# Online Student-worksheet Based on Toulmin Argumentation Pattern in Physics Learning (Check Similarity)

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# Online Student-worksheet Based on Toulmin Argumentation Pattern in Physics Learning

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**Abstract.** This research provides an online worksheet that can help improve students' argumentative skills in learning physics. The media developed is based on Toulmin's Argumentation Pattern. The resulting product is an online worksheet that is valid and effective for use in physics learning. The development stage used a 4-D model. Validation was carried out by media experts and learning experts using a questionnaire. The validation questionnaire includes four aspects (Concept Accuracy, Clear Meaning, Physical Appearance, and Element Completeness). Besides, the media was also tested in small groups to determine the user's response to four aspects (Language Clearness, Attractiveness Layout, Content Understandable, and Communication flow). The effectiveness of the media was measured using a pretest-posttest one group design and the gain score. The argumentation skills test was in the form of ten essay questions. The student answer using TAP components. This study's results indicate that this online worksheet is valid and effective in encouraging the development of students' argumentative skills. Three essencial characteristics of the worksheet encouraging the skills are using issues related to daily-life, various media types, and providing many activities.

Keywords: online worksheet; Toulmin argumentation; physics learning; argumentation skills

## 1. Introduction

Education is more meaningful if learning is directed at decision-making, not only understanding concepts. Humans are used to making decisions, assuming that actions are a reflection of the results of the decision-making process in their minds. From the problem identification process to selecting the best solution, this is called the decision-making process. Therefore, argumentation skills are needed to make wise decisions based on the scientific knowledge obtained by students in addressing socio-scientific issues. In driving the improvement of the learning process in Indonesia, MOEC developed the 2013 Curriculum. An appropriate learning model is needed to fulfill the learning expected in the curriculum. One learning model that is thought to be following the implementation of the curriculum and physics learning principles is the TAP model (Toulmin Argumentation Pattern). The TAP model is a learning model that emphasizes students actively in learning that is carried out by arguing activities following existing facts. Learning using TAP is thought to be able to support students' creativity in solving problems. By doing or revealing, students can apply experiences and are easily understood [1]. Arguments are used to strengthen a claim based on evidence and logical reasons. Toulmin's argument component consists of claims, data as evidence, warrant, support, qualifications, and reservations. There are indications that students can put forward claims, data, and justifications that show students can be said to have argued. This argumentation can be considered as a constructivist teaching method. Argumentation can also be viewed as evidence-based scientific reasoning and can also be considered a reasoning between alternative viewpoints based on data. The

argument also refers to someone who can logically support a theoretical position. Some studies say that students who engage in argumentation have a higher level of literacy. Argumentation is a cognitive activity in building scientific knowledge [2].

Students can apply learning models such as argument-driven inquiry (ADI) [3], argument-based learning to improve the students' argumentative skills [4]. However, based on the initial analysis at a high school in Merangin, Jambi province, through in-depth teacher interviews. The students' argumentative skills were still low. This evidence was the inability of students to provide arguments when answering a problem. Generally, students have weaknesses in arguing, which is caused by not being used to it [5]. The learning arguments have not received special attention from teachers, including in the provision of learning tools that support this. So far, teachers tend to test students' abilities by choosing answers, understanding, understanding simple concepts, providing short explanations, calculating formulas, and concluding a topic [ To improve the ability to argue, it is necessary to develop appropriate media for these problems, one of which is the TAP-based learning model. This learning model uses clear stages, so it helps learners to start arguing. Many research results show that the provision of worksheets with specific characteristics can lead to improved argumentation skills such as Argument-Driven Inquiry (ADI) based student worksheets [4], learning partial argument negotiation [6], and total argument negotiation [7], argument-based learning [8], science writing heuristics (SWH) [4], and problem-based learning [9].To encourage increased argumentation skills, TAP is relatively tested when used in education [10]-[12]. According to Toulmin, argumentation consists of the following elements: Claims (statements that are presented in response to a problem, Data (including evidence or support at the time the claim is made), and Warrant/ guarantee (supports the relationship between claims and data) [12]-[14].

