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To cite this article: L Syerliana et al 2018 J. Phys.: Conf. Ser. 1013 012031

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Argumentation skill profile using “Toulmin Argumentation Pattern” analysis of high school student at Subang on topic hydrostatic pressure

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Abstract. This study aims to know profile of argumentation skill high school student at Kabupaten Subang. To achieve this goal, researcher conducted a descriptive study to analysis student test results of argumentation skill of 35 students XII SMAN. Data collection using argumentation test which has validation by expert and then it is analyzed using TAP (Toulmin Argumentation Pattern) which consist of some components such a data, claim, warrant, backing, and rebuttal on the topic of hydrostatic pressure. The method used in this research is descriptive method. The result of this research show the student’s scientific argumentation skill is still low, this is proven by 54% average claim score, 38% data, 29% warrant, 35% backing and 35% rebuttal. These findings will serve as a basis for further research on innovative learning models that can improve students' argumentation skill.

1. Introduction
The 21st century skills in the “21st century knowledge-skills rainbow” scheme are (1) life and career skills, (2) learning and innovation skills, and (3) Information media and technology skills. Learning and innovation skills involve (a) Critical Thinking and Problem Solving, (b) Communication and Collaboration, (c) Creativity and Innovation [1].

Critical thinking is an underlying skill and needs to be mastered first before other learning and innovative skills. There are three basic critical thinking skills that are first introduced to students: (1) understanding the arguments and beliefs of others; (2) critically evaluating such arguments and beliefs; (3) developing and maintaining the argument and belief [2].

Science including physics in it aims to develop and improve a science. In publishing new science the scientist involves criticism and argument [3]. On the regulation of the minister of education and culture No. 103 and No. 59 year 2014, activities in science learning is expected not only to train students to conduct experiments but also trained students' abilities in interpreting, processing, reasoning, and presenting information so that students are expected to propose arguments based on experimental results.

Thus, argument plays an important role in the main practice of science. Therefore, the goal of science learning should be no longer just to develop the concept of science but also to learn how to engage arguments in science expenditure [4].
In science, argumentation is not a heated exchange between rivals that results in winners and losers or an effort to reach a mutually beneficial compromise; rather it is a form of “logical discourse whose goal is to tease out the relationship between ideas and evidence” [5]. Scientific argumentation, as a result, plays a central role in the development, evaluation, and validation of scientific knowledge and is an important practice in science that makes science different from other ways of knowing [6].

The argument in science learning in the classroom contributes in five dimensions: First, the argument supports the existence of cognitive and metacognitive processes according to the performance characteristics of the experts who can be models for students. Second, arguments support the development of communication competence and critical thinking. The three arguments support the achievement of science literacy and train students to speak and write using the language of science. The argumentation supports enculturation into the practice of scientific culture and develops epistemic criteria for evaluating knowledge. The five arguments support the development of reasoning, especially in the selection of theories or the determination of attitudes based on rational criteria [7].

Toulmin’s argumentation pattern (TAP) has been used to assess and model scientific research [3]. Toulmin Argumentation Pattern (TAP) including its components such as, claim, data, warrant, backing and rebuttal is used to analyze the argumentation skill. TAP components as follows: Claim is the values that are maintained by people or what is exist; Data is the statement which is used as the evidence to support the claim; Warrant is the statement which is used to explain the relation between data and claim; Backing is the basic assumption, is often explained implicitly; Rebuttal (disclaimer): is the statement opposed to the data [8].

Since how important the argumentation skill are, but description about profile of argumentation skill have not known especially at high school students at Subang. Therefore, this research held to investigate profile of argumentation skill of high school student at Subang. Information about argumentation skill expected will give new information for teacher to identify student’s ability to solve physics problem. When we know this information, teacher expected can plan and do better learning process to develop student argumentation skill.

2. Methods
The method used in this research is a descriptive method. It is used to identify the students’ argumentation skill. A developed instrument in this research aims to identify the students’ argumentation skill in the topic of hydrostatic pressure of the high school student at Subang. Toulmin Argumentation Pattern (TAP) including it is components such as claim, data, warrant, backing, and rebuttal is used to analyze the argumentation skill. Generally, TAP model is investigated as an informal measurement to analyze an everyday reasoning about the social issues, in this case is hydrostatic pressure.

