Argumentation Skills Profile on 8th Grade Students using Toulmin's Argument Pattern on Controversial Topic

Yosan Setyo Utomo*, Ashadi, and Sarwanto
Sebelas Maret University, Surakarta, Indonesia

*Email: yosan.assegaf@ymail.com

Abstract: Arguments are very important for students and a lot of research has been done to identify the best approach to integrating argumentation into the learning process. The purpose of this research is to find out the profile of students' argumentation skills and find out how to measure the quality of argumentation. The qualitative design was used in this study. The sample consisted of a total of 90 eighth graders consisting of two different schools in the junior high school. The findings show that more than half students do not have complete quality argumentation. The quality of student argumentation is only dominated by basic argumentation skills which consist of claim, warrant, and data. Analysis of argumentation skills using Toulmin Argument Pattern (TAP) with a controversial topic. The results of the student work were analyzed for the quality of their arguments with TAP which consisted of claim, warrant, data, backing, rebuttal, and qualifier.

Keywords: Argumentation Skill; Science education; Assessment; Toulmin argument pattern.

1. Introduction

Argument skills have a central role in science education [1],[2]. Although argumentation has a significant role in science education, it is rarely used in science courses and laboratory activities [3], [4], [5]. In addition, in everyday life students outside of school face debatable issues that are inherent in the popular problems of science that they often encounter. They are asked to be able to interpret it critically, especially to make decisions. To do this, they must recognize whether the argument is supported by evidence, the quality and quantity of the evidence, and the meaning of the pragmatic message, or their intentions [6].

In the more general interest of people who want to become pioneers in the field of science and technology, it is necessary for people to have critical thinking and the ability to think reflective. For this problem, it appears that arguments are very important for progress. Argumentation is important because it is the first step towards and starting the process of formation of differences [7]. Yet, studies of students’ argument skills in science contexts report these skills to be under-developed at best, even at the college level [8], [9], [10], [11], [12].

Teaching students to debate has not been much empowered. Although [14] argues that argumentation is the solution to many problems in education, on the one hand it helps students to things that are difficult to learn, and on the other hand helps process learning in the classroom.

Arguments in science education are considered as core practices that can empower students to develop their reasoning skills, criteria for evaluating knowledge, scientific literacy and skills of subsidiaries [9],

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The question that arises is: What is the profile of student argumentation skills? How do you measure student argumentation skills?

The research aims to find out the level of student argumentation in relation to the knowledge of a particular topic and to know how to measure student argumentation skills.

The rest of this paper is organized as follow: Section 2 presents related works. Section 3 describes the proposed research method. Section 4 presents the obtained results and following by discussion. Finally Section 5 concludes this work.

2. Related Works

Argumentation skill has two goals. One is to secure commitments from the opponent that can be used to support one's own argument. The other is to undermine the opponent's position by identifying and challenging weaknesses in his or her argument [18].

2.1 Student argumentation skills

Argument skills are associated with the appreciation of science as an enterprise that advances through the coordination of evidence with theories, rather than as the accumulation of facts [19]. In answering a set of questions or to be able to prove the truth, requires the placement of arguments and concrete evidence [7]. Previous research shows that there is a difference in the development between adolescent and adult argumentation skills. Teenagers and adults differ in looking at the focus of the argument. Teenagers focus on exposing their own positions and using relatively weak argumentative strategies, whereas adults focus on other people's positions, trying to weaken other people's arguments and use strong argumentative strategies [20]. In this study, it is different from [20], which is finding out the arguments in adolescence. The argumentation skills obtained will only describe students in their teens. In this discussion, junior high school students are considered to represent teenagers.

As far as argumentation skills in individuals of different ages are concerned, there is evidence that even young children have some competence in generating arguments to support claims [21], [22] and in understanding the structure of an argument [23]. On the other hand, research has documented that argumentation skills are not highly developed in young people and adults, who may have difficulty producing relevant evidence to support their positions, counter-arguments, and rebuttal [24] or be guided by belief bias when evaluating arguments [25].

In research [26] that examines the effects of engagement in dialogical arguments with colleagues who have opposite views of the topic in addition to involvement in activities that focus on arguments with colleagues who share the same opinion. While this research relies on the same topic with different perspectives. Students are given the freedom to express their arguments. Other research investigates online arguments, as was done [27] which investigates the relationship between conditions (with / without giving requested questions as a scaffolding tool), students' conceptions and approaches to online argumentation in an online argumentation environment [27]. In this study, arguments were obtained from offline testing. The test is given in the paper and pencil test. This is considered to provide equal opportunities for all students to answer.

Argumentation is not only limited to contributing to the conceptual understanding of students. According [28], who define argumentation as a core practice of scientific endeavor, the goal of science education is not to train students as specialists in a specific knowledge domain, but to encourage them to engage in discourse in general and argumentation in particular in a social constructivist sense. Many studies report, the integration of argumentation into relevant learning activities can contribute to improving scientific literacy [3], [29]. Arguments can be described in several ways and at different levels. Unlike category syllogism in formal logic, the contents of informal arguments are important for their evaluation. They are indeed evaluated in terms of their views, which refers to two criteria: acceptance of
supporting evidence themselves and their relevance in terms of the extent to which they support conclusions [30].

In addition, [31] asked about how students' arguments might relate to prior scientific knowledge and they found that students' pre-knowledge had additional effects on their arguments, and this study showed that any attempt to increase students' knowledge through argumentation was closely related to the learner's initial knowledge. An argument is a conclusion sustained by at least one reason. Informal reasoning assumes importance when the problems are complex, controversial or ill-structured with no definite solution [18], [24], [30], [32]. Mastery of the required science content knowledge relevant to the topic under discussion enables people to construct higher quality argumentations compared to less-informed peers. However, there are also some contradictory findings in the literature [13], [24], [32].

The position of this research is as a basis for knowing the extent to which juvenile argumentation skills are especially for the 8th-grade students. To minimize the influence of the quality of argumentation on the mastery of a science content. So the science content used is content with controversial issues so that information is expected to be obtained by students.

2.2 Assessment of the quality of argumentation

Assessment of the quality of argumentation refers to the 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 [41].

A number of studies have applied the Argument Pattern of Toulmin to analyze arguments [7], [34], [35]. An argument is obtained from a series of sentences that are interconnected and based on a statement that is believed to be true [33]. According to Toulmin’s argumentation main elements are:

Claim (C): Claim is an idea that is put forward about a notion, an opinion or a result (explanations searching to interpret natural phenomena compose a special sort of claim).

Data (D): It is a fact that is based on realities and it used for supporting claims.

Warrant (W): It explains relationships between claim and data. It is an explanation that how data support claim.

Backings (B): It is main assumption that support warrant’s acceptability. It is necessary when warrants are not accepted.

Rebuttal (R): It is used in the even that claim is not acceptable.

Qualification (Q): Express the grade of certainty or uncertainty of an argument, for instance “probably”, “sure”, “it depends”

Although the use of TAP as an analytical tool for arguments has undergone various criticisms [36] however TAP is an effective way to compile arguments or design weak arguments. The TAP offers a complete structure to build high-quality arguments by fully and accurately linking various components to the issues discussed. This structure is flexible and thus can be applied to various fields (for example, law, science, politics, etc.) [4], [37].

In addition, research by [38] shows that TAP can be used as a structure to help students think about how to make arguments by describing the relationships between the components of the argument. For this purpose, many other researchers have used TAP to design arguments to help students construct arguments or explanations [7], [34], [39].

Argumentation research conducted by several people concluded that student discussions were weak and some students were not involved in arguments in science classes [4], [9], [40]. Engage in the decision-making process, using data to support and refute arguments used in calculating the quality of arguments.
With the process of argumentation, students learn the concept of science and also have the opportunity to practice the way they fill or reject their ideas.

In this work, the assessment of the quality of the argument uses TAP. The use of TAP has been widely used by other researchers, so it is considered TAP is very appropriate to assess the quality of argumentation. TAP can be used in various disciplines including in science learning.