In general, it is obtained that the practical arguments used in the study make a positive contribution to learning performance [4],[12]. However, these studies are still limited to use in face-to-face learning. In the current learning conditions mostly done online, it is necessary to develop more appropriate learning innovations. One alternative is to integrate worksheets into the learning management system. This media can get the maximum benefit from the features available on the learning management system. Each child is unique. For students who are new to learning activities in class, it does not mean that students do not know what will be learned. Still, students have knowledge that comes from previous experiences as a basis for starting new learning. Students can find understanding through their learning experiences in the classroom. Online learning provides opportunities for each student to learn according to their individual characteristics in achieving the expected learning goals. In this case, it is the ability to argue. The worksheet is a learning medium that can be adjusted according to each student's level of learning speed. It is necessary to develop a worksheet to provide this online argumentation-based teaching material according to the learning objectives, the characteristics of students, and the subject matter funds. Based on the situation described above, this study aims to develop an online student worksheet based on the Toulmin Argumentation Pattern (TAP) in physics lessons [12].

## 2. Method

This research uses product development stages including needs analysis, initial design, expert validation, practicality testing, and effectiveness testing. Two media experts and two learning experts validated the worksheet. The trial test was carried out on five students. The effectiveness test was carried out in one group of 21 students. The material applied in the worksheet is a static fluid topic. In applying the worksheet, the teacher used Edmodo as an learning management system accommodating the activities on the worksheet. The features used were posts, assignments, quizzes, libraries. This research was conducted on the eleventh-grade students. To assess the validity, media experts (2 people) and learning experts (2 people) filled out a questionnaire with item structures including Concept accuracy (7 items), Clear meaning (4 items), Physical appearance (4 items), and Element Completeness (7 items). This questionnaire uses a Likert scale from 1 (Very Poor) to 4 (Very Good). The practicality of the media is measured by the students ' acceptance of the product. Students are asked to pay attention and try the media. After that, they are asked to respond by filling out a questionnaire whose structure includes Language clearness (2 items), Attractiveness Layout (6 items),

Content Understandable (4 items), and Communication flow (5 items). This questionnaire uses a Likert scale from 1 (Very Poor) to 4 (Very Good). Effectiveness is measured by using a test in the form of an essay that measures the ability of argumentation when answering seven questions (problem-solving) related to static fluid material. The assessment technique uses a rubric as in Table 1.

**Table 1.** The technique for scoring test results

| Level | Score | Description of argumentation ability |
|-------|-------|-------------------------------------|
| 4 | 10 | The claim is true, Data is relevant/true, and the reason is linking data with claims. |
| 3 | 7.5 | The claim is true, Data is relevant/correct, and the reason is not linking data with claims. |
| 2 | 5 | The claim is true, Data is irrelevant/false, and no reason |
| 1 | 2.5 | The claim is wrong, Data is irrelevant/false, and no reason |
| 0 | 0 | There is no answers |

Questionnaires for validity and practicality are calculated based on the average and then categorized to determine the results on the criteria 12 Less, Enough, Good, or Very Good (Eko Putranto, 2010). To evaluate the effectiveness is done by using an independent T-test on the results of the post-test.

## 3. Result

The resulting product has several important characteristics which are expected to improve the ability to argue. The TAP model is characterized by claims, Data, and Assurance shown in cognitive processes in solving problems. This thinking process is shown in the examples of existing issues, shown in Figure 1. By providing various examples, students gain experience to apply the TAP model and internalize it in their thinking process.



**Figure 1.** Example of the problem using Toulmin Argumentation Pattern answer

Besides, the problems used in learning that activate the ability to fragment are also based on everyday phenomena. In this case, the physics phenomena in real-life were used as the argumentation trigger. This approach is also related to the findind of other researcher [15]. Some examples of this phenomenon are shown in Figure 2 (insects and surface tension), Figure 3 (on fluid and viscosity).



