

The Development of Students' Worksheet Based on Guided Inquiry (SW-BGI) for Work and Energy

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Abstract— The aim of this study was to develop an inquiry-based students' worksheet which was applied to work and energy materials. Each stage facilities students to improve their critical thinking skills. The development is carried out in stages, namely preliminary study, planning and goal setting, initial product development, feasibility assessment, limited trials, revision of initial product, field trials, and revision of final product. The students' worksheet was validated by the expert, the colleagues, and the education practitioner. The data validation used questionnaire. Students' worksheet are validated from construction, material and the suitability Inquiry requirements. The students' worksheet revised according to the advice of the experts. It can be concluded that the students' worksheet by using guided inquiry in the category of very feasible so that it could be applied in physics learning.

Keywords— *Students' Worksheet, Guided Inquiry*

I. INTRODUCTION

Physics is one part of science which deals with all processes that are systematic, for example contained in practicum activities where students are assigned to carry out experimental activities to find out or prove concepts with experimental steps. Physics is also one lessons which has closely related to critical thinking skills.

Critical thinking skills are one type of High Order Thinking Skills (HOTS). The development of HOTS is rapidly to teachers, so They must prepare students readiness to compete in the current industry 4.0 revolution. One type of HOTS is critical thinking skills. Fisher [1] stated that critical thinking skills are the thought processes ability of things substance, or problem by skillfully dealing with the structure of thought owned and applying intellectual standards in expressing goals, in relation to firm reasons about a belief and activity which has been done. So critical thinking skills be thought processes based on structurally processes carried out in which a person must be able to decide action believed to achieve the goal.

Critical thinking skills are very important because they aim to find relevant and reliable knowledge relations with real life. This is in accordance with the statement of Arend [2] that critical thinking skills applied in physics studies both studying procedural knowledge so that the facts contained in

each stage are easily understood, as well as conceptual knowledge that requires higher-level thinking connecting the facts that exist so that the concept can delivered well. There are five critical thinking frameworks in analyzing concepts according to Ennis in Costa, namely [3]:

1. Providing a simple explanation,
2. Empowering the skill base,
3. Concluding
4. Having further explanation
5. Implementing strategic tactics.

According to Peter [4], there are several things can be done to improve the skills include: (1) using learning strategies that involve active students, (2) instructions are focused on the learning process not on content, (3) using assessment techniques that provide intellectual challenges for thinking instead in the matter of remembering. Therefore, efforts can be made to improve Critical thinking skills are by developing learning devices that are in accordance with learning activities that are able to support the thought process.

Learning tools are one factors played an important role in learning activities because they are a guide, a measure of learning success and as a facility in achieving learning objectives. Efforts in improving critical thinking designed learning tools as best as possible through learning based on scientific methods. One of the important learning tools to develop is the Student Activity Sheet. Worksheet can help teachers focused to students to find the concepts through group activities. Other Components of worksheet are: 1) subjects, semesters, and places, 2) learning instructions, 3) competencies goal, 4) indicators, 5) supporting information, 6) tasks and work steps, 7) assessment.

Many worksheet have developed in previous researches, they are adapted to some aspects of the development of worksheet in research and learning, students' characteristics, learning material, curriculum, conditions of the school, and worksheet based on applications. Based on the assessment of the material, media, linguists, and learning experts, the developed worksheet stated to be used for learning with an average V Aiken score of more than 0.80, an assessment of the teacher with a percentage score of 87.04%, and an

assessment of the students with a score of learners 84.07% which shows the category of "Very Good". 2) Development of worksheet conducted by Irma, Connie and Eko [5] which aims to produce inquiry-based worksheet based on PhET simulation students to improve students' mastery of concept concepts. both) and the analysis of students' test data after the use of workheet shows that there is an increase in mastery of the concept of light wave material with an N-gain score of 0.76 (high). inquiry-based research that is developed covers the stages of making predictions, conducting investigations, collecting, interpreting data, and conclusions. The results of research show that of Iki's the category is very good, there is an increase in students' critical thinking skills with a total average gain score of 0.43; and an increase in student learning outcomes with a total average gain score of 0.34 so that the worksheet is appropriate to be used in science.

