

CHAPTER I

INTRODUCTION

1.1 Background

Concerning the increasingly advanced era, human qualities need to be improved so that they can express the best qualities that exist within themselves (Ho et al., 2019). New standards have been adopted in the curriculum of education. Therefore learners need to be prepared to learn 21st-century skills, knowledge, and attitudes to cope with the growing and evolving community of today (Noviyanti, Mukti, Yuliskurniawati, Mahanal, & Zubaidah, 2019).

The 21st century skills also include the skills of argumentation. This ability has been emphasized in science learning over the years. (Acar, 2014; Chin, 2016; Osborne, 2013). In science learning, scientific argumentation is a complicated cognitive ability that involves "rational reasoning between hypothesis and evidence" (Lee, 2014). It is in line with Regulation No 103 and 59 of the Minister of Education and Culture 2014, science learning activities are expected not only to equip students to conduct experiments but also to equip students in interpreting, processing, reasoning, and presenting information so that students are expected to propose arguments based on experimental result (Kemendikbud, 2014). The argumentation activities not only allow students to master scientific concepts but also enhances students in scientific discussions as the purpose of science education that's supposed to be (Syerliana dan Setiawan, 2018).

Scientific argumentation skills consist of the ability to literate, to think critically, to give reasons, and to develop awareness communication (Noviyanti, Mukti, Yuliskurniawati, Mahanal, & Zubaidah, 2019). Students need to perform a set of activities to construct the correct argument. The process begins with the collection of claims and data (ground), and it is followed by a statement of reasons (warrant), support (backing), qualifying, and rebuttal. (Dusch, Schweingruber, & Shouse, 2007; Sampson & Gerbino, 2010). That's process known as Toulmin's Argumentation Pattern (TAP) that defines the key components of the argument (Toulmin, 2003). The rebuttal has been given priority as the most complex

cognitive function (Kuhn and Crowell, 2011) and as a key attribute that distinguishes argumentation from other rational debates, such as interpretation (Osborne & Patterson, 2011).

The ability to develop scientific argumentation skills was an important part of the social science field (Klopp & Stark, 2019). The study showed that argumentation can enhance students' scientific achievement, improve science literacy, and also has a role in enhancing critical thinking skills and understanding the concept in-depth (Ho et al., 2019). Strong arguments also have a positive effect on improving students' communication and writing skills (Noviyanti, Mukti, Yuliskurniawati, Mahanal, & Zubaidah, 2019).

However, in reality, the ability to make an argument in some countries, including Indonesia, is still relatively low. The results of the 2015 OECD survey showed that 20% of PISA participants were still below the average for scientific literacy. One of the indicators of science literacy is the ability to make and evaluate evidence-based arguments, which means that scientific argumentation is included as a component of scientific literacy (Nurinda, Sajidan, & Prayitno, 2018). Scientific argumentation skills of students is also still low compared to other skills such as science process skills, critical thinking skills, creative thinking skills, and student independence (Putri & Rusdiana, 2017).

Other research has stated that the majority of Senior High School students in Malang had low scientific argumentation skills (Syerliana & Setiawan, 2018). It can be seen from the highest point made by the students that the claim was about 80%, while the warrant, backing, and rebuttal aspects did not reach 50%. This result is also reinforced by the level of argument raised by students who did not reach the fifth level. The greatest achievement of the level argumentation at the first and second level, is that students still have difficulty conveying the results of their analysis both orally and in writing (Anwar & Susanti, 2019).

In other hand, the results of research on the quality of arguments conducted at one senior high school in West Java show that written arguments are better than oral arguments (Anisa, Widodo, Riandi, & Muslim, 2019). On average, the written argument showed the aspects of claims, data and warrants, and some additional counter-claims and rebuttal. Whereas in oral argument the aspect of argumentation

is the same as in written argument but there is no counter-claim or rebuttal found (Anisa et al., 2019).

