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Analysis on senior high school’s reasoning skill

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Abstract. This research aims to get analyzation of reasoning skill in Senior High School level. Defined as ability in drawing conclusion expressed in logical argument, the analyzation on reasoning skill is measured by student argument in answering essay question involving respiratory system topic. The arguments are categorized into five levels based on Toulmin Argumentation Pattern (TAP) consists of Claim, Data, Warrant, Qualifier, Backing, and Rebuttals. The subjects are students of Senior High School chosen by purposive sampling. The method used in this research is descriptive. The results shows that level of students argumentation lies 29.17% on level one and 70.83% on level two. This results indicates that most of Senior high school students are having difficulty in giving explanation on their claim using the data related to fact or theory they have acknowledged.

1. Introduction

Learning science is actually learning about natural phenomena. To learn science is to gain knowledge by observing natural phenomena and interpreting it into logical explanation. One must be able to communicate the explanation of natural phenomena to fully achieve the knowledge. This sequence is expressed into scientific approach which is began with observing and completed with communicating the result. Thus, the science curriculum in school is designed to gain science knowledge of students by implementing scientific approach. Along with the implementation of scientific approach, there are some skills that are necessary to be developed by science learner. One of the skills is reasoning skill.

Reasoning based on [1] is defined as a process of drawing conclusions from some initial information (premises). Meanwhile, the reasoning skill is defined as ability to retrieve initial premises for drawing conclusions. Referring to [2] reasoning is defined as process of a argumentation as in reasoning consists of a flow of propositions within discourse of reasoned argumentation. Thus, this study analysed the conclusion of reasoning in expressed logical arguments. Related to science approach, conclusion is drew from the information that is translated into explanation and are communicated in form of logical arguments while information is gathered by observing the phenomena while. This explains why reasoning skill becomes important as it is always goes hand in hand with the ability to do scientific approach for learning science. However, the practice of science learning in school does not always guarantee the student reasoning skill. Ideally students need to be able to use their science knowledge to implement it for solving real life problem. In this process, students need to relate facts, data and theory.
they’ve learned to produce a conclusion that will be implemented for solving problem. The conclusion is expressed in a way students arrange their arguments. Thus, the quality of argument can be used to identify students’ reasoning ability in comprehending science knowledge. In short, arguments as the outcome of reasoning portrays student’s attainment in learning science.

Based on explanation above, this study aims to describe High School Students’ reasoning skill by analysing students’ argument regarding on certain science topic. The High School level was chosen because it is the starting level in secondary education system. The students’ arguments were analysed using Toulmin Argumentation Pattern (TAP) refers to the study in [3] based on [4]. The Toulmin Argumentation Pattern categorizes arguments into five levels based on the components attached in argument; claim, data, warrant, backing, qualifier, and rebuttal. In [5] claim is the conclusion, proposition or assertion someone gives to a problem statement, data is the evidence that supports the claim, warrant is an explanation of relationship between the claim and data, backings is basic assumption to support the warrants, qualifiers is condition under which claim is true, and rebuttal is statements that refute alternative or opposing claims, data, and warrants.

2. Method
The method used in this study is descriptive method refers to definition by Fraenkel [6] which is stated giving a state of affair as fully and carefully possible. The participants are students from X High School in Bandung who are chosen by purposive sampling. The school is chosen because the reputation of holding high academic achievement in national and international competition. Essay question related to respiratory system topic was given to the participant to measure their ability in reasoning to problem statement. The answers were later analysed using Toulmin Argumentation Pattern to see how participant arrange their logical arguments. The rubric of TAP based on [5] adapted from [4]. Toulmin Argumentation Pattern categorizes arguments into five level based on the component of argument; claim, data, warrant, backing, qualifier, and rebuttal, in which level 1 only consist of claim, level 2 consists of claim and data or warrant, level 3 consists of claim, data, warrant, and backing or qualifier, level 4 consist of claim, data, warrant, backing and qualifier, and level 5 consist of claim, data, warrant, backing, qualifier, and rebuttals.

3. Result and discussion
The reasoning skill in this study analysed on how the students arrange their argument for answering essay question about respiratory system. The essay requires students to relate the structure and function of respiratory organ, and observe the information from the question to give the claim on the problem. Referring to [7] argumentation described as process of discussion between different viewpoints, then the students arguments were analysed based only on the component of argument, regardless the what claim it states.

