument based science inquiry (ABSI) model can facilitate investigative activities and build student arguments [15].

4. Conclusion

Based on the research that we have done, information is obtained that Science Teachers in SMP Plus AnNaba Sukabumi have used the three learning models suggested by the Ministry of Education, namely Problem Based Learning, Project Based Learning, Discovery / Inquiry Learning. The selection

of learning models that will be applied is adjusted to the material of the science they will be teaching. The ability of scientific argumentation of students in SMP Plus AnNaba Sukabumi is still lacking because of several things including the lack of interest in reading from students so often students only get information or learning material from the teacher (teacher-centered). The second reason is because there are some students who are shy so they are afraid to be laughed at by their other friends when expressing their opinions. The third reason is the lack of internet facilities and LCD injectors in schools so that computer-based learning in schools is rather difficult to implement, so students cannot be forced to search for information through the internet when learning takes place.

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