Many studies have shown that the difficulties of students in formulating arguments are caused by a lack of participation in scientific discussions. Argumentation rarely occurs in traditional classes where teachers dominate class discourses (Ozdem et al., 2013). This trend may be triggered by the lack of an instructional learning environment that makes it easier for students to express their views based on both oral and written scientific evidence (Sampson & Blanchard, 2012).

Therefore, the learning process is needed to encourage students to ask questions and make arguments based on real problems (Noviyanti, Mukti, Yuliskurniawati, Mahanal, & Zubaidah, 2019). One of the instructional models is Problem Based Learning (PBL). According to Servant (2019), PBL will improve problem-solving skills, build decision-making skills and increase self-confidence, transparency and communication. Moreover, there is study found that teaching and learning practices that apply PBL models enable students to better use, incorporate and interpret relevant knowledge by offering more strategies than those in the classroom (Duda, Susilo, & Newcombe, 2019). PBL is believed to be effective in improving social skills through group work (Merritt, Lee, Rillero, & Kinach, 2017) and improve students' scientific argumentation (Nurinda, Sajidan, & Prayitno, 2018).

PBL model uses real-world challenges as a context for students to learn about problem-solving skills (Arends, 2007). Problems posed by teachers are issues related to the real world and interesting for students to be trained to solve problems (Bilgin, Senocak, & Sözbilir, 2009). The real problem that can be used as a source to improve the ability of scientific argumentation is a problem related to science, and one of the topics is about energy resources (Borgwardt et al., 2019). Energy resources are natural resources that can be processed by humans so that they can be used to meet energy demand. As we know, in this digital era, more people are using properties that need the energy to produce and to power and it causes the energy demand has recently increased as the addition to population growth (Nabavi, 2019).

According to the BP Energy Statistics Review, as the one of the most widely-considered and widely-used publications in the energy industry conducted in 2010, crude oil and natural gas will be exhausted in the next 45 and 60 years, with current global energy consumption policies. Whereas, the world still uses this fuel as the main energy source (Iea, 2019). Thus, the sustainable use of fossil-based fuels is not promising due to their restricted supply and environmental effects, such as greenhouse gas emissions and other air pollutants (İskenderoğlu & Akdağ, 2019). Therefore, everyone should have the right knowledge to solve this problem to foster a sense of responsibility and energy-efficient living among citizens of the 21st century (Ochoa, Alvarez, & Acevedo, 2019).

Based on the importance of scientific reasoning skills, which emphasized in the theories above, this study tried to measure the ability of students' scientific reasoning as the main focus. Therefore, profiling secondary students is expected to be the best way to determine the conditions of students' scientific reasoning skills in science today. So that in the end, this research will produce information for educators as a benchmark for taking effective and targeted actions as solution to improve argumentation skills that have an impact on improving other skills.

Many studies (Putri & Rusdiana, 2017; Syerliana & Nurinda, 2018; Noviyanti, Anwar, Anisa, 2019; Faize, 2020) have been conducted regarding reasoning skills. Those studies are mostly carried out at high school and university level, and the points analyzed are scientific reasoning skills in the form of oral or written in separate research. Whereas in this study, this research is focused on oral and written scientific argumentation and has an intention to its correlation. This research conducted for junior high school students in the form of online learning as the impact of the pandemic case of COVID-19. While in previous studies, oral reasoning produced through debate, but in this study the students have to make a video of scientific reasoning by themselves to produce oral scientific argumentation.

Therefore, in this study, the process of students' scientific argumentation skills was examined in written essay tests and argument video, to investigate the specificity of the quality of students' scientific arguments in learning energy resources. The point of this research is to focus on the analysis of students' scientific

argumentation skills both in oral and written argumentation, the researcher also looks more closely at the correlation of oral and written scientific argumentation skills. Based on that statement, this study has the intention to conduct research entitled *“Analysis of students’ scientific argumentation skills through problem-based learning on energy resources topic”*.