The selection of the right learning model needs to be taken account in the development process of the worksheet so that the learning objectives can be achieved. As is the case in this study, the development of worksheet conducted using the Inquiry model. The selection of the model is one of the models scientifically so that it is appropriate to be used in learning with the aim of increasing critical thinking skills. The process of inquiry learning activities in an effort to understand a concept include the presentation of the problem, collecting verification and, collecting,organizing data and concluding formulations, analysis of the incury process [6]. The selection of the Inquiry model is also consistent with the current curriculum and in the implementation using a scientific approach (scientific). To strengthen the scientific approach is necessary to be applied a learning model based on findings, problems, and projects so that the learning objectives are achieved. Suitability of Inquiry Terms.

The purpose of developing this worksheet is to help students to improve critical thinking skills so as to understand concepts in a whole and systematic way. According to Opitz et al, students' knowledge must be intact so that it can be used to solve broader problems [7]. Difficulties in understanding the physics concepts experienced by students include being marked by students not being able to relate material to experiences in daily life so that concepts are poorly understood, students are less able to think structurally and analytically this is supported by research findings that state higher-order thinking skills in Bima are still in the low category [8]. As a result when faced with evaluation questions students are not able to translate the questions properly.

One of the physical materials that is of concern because it is considered difficult is effort and energy. The concept of effort and energy is derived from Newton's legal concept which is the basic concept of motion [9]. Some researchers have examined difficulties with the material Business and energy and concluded that there are misconceptions conducted by students on the material Business and Energy [10, 11, 12]. So it is necessary to provide learning tools that make it easy for students to learn and understand the concepts of Business and Energy well and intact by practicing students' critical thinking skills.

II. MATERIALS AND METHODS

The method this research uses the Research and Development (R & D) method by adopting the development of Borg & Gall [13]. The development stages include: 1) Preliminary studies, 2) Planning and setting goals 3)

Developing Initial Products and assessing eligibility, 4) Conducting Limited Trials, 5) Product Revision Based on Limited Trial Results, 6) Field Trials and 7) Product Revision Based on Field Trial Results. This research has reached the third stages of developing initial products and assessing feasibility. Where in assessing the feasibility we used four valuator as namely two teachers as learning practitioners and two peers.

In collecting research data using a questionnaire, the validity will be filled out by the validator. The instruments in this study are:

1. The Learning Instrument is a worksheet
2. Research Instruments: workheet validation

Worksheet developed by the Inquiry method systematically. The validation sheet contains several assessment points, namely Completeness of worksheet Components, Conformity of Content and Material, Conformity of Construction Requirements, and Conformity of Inquiry Requirements. 3: Enough; 2: Poor; 1: Not OK.

The analysis technique used in the study used different techniques, namely: The step taken in worksheet validation is to provide expert judgment on each component of the workheet content feasibility assessment aspects. Each component of the assessment is assessed by valuator who are experts in their fields. The results obtained are then analyzed by calculating the overall value with the equation

$$P = \frac{n}{N} \times 100\% \quad (1)$$

Information:

P: Feasibility percentage

n: Average number of aspects of the assessment score

N: The maximum number of score aspects of the assessment

Criteria for evaluating average scores and percentages can be seen in Table 1.

TABLE I. SCORE INTERPRETATION

| Percentage (%) | Criteria |
|----------------|-----------|
| 0 – 20 | Poor |
| 21 – 40 | Enough |
| 41 – 60 | Good |
| 61 – 80 | Very good |
| 81 – 100 | Excellent |

III. RESULTS AND DISCUSSION

Worksheets developed using inquiry learning models that encourage students to think about systems and analytical help so as to improve critical thinking skills. In addition, in the worksheet. This report should be discussed by students in accordance with topics relevant to the concepts of Business and Energy, with the hope that students can abstract the situation and be able to relate it to the resulting physics concepts. To understand the Business concept, in this worksheet a concrete example is given close to the environment, which is the case of a car passing through the Sambori crossing area. Where the Sambori area is close to the school so students are able to imagine the things that are happening and are able to abstract the physical variables in the case. Meanwhile, to evaluate the Energy Concept, a report

that reviews the badminton sports activities contained therein. This is expected to improve students' critical thinking skills. If students are able to relate problems and can relate to material, students will be able to understand the concepts of effort and energy well.

