The feasibility of worksheet based on scientific creative thinking skills and critical thinking skills for physics learning in high school

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Abstract. This research aimed to determine the quality and comprehension of worksheet based on scientific creative thinking skills and scientific critical thinking skills. The method used in this research is research and development. The instruments used in this study consist of the test instrument of quality worksheet and the instrument of comprehension worksheet. Data analysis techniques for worksheet quality through questionnaire worksheet consisting of several aspects as much as 20 items, while data analysis for the comprehension worksheet using test of main idea the paragraph and test supporting main idea the paragraph. The result of data analysis for test of worksheet quality obtained by result of scoring of questionnaire value from three expert lecturers and 10 of physics teachers, converted in the form of percentage obtained the quality of worksheet developed by 82.5% that is in very good category. The result of data analysis for comprehension test conducted on 32 students is 87.5% in the independent category (high). The Average of quality test results and comprehension test of 85% are included in the eligible category. Thus, the feasibility of worksheet based on scientific creative thinking skills and critical thinking skills on the topic of momentum impulse is worth to using.

1. Introduction
In this 21st century, education is becoming increasingly important to ensure students have the skills to learn and innovate, the skills of using technology and information media, as well as to work and survive by using skills. One of the skills that students should have to face the 21st century learning is creative thinking skills and critical thinking skills [1]. Learning that can train the 21st century skills must be a student centered, teamwork, and learning related to the context of the everyday lives of students [2]. Creative and critical thinking are both essential for students in all aspects of educational studies [3]. In studying physics, students are required to have a creative thinking skills to solve problems with the scientific method. Scientific creative thinking is part of the scientific creativity that can be developed and obtained through the process of learning so that students are able to create new understanding, explore the problems and finding solutions what can be done to resolve the problem with the scientific method [4]. Not only the creative thinking skills, critical thinking skills are also needed in the study of physics to solve problems with the scientific method. Critical thinking is the process of thinking reasonably and focus on making decisions about what should be done to solve the problem [5]. Many factors can affect a learning process. The most influential factor is the interaction between students, teachers, and teaching materials [6]. Therefore, in using teaching materials, where it
interacts directly with the students during the learning they must be really well prepared. One of the teaching materials that can facilitate active learning and student centered is a worksheet [7].

In fact, based on the results of the field study and observation at one of the high school in Bandung, showed that 1) the learning process is more centered on the teacher so, students are actively involved in it. Therefore, the learning process is not able to train students thinking skills that suit the demands of 21st century learning, 2) scientific creative thinking skills and critical thinking skills student is still very low, and 3) the worksheet that was used at the school still lacks direct students to improve the skills of scientific creative thinking and scientific critical thinking. Based on existing problems, researchers interested in conducting research on the development of worksheets to improve the scientific creative thinking skills and critical thinking skills for physics learning in high school on the topic momentum impulse. The purpose of this research is to generate physics worksheet on the topic of momentum and impulse that can improve scientific creative thinking skills and critical thinking skills, as well as gaining an overview eligibility of physics worksheet on topics of momentum and impulse. The research question is how the quality of physics worksheet made according to expert and teacher and how comprehension main idea worksheet for students.

2. Method
The research method used is the method of research and development [8]. At this stage of the development of teaching material in this study using a method adapted from methods of the model for the process of writing instructional materials [9]. The object of research is the physics worksheet on the topic momentum impulse for high school student. The instrument used in this study were quality test questionnaire and main idea comprehension test. The numbers of respondents for data validation of worksheet quality based on creative thinking skills and critical thinking skills were 13 experts consisted of 3 physics lecturers and 10 physics teachers. Meanwhile, the numbers of respondents for the data of main idea comprehension were 32 students at one of senior high school in Bandung.

3. Result and Discussion
Research results presented consists of the results of the validation worksheet based on creative thinking skills and critical thinking skills from the experts and the results of main idea comprehension from the students. The product quality test is assessed on the basis of 20 descriptors which were categorized into three component [9]. The results are interpreted to be, very less with the score of 0-25, categorized less with the score of 26-50, categorized good with the score of 51-75, and categorized very good with a score of 76-100. Table 1 shows the results of the worksheet quality test has a percentage of 82.5 contains the category very good.

<table>
<thead>
<tr>
<th>No</th>
<th>Quality component of worksheet</th>
<th>Score</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Correspondence between indicator and basic competencies</td>
<td>85.5</td>
</tr>
<tr>
<td>2</td>
<td>Correspondence between indicator and description of content</td>
<td>82</td>
</tr>
<tr>
<td>3</td>
<td>Correspondence between basic competencies with breadth and depth of content</td>
<td>80</td>
</tr>
</tbody>
</table>

The test of comprehension of the main idea is assessed using the assessment rubric consisting of the aspect of assessment the main idea and the aspect of assessment the supporting sentences of main idea, with a maximum of 4 If the student response is complete, specific, and true, score 3 If the student response is correct but incomplete, score 2 If the student response only give details but not the main idea, a score of 1 if the student response was not true but he's been trying, score 0 If students do not attempt to respond to what was ordered. Furthermore the percentage average score interpreted, low (category difficult), moderate (instructional category), and high (standalone categories) [9]. Main idea
comprehension test consisted of 32 respondents with 3 sub-topics, namely momentum, impulse, and collision. Table 2 shows that the results of the valuation worksheet, where the average of main idea comprehension test is 87.5% which belong to the category of independent (high) very good.

**Table 2. The Result of Worksheet Comprehensibility Test**

<table>
<thead>
<tr>
<th>Worksheet</th>
<th>Topic</th>
<th>Percentage of comprehensibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Momentum</td>
<td>86</td>
</tr>
<tr>
<td>2</td>
<td>Impulse</td>
<td>95</td>
</tr>
<tr>
<td>3</td>
<td>Collision</td>
<td>90</td>
</tr>
</tbody>
</table>

The results of quality test and the comprehension test is 85% which belong to the category worthy. So, physics worksheet based on scientific creative thinking skills and critical thinking skills on the topic momentum impulse developed can be categorized is worth to use. the feasibility of the worksheet because the worksheet model developed with the process of writing worksheet which has several stages, so that development is done more structured. In addition, this model of writing presented what was written and explained again with pictures, graphs or tables, so make the writing becomes more clear and comprehensive.

Writing worksheets begins with analyzing the skills that students should have a standard based on the competence of graduates, core competence, and basic competence. This step is done so that the worksheet that was developed in accordance with the demands of the curriculum. Next do the formulation of indicators of learning which adapts with the scientific creative thinking skills aspect and critical thinking skills aspect. The next step is to create a list of topics and subtopik which will be explained and developed in a worksheet, it is obtained through the determination of the scope of the material. the material covered is then associated with its relevance in everyday life. The phenomena presented adjusted with the concept discussed in the lessons and learning activities designed to encourage student learning by looking at the real situation. Once the list of topics and subtopik have been determined, the next stage is the creation of concept maps. Concept map provides a hierarchical arrangement of topics that will be written [10]. After the concept mapping is done, the next thing is to make the draft outline that serves as a reference for writing worksheet. Draft outline made with the sort of material that is common to special or from specific to general.

The next step to determine the most appropriate representation mode to describe the information or concepts in a worksheet. The selection mode is not only one kind is due to one of the modes which certainly has limitations in explaining a concept/information in a worksheet. Then the material taught in the create in the form of multiple representation, that explain a concept with different modes. The aim is to facilitate the readers in order to understand information/concepts found in the worksheet. The use of multi representation it is believed will complement the weakness of other representation mode. The next step is to compile the multimodus representation into an explanation of discourse that is integrated. Figure 1 describes the multimodus representation contained in the worksheet.
Then the researchers devise activities in the worksheet by integrating aspects of scientific creative thinking skills and critical thinking skills shown in Figure 2 and figure 3.

4. Conclusion
Based on the results of the research on the development of physics worksheet based on scientific creative thinking skills and critical thinking skills on the topic momentum impulse that has been done, it can be concluded that the physics worksheet developed by using methods of the model for the process of writing instructional materials worth to use. It is shown from the results of the assessment of the quality aspect of the worksheet has a percentage of 82.5 contains the category very well, as well as main idea comprehension test of worksheet has a percentage of 87.5, which belong to the higher
category (standalone category). So, the feasibility of the physics worksheet based on the scientific creative thinking skills and critical thinking skills is 85% into the category deserves to be used.

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6. References