The result from students’ argumentation in answering each essay questions were analysed. The result shows that their answers varied from level one until level three, with the highest percentage were on level two. The data is shown in Table 1

| Levels  | Percentage |
|---------|------------|
| Level 1 | 38.33%     |
| Level 2 | 55.00%     |
| Level 3 | 6.67%      |

Students with more component in answering their question, can support their claim with the data and connect their answer using warrant, and also give explanation under which condition that they claim might be true. This means that the students are able to make arguments into level three arguments based
on TAP with claim, warrant, data and backing or qualifier. Meanwhile most of the answer fall on level two with only give claim and support it using data and-or warrant. Some answers also only state the claims without any reasoning process on what aspect supporting the claims. This means students are having difficulty in gathering information and communicating their support for their conclusion. This describes that most students able to give claim to make an intuitive conclusion but still having difficulty in providing supporting reason. Based on the data in this study, there is no students that can gives level four argument. Compared to the similar study in [8] to junior high school students, that study shows that in junior high school some students can provide argument on level four, but in this study no one of the high school student can provide the answer on four level argumentation. Supposed based on [8] the students argumentation tend to get better overtime, along with more experience that information they gathered. This difference founding in the study presumably because the difference in type of argumentation used, the study in [8] used oral argumentation in debating session, while this study used written argumentation in answering essay questions. Based on explanation in [9] there is the difference task given in writing argumentation and oral argumentation. There should be shift in cognitive aspect to be able to make writing argumentation. As student mostly get information by hearing narrative explanation, it is easier for them to arrange argument orally. That make written argumentation slightly more difficult than oral argumentation. Resulting in lower level of argumentation expressed in written argument. Although there is different founding in the result, but both studies along with related study in [5] agree that most students in high school provide level two argumentation.

The data in table 1 shows that some answers reach level three of argumentation, but it does not always mean that students’ skill is also on level three. The answers of each students on every items were analysed to get the description of average reasoning skill level of every students. The data that describes students’ reasoning skill based on argument level is shown in Table 2

| Levels   | Percentage |
|----------|------------|
| Level 1  | 29.17%     |
| Level 2  | 70.83%     |

The data on Table 2 shows that High School Students’ Argumentation is only reach level two for the highest, with percentage of level one is 29.17% and level 2 is 70.83%. Means that in making conclusion, students are able to make claim on a problem and give their explanation with or without providing the data. Because based on TAP, the level two arguments have claim, warrant, and/or data. Indicating that student can give either warrant or data to support their claim or give both of warrant and data.

This rule makes the argument in level two has different quality because of the different number of component in argument. Based on the study in [4] the argumentation on same level can be divided into weak argument and strong argument. Thus, this study decided to analyse tendency of the quality in level two arguments. The students’ answers that are on level two argumentation were gathered and categorized into strong argument that gives claim with only data or warrant and weak argument with claim, data, and warrant. The result is shown in Table 3.

| Quality                                      | Percentage |
|----------------------------------------------|------------|
| Strong argument (Argument with Claim, Warrant or Data) | 69.23%     |
| Weak argument (Argument with Claim, warrant and Data)    | 30.77%     |
Based on the data in Table 3, most of the arguments in level two are only provided with either warrant or data to support their claim. Only 30.77% arguments are provided with complete data and warrant or defined as strong argument. Refers to the explanation in [5], data is defined as evidence that support claim, while warrant is relation between claim and data. Supposed, when the argument provides data, there should be warrant to relate the claim with the data, means that both of warrant and data should be provided to make a complete reasoning. However based on data in Table 3, most of arguments in level 2 only able to provide claim with either data or warrant as weak argument. In reasoning process, claim is the conclusion given to the problem, data is the fact that was provided in the problem including the knowledge of students, and warrant is assumption of students to make connection on how students use the information or data to make a conclusion or claim on a problem. This means that most of students have not be able to make a complete conclusion by relating with the fact and theory they’ve learned.

Students’ difficulty in providing arguments with relation between their claim and data indicates that they still have low ability of reasoning. This is supported by the data that show the argumentation of students are on level 2 at the top from the highest argumentation level on level 5. This is far from the ideal complete arguments. Despite the reality of low reasoning skill, the data in table 1 that shows the analyzation of students’ arguments shows that most of students still have difficulty in relating the evidence from observation with the knowledge they get from learning science for drawing a conclusion. This is shown by high percentage of weak arguments in students answer.

4. Conclusion
High School Students’ Reasoning Skill based on the argumentation in answering essay question is identified to be in level 2. The analyzation of students’ arguments shows that most of students still have difficulty in relating the evidence from observation with the knowledge they get from learning science for drawing a conclusion. This is shown by high percentage of weak arguments in students answer.

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