3. Material & Methodology
This section presents the material used and the proposed methodology.

3.1 Data
The study was conducted on 90 students in grade 8 of 2018/2019 Academic Year. Consisting of 36 men and 54 women taken from two different schools located in Surakarta, a city in Indonesia. The two schools consisted of students of similar socioeconomic backgrounds ranging from low-class to middle-class. The academic performances of participants were about average compared with other students of the same ages. Profile of argumentation skills is obtained by examining the test results given to students. Tests are given in the form of an essay. Test questions have been analyzed by experts and Gregory tests are carried out. Gregory test is done to find out the content validity of the description questions which are used as argumentation tests.

3.2 Method
The study was conducted using a descriptive research approach, to obtain the profile of students' argumentation skills. The test is given in the form of a description of the controversial issue of environmental pollution. Argumentative assessment refers to the Toulmin’s Argument Pattern (TAP) with elements of argument elements which include claim, data, warrant, backing, rebuttal dan qualifier [33].

4. Results and Discussion
This section presents the results obtained and following by discussion.

4.1. Result
Data analysis techniques are carried out by analyzing the results of the tests based on the TAP indicator. It calculating the mean (see Table 1).

| N  | Claim | Warrant | Data | Backing | Rebuttal | Qualifier |
|----|-------|---------|------|---------|----------|-----------|
| 90 | 84    | 51      | 57   | 28      | 15       | 26        |

From Table 1, in the claim indicator there are 84 students who can express it. There are 51 students for warrant and there are 57 students who can disclose the data. Whereas for backing, rebuttal and qualifier each number of students can reveal around 28, 15 and 26 students.

4.2. Statement of results
Although every element that exists is important in shaping the argument. However, the analysis is limited by the indicators used in determining the quality of argumentation. The results of the quality of the argument can be seen on each indicator that has been determined. Then on each indicator can be seen the level of mastery. To facilitate the comparison of each element of argumentation, it can be seen as a percentage is shown in Figure 1.
Figure 1 states the average student who can express argumentation skills for each indicator in percent form. Results are obtained from the average student who can express arguments for each indicator and change it in percent form.

4.3. Explanatory text

Theoretically, complex argumentation skills include all elements in the TAP. But in practice, it is found that many students have difficulty reaching all these aspects in their entirety. This can be seen from the graph that not all students can express their arguments completely. Even the highest results found in claims only have a percentage of 93.33% of students who are able to express them. Whereas for rebuttal the lowest percentage was 16.66%. Rebuttal being the lowest is a natural thing, this is because research is conducted on 8th-grade students. Their age is between 13-14 years. With this age that is still classified as adolescence, students still focus on their position and do not try to see from the point of view of others.

Data which is a reinforcement of the claim is not too much can be revealed by students. Only about 63% of students can submit arguments with data. This is inseparable from the topic used as the test material. Although the topic being tested is a controversial issue, but not a few who still don't know. In linking claims with data, a warrant is needed. Judging from the results, it can be stated that students who have claims and data cannot fully submit a warrant. Whereas to submit a warrant only claim and data is required, but some students do not do well. This can be seen from the difference between warrant data and about 6% of the total number of students. Backing gets a presentation higher than rebuttal with 31.11%. This is considered reasonable because to declare backing easier than rebuttal. The backing point of view comes only from yourself, in contrast to rebuttal. So that students are better able to express better backing.

Test results are analyzed from the description problem with controversial issues. The essay test makes students freer to express their arguments. The problem with the issue of controversy is expected to minimize the influence of content on the quality of argumentation. Analysis using TAP can reveal the quality of the argument properly.

4.4. Discussion

The skill of argumentation that can be revealed by students is quite a lot. The highest percentage is from Claim, Data, and Warrant. For these three indicators, the students were most often exposed. In the rest of this paper, relevant literature is discussed in terms of the link between the quality of argumentation and content knowledge. First of all, a recent study [4] reveals that 12th graders’ domain-specific knowledge of...
models of the theory of evolution is a determining factor in generating higher quality scientific arguments.

