The development of students worksheets is oriented to the higher other thinking skill with problem solving models on electromagnetic induction materials

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Abstract. This research was aimed to develop a valid Student Worksheet (LKPD) oriented to Higher Order Thinking Skills (HOTS) with a problem solving model on electromagnetic induction material. This research was a type of development research (Research and Development) with type 1 design consisting of 5 stages, namely: 1) potential and problems 2) literature study and information gathering 3) product design 4) design validation 5) tested design. Design validation was carried out by 3 expert judgments and 3 Practitioners to assess products developed from aspects of presentation, content, and language. Based on the results of the validity of the presentation aspects, the results were 76.3% (very good categories), content aspects at 74.4% (good categories), and language aspects at 80.1% (very good categories). Based on these results, it was concluded that the HOTS-oriented LKPD developed was declared valid and was a tested design with a percentage of the total validity test which was 86% (very good category).

1. Introduction

The world development of the 21st century is marked by the use of information and communication technology in all aspects of life, including in the learning process. The world of work demands changes in competence. Important competencies in entering the life of the 21st century are in the form of critical thinking skills, problem solving, and collaboration. Schools are required to be able to prepare students to enter the 21st century [1]. The government expects students to achieve various competencies by applying HOTS (Higher Order Thinking Skills) or high-level thinking skills [2].

Brookhart describes the type of HOTS based on the purpose of learning in the classroom, which consists of three categories, namely HOTS as a transfer which includes the skills of analyzing, evaluating and creating. HOTS as critical thinking, and HOTS as problem solving [3]. An educator can equip students to acquire life skills through the development of LKPD (Student Worksheet). LKPD directs students to solve physics problems through problem solving steps. Through problem solving students can develop science process skills and high-level thinking skills [4]. The problem solving learning process provides opportunities for students to play an active role in learning, searching for, and finding information themselves to be processed into concepts, principles, theories, or conclusions. In other words, problem