The argumentation test was given to 35 students and the answer is analyzed by the TAP analysis and scoring use rubric adapted from NSTA (National Science Teacher Association). After scoring, the next step is do the percentage of each argumentation skill indicator. Thereafter do the performed categorization for each indicator, namely grouping scores obtained by students in the category of very high, high, fair, low and very low. This categorization adapted from ability categorization as in Table 1. Guidelines for the categorization of students’ argumentation skill such as in Table 1 below.

| Percentage score (%) | Category |
|----------------------|----------|
| 81 – 100             | Very high|
| 61 – 80              | High     |
| 41 – 60              | Fair     |
| 21 – 40              | Low      |
| 0 – 20               | Very low |
Data student score and the percentage will be used by the researcher to conduct descriptive analysis.

3. Results and Discussion

Argumentation skill test given to 35 of high school student of XII class at SMAN Kabupaten Subang. The result of students’ argumentation skill assessment on hydrostatic pressure concept is presented as follows:

![Toulmin Argumentation Pattern (TAP)](image)

**Figure 1.** Profile of students’ argumentation skills class XII on Hydrostatic Pressure Concepts

According to the Table 1 above, the claim have higher percentage and the warrant has the lowest percentage. The pattern is similar to the results of research that has been done on pre-service physics teacher. Where is the finding that most pre-service physics teachers are still weak in explaining why the evidence is included and how the evidence can support the claim [9]. Although the claim has the highest percentage (54%), the results of the answer analysis on the claim indicator show that most students make fairly accurate but vague or incomplete claim. Only two student can makes an accurate and complete claim and includes points from the question in the writing.

Furthermore the second largest percentage value is the data that is equal to 38%. Eleven student does not provide data, or only provides inappropriate data or vague data, like “the data shows me it is true”. Other student makes a general statement regarding data, but does not include specific details.

Backing and rebuttal have the same percentage that is equal to 35%. Most students know that the main law of hydrostatic is a theory that can support their claims or counterclaim. The majority of the students may mention that those affecting the hydrostatic pressures are high (h), the density of the liquid (ρ), and the gravitational force (g), there are two students who even write it in mathematical equations. But, the students did not explain the relationship between pressure and depth, pressure and density. Which should be mentioned alongside the main hydrostatic law in making backing. As for rebuttal, almost all students can declare "no" to the wrong claim. However, the student’s disclaimers are not strong, tend to be weak. Only three students were able to explain the rebuttal well.

Warrant is the aspect of argumentation skill that the smallest percentage among other indicators is 29%. In making warrant, most students only repeats data and links it to the claim, but does not explain how the data supports the claim. Only four student who provides reasoning components for some of the data and explains how the data supports the claim. This is in accordance with the research that has been done by Choi, Klein, and Hershberger (2014) that one of the difficulties in making arguments is to construct and develop a relationship between claims and data [10].

The result of this research relates to the research finding conducted by Brem & Rips that “When students are asked to provide reasons for their arguments, many students tend to rely on unproven reasons to justify their claims or students using only plausible explanations as a way to replace lost
evidence [11]. Although students can generate claims, they usually do not give reasons for the claim [12].

The results of this study are different from previous research which shows students' skills in making backing is always lower than warrant [13 - 15]. This happens because the backing of this research is the ability of students to express a theory of physics that supports their claims or rebuttal. The theoretical physics here is the laws of physics that students have studied before. Students only need to recall for choose, mention, and explain what laws fit the claim or rebuttal they have made. Argumentation quality is depended on the assignment features, the students’ personal interpretation, the way to present the assignment, and sometime it relates to the misconception, intuition, personal or general experience [16].

The low of student’s argumentation skills due to some factors. First, student not used to do question like argumentation skill type, usually student get mathematical type so student just need to substitution the number. Second, learning model in the class doesn’t facilitate student to develop argumentation skill. Third, lack of clear guidance for teacher how to do assessment and development of argumentation skill. So, teacher must plan a learning model that can facilitate student to train their ability to make claims, use data to support their claims, and justify claims with scientific evidence.

Following up on this argumentation skill profile is expected to improve the quality of better learning in schools.

4. Conclusion
Based on the result of research and discussion, it can be concluded that argumentation skill of SMAN Kabupaten Subang is still low when compared with the maximum score of 100. Average score of argumentation skill is 38. Student obtained lowest score in warrant. These findings will serve as a basis for further research on innovative learning models and strategies that can improve students' comprehension and argumentation skills.

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Acknowledgments
The author would like to say thank to the students in our research classroom at SMAN Kabupaten Subang who have help the author, and also author want to say thank to Dr. Muslim and Prof. Dr. Wawan Setiawan whose generous advices guided the research and development of the manuscript.