1.2 Research Problem

Based on the background description above, the research problem in this study is: “How is the Analysis of Students’ Scientific Argumentation Skills through Problem-Based Learning on Energy Resources Topic”. Then the problem was broken down into some research questions.

1.3 Research Question

Based on the research problem above, this study is elaborated into some questions namely:

- 1) How is the profile of students’ written scientific argumentation skills through problem-based learning in learning energy resources?
- 2) How is the profile of students’ oral scientific argumentation skills through problem-based learning in learning energy resources?
- 3) How is the learning process of problem-based learning on scientific argumentation skills through in learning energy resources?
- 4) How is the students’ oral correlate to written scientific argumentation skills through problem-based learning in learning energy resources?

1.4 Limitation of Problem

In order to avoid a wide problem in this research, then the research is limited to as follow.

- 1) There are so many kinds of steps in the implementation of problem-based learning, among others are five steps of PBL (Agustina, 2017), nine steps (Hung, 2009), and seven steps (Schmidt, 1983) and many more. But this research focuses on five problem-based learning steps advanced by Agustina (2017). Five steps of problem-based learning used in this research are

organizing students into problems, organizing students to learn, assisting independent and group investigation, developing and presenting words and exhibitions, analyze and evaluate the problem-solving process.

- 2) There are not so many variations in explaining scientific argumentation component, and the most complete is the component of Toulmin which consists of six aspects. Some experts use some elements or use it completely. However, the component of argumentation used in this research is based on six aspects of Toulmin Argumentation Pattern (TAP). Those aspects are claim, data, warrant, backing, qualifier, and rebuttal.
- 3) In this research, the topic chosen is energy resources. It is limited by core competency number 3 and basic competency number 3.5 for seventh graders in junior high school.

1.5 Research Objective

The main objective of this research is to investigate students' scientific argumentation skills through problem-based learning on energy resources topic. Furthermore, the detailed objectives of this research are as follows:

- 1) To investigate the profile of written students' scientific argumentation skills through problem-based learning in learning energy resources.
- 2) To investigate the profile of oral students' scientific argumentation skills through problem-based learning in learning energy resources.
- 3) To investigate the learning process of problem-based learning towards scientific argumentation skills in learning energy resources.
- 4) To investigate the correlation between students' oral and written scientific argumentation skills through problem-based learning in learning energy resources.

1.6 Research Benefit

The results of this study are expected to give benefits for several parties, including students, teacher, and researchers. Each of those parties will be explained as follows.

For the students, the results of this study can be used as a source of information for developing their scientific argumentation skills independently and they can apply these skills in daily life problems both personal and social spheres. For the teachers, the results of this study can be used as recommendations in selecting alternative learning models and as a reference in developing students' scientific argumentation skills.

For Researcher, this study provides real information about the condition of students' argumentation skills both oral and written at the secondary school level in 7th grade, and through this study, the researcher also learns to conduct research systematically. For other researchers, the research result can be used as a reference to describe the natural conditions of students' argumentation skills for oral and written argumentation. The information resulted from this research can become an evaluation material for continuing research that is expected to have a positive impact on education.

1.7 Research Paper Organization Structure

In order to get an organized structure of the paper, this paper is arranged based on this following structure. Chapter 1 (Introduction) presents the background of the research followed by the problem and limitation as the basis to conduct this research. This part also presents the purpose of the research and the benefit gained from this research. Chapter II (Literature Review) explains some literature and theories of problem-based learning, scientific argumentation skill, energy resources topic. Chapter III (Research Methodology) this chapter examines the step of the procedures, the type of research, and the data analysis include the validation of the instrument. Chapter IV (Result and Discussion) presents the interpretation of the data as a result of the research. The result is supported by other findings and theories raised by another expertise and researcher. Chapter V (Conclusion and Recommendation) consists of conclusion and recommendation as the answer to the research question in chapter I.