The argumentation indicator dominated by students is claims, warrants, and data. These three indicators are most often seen by students, because these three indicators are the basis of the argument [33]. More than 50% of students can express basic arguments with the TAP indicator. For example, some knowledge content reveals some patterns of argumentation as producing more claims of knowledge, data, and warrant, they do not guarantee to articulate higher quality arguments [30]. Some basic components of an argument are often seen in the argumentation process [30]. But in the absence of backing, counter-arguments and qualifier the quality of argumentation will be limited to a lower level.

There are no significant argumentation indicators regarding the backing, rebuttal, and qualifier stated by students. This shows that the quality of student argumentation is not too high. Because the argumentation indicator which consists of backing, rebuttal, and qualifier includes high-level arguments [33]. Some studies make the level of argumentation at the highest level. In the literature, much research has been carried out on the Toulmin Argument Pattern to assess individual arguments [4], [7], [14]. In general, TAP has six components. Three of these (claims, data, and warrant) are the basis for the argument, and the other three components (backing, rebuttal, and qualifier) then or complete the argument.

The tool used to measure argumentation skills is TAP. This tool has been used in a number of studies and it has been reported functional for assessing the quality of both scientific and socio-scientific argumentation [7]. The research [42,] conclude in their study within the scope of a physics lecture that students’ argumentation quality is positively influenced by their knowledge of physics and the quality of conceptualizations. Topics on arguments questions discuss controversial issues. The topic of environmental pollution is considered appropriate because it is a controversial issue that needs to be discussed. In a similar examine the extent to which students with prior field knowledge engage in argumentation. They are implicitly and different from the quality of students' arguments that are not related to pre-existing knowledge. Very similar conclusions are reported in more recent case studies [43].

In the rest of this paper, relevant literature is discussed in terms of the link between the quality of argumentation and content knowledge. It must, however, be kept in mind that, in the processes of argumentation, teachers do not adopt a knowledge transmission model of pedagogy, rather they adapt both themselves and their students to a pedagogy that requires knowledge construction for an argumentative classroom culture [14].

According to [3], teachers should provide classroom environments to let their students engage in argumentation to develop their conceptual qualities, investigative competence, and their understanding of the epistemology of science and of science as a social practice. In the relevant science education literature, it is reported that the quality of argumentations generated by individuals can be affected by their social environment [44], their field knowledge [13], [30], [42] and their teachers [14], [35].

5. Conclusion and Future Work

This paper has illustrated various transformations about the concept of argumentation as an object of testing argumentation skills. In science education at the junior high school level, through testing his profile in research that took place in Surakarta. The results show that students’ argumentation skills are dominated by basic argumentation skills. Basic argumentation skills are claims, warrant, and data. With more than half of students already able to express arguments at the primary level. But at a higher level of argumentation, students have not been able to do it well such as expressing backing, rebuttal, and qualifier. Therefore, it can be concluded that the ability of student argumentation is still at the level of basic argumentation. Based on the data above, when students learn about science, they must be taught how students are encouraged to give ideas based on their data or knowledge. This is as shown by research [1]
which says that science education must be emphasized in appropriate scientific discussions. Argumentation skills by analyzing essay test results with controversial topics, namely pollution. Argumentation quality analysis is carried out using TAP [7] which consists of claims, warrant, data, backing, rebuttal and qualifier. The use of TAP has been widely used in research and in accordance with science topics. TAP has been functionally reported to assess the quality of scientific and socio-scientific arguments [33]. The results of this study provide references for further research and system development related to argumentation. In addition, the structured and TAP argument scaffolding developed in this study can be applied to formal and informal science curricula. As a final comment, as [5] reports, on the way to engaging in scientific argumentation, individuals tend to benefit from social and cognitive strategies and deliberate focus on the discussion process must be considered as an important constituent.

As a suggestion, we ask researchers who deal with the argumentation process so that argumentation skills are applied in practice. Expect argumentation skills to be prepared and optimized. That way the benefits of argumentation skills can be obtained maximally.

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