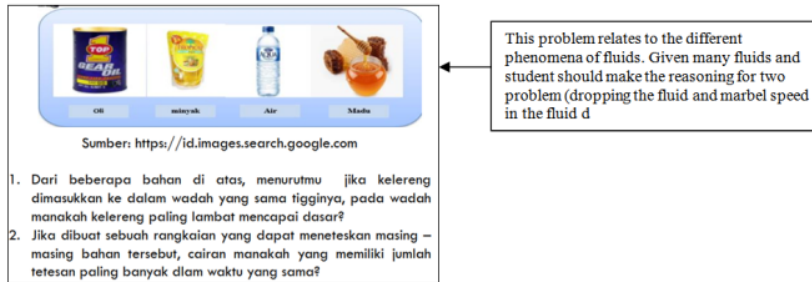**Figure 2.** Insect as the case of preface tension.

**Figure 3.** Fluid and volatility phenomena

Test questions to measure the ability to argue were developed in an essay using the TAP model—the example question is in Figure 4.
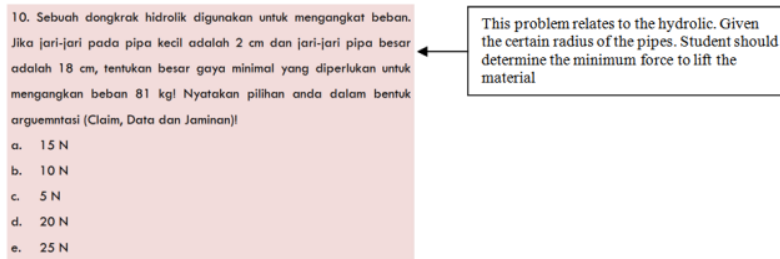


**Figure 4.** Problem 10 is an example of Toulmin argumentation-based

Validity by experts includes criteria for language appropriateness, including the precise meaning and ease to understand. Criteria for content attractiveness including support to self-learning, curiosity, and related to the relational-life problem. The criteria for learning activities including observation, reasoning, and communication. Physical layout criteria including cover design, pagination, and font. The results of this validation are shown in Figure 5.
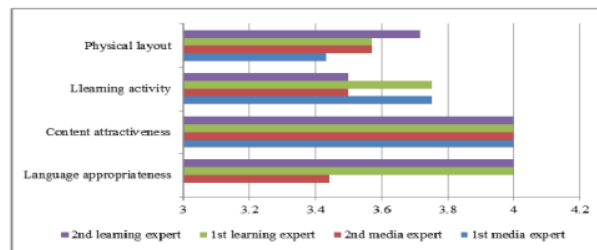


**Figure 5.** Validation summary from experts

Student responses when using student-worksheet include aspects of language clearness, layout attractiveness, content understandable, and Communication flow shown in Figure 6.
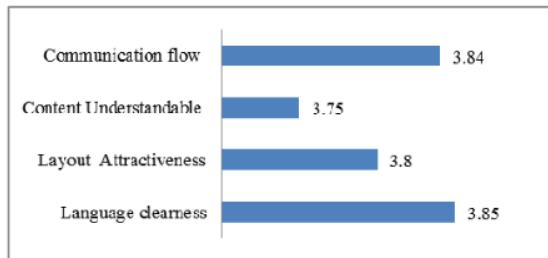
**Figure 6.** Students' response to worksheet

The increase in learning outcomes can be seen from the students' pretest and post-test scores, as shown in Figure 7. Increasing the ability of students to argue is in the quite effective category. This result indicates that the TAP-based student-worksheet is effective enough to improve the argumentation skills of students.
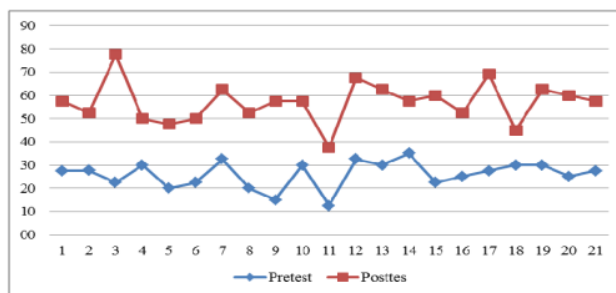


**Figure 7.** Gain Category based on TAP activity (n=21)

Table 2 shows the summary of the pre and post test result releated the gain level category. It shows there are 16 (76%) students were in the medium and high category.

**Table 2.** The level of gain category

| n=21 | Pretest Score | Posttest Score | Gain |
|---|---|---|---|
| Average | 26.0 | 57.0 | 31.0 |
| Standard Deviation | 5.8 | 8.8 | 8.6 |
| Gain category of the post-test | Low | 5 (24%) | |
| | Medium | 12 (57%) | |
| | High | 4 (19%) | |

## 4. Discussion

The student-worksheet developed in this study is arranged coherently and systematically. Systematics in the presentation of the subject matter of static fluids is based on elaborating core competencies and essential competencies determined to be determined indicators of achievement. In student-worksheet, there is already a scientific approach to learning which is included in TAP-based learning activities. Based on the results of the validation of this student-worksheet, it is feasible and effective enough to improve the ability to argue through learning physics on the subject of static fluids in eleventh-grade students. In addition, students also consider that this student-worksheet is practical in helping them learn physics on the subject of static fluids. The responses to the ability to argue between pretest and post-test are shown in Figure 8.
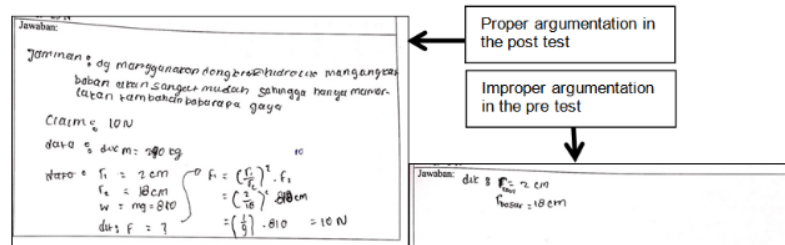
**Figure 8.** The argumentation comparison between pre and post-test on answering Problem 10

The learning model can be interpreted as a teaching pattern that explains the process. Students can interact and communicate, resulting in notable changes in student behavior [16]. There are a lot of changes that occur in a person, both in nature and type, because, of course, not every change in a person is a change in the meaning of learning [17]. There is an increase in learning achievement (the ability to argue) seen from how much interest in learning from the students themselves. If there is no interest in students to learn, there will be no increase. Students play an essential role in determining the learning process's success [15]. Learning results are the ability skills after receiving learning experience. There are three kinds of learning outcomes: life-skills, knowledge, and attitudes [18]. In this study, learning has been carried out that encourages argumentation skills which includes learning objectives, learning materials, learning methodologies, and learning assessments. Media development that provides various forms of display of a phenomenon can encourage the development of students' thinking. The accuracy of the chosen learning method and the perfection of its application play an essential and significant role in improving learning achievement and the quality of learning [7]. The seriousness of using techniques that are based on adequate knowledge of the theory and principles that guide a method will be a good asset for the implementation of learning capital which leads to increased learning achievement of students [3].

## 5. Conclusion

Student-worksheet with TAP can improve the ability to argue. Several characteristics support this student-worksheet, namely using phenomena related to everyday life, using various media types (text, video, links), providing various activities. With these characteristics, students become more enthusiastic in learning, which impacts increasing their argumentation skills. However, these results have limitations because they have not been tested in experiments with a control group using other media or learning strategies.

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