The development of worksheet goes through several stages, namely 1) Preliminary study: Needs analysis is carried out with literature and field studies. The library study conducted by analyzing the importance of critical thinking skills as well as the excellence of worksheet that would develop with appropriate learning models while the field observed in observing physics learning activities and analyzed the weaknesses of basic physics learning tools that have been used. 2) Planning and setting goals: (a) analyzing the subject matter; (b) analyzing the competencies to be achieved; (c) formulate the learning achievements to be achieved. 3) Developing Initial Products and assess eligibility: worksheet is prepared by exploring the sources and developed through various relevant references and charged steps of Inquiry to improve critical thinking skills. After the initial product is designed, a feasibility assessment is conducted first with a validation test towards the teacher as a practice and a colleague.

Then analyzed and revised.

The assessment of worksheet is done by the teacher as a practical and peer-to-peer, with two people. The aspects assessed are among others the completeness of worksheet components, conformity and material, conformity of the construction requirements, and the suitability of Inquiry terms.

TABLE I. ASSESSMENT BY TEACHERS

| Judgment Aspect | Percentage | Category |
|---|------------|-----------|
| The completeness of worksheet components | 93 | Excellent |
| Conformity and material | 90 | Excellent |
| Conformity of the construction requirements | 88 | Excellent |
| The suitability of Inquiry terms | 85 | Excellent |
| Total Score | 89 | Excellent |

Based on the table of the average score obtained the percentage of eligibility for completeness of components by 93% with very decent criteria, suitability of content and material by 93% with very decent criteria, Conformity of construction requirements by 88% with very feasible criteria and suitability of Inquiry conditions by 85%. provided by colleagues in the development of worksheet can be seen in Table 2.

TABLE II. WORKSHEET ASSESSMENT BY PEERS

| Judgment Aspect | Percentage | Category |
|---|------------|-----------|
| the completeness of worksheet components | 85 | Excellent |
| conformity and material | 87 | Excellent |
| conformity of the construction requirements | 80 | Excellent |
| the suitability of Inquiry terms | 85 | Excellent |
| Total Score | 84 | Excellent |

Based on the table of the average score obtained the percentage of eligibility for Completeness of Components by 85% with very decent criteria, suitability of content and material by 87% with very decent criteria, Conformity of construction requirements by 80% with very feasible criteria and suitability of Inquiry requirements by 85% with very feasible criteria.

In addition to being seen from the assessment score threshold for the LKPD structure, the feasibility level of the LKPD can be seen also from the evaluation score given by the validator, as shown in Table 3.

TABLE III. ASSESSMENT BY ALL OF VALIDATORS

| Judgment Aspect | Percentage | Category |
|---|------------|-----------|
| The completeness of worksheet components | 89 | Excellent |
| Conformity and material | 89 | Excellent |
| Conformity of the construction requirements | 84 | Excellent |
| The suitability of Inquiry terms | 85 | Excellent |
| Total Score | 87 | Excellent |

Based on the results of the validation assessment by the Muslim clause, it can be concluded that the worksheet that developed included in the criteria is very feasible. Although the worksheet assessment results are considered to be very feasible to be used, but there are some suggestions from the validate related to the improvement of this product.

Based on the description above, it can be concluded that the development of worksheet based on Inquiry could be a good alternative in facilitating student thinking skills. Even though the research is not until the trial phase is limited and then the value of the validator assessment results can be seen that the use of the learning model is very suitable for training the skill of thinking in critical terms in the learning process. This is done by the results of research that has been done by Gall & DeBorg [13] that the development of worksheet based on self-esteem can improve critical thinking skills and learning outcomes with each category.

IV. CONCLUSION

Based on the results discussion outlined, it can be concluded that the Inquiry-based Educational Worksheet (LKPD) that has been developed has passed the assessment process by a validator that includes the teacher as a practical and peer-to-peer worksheet in the category of "very feasible" and can be used in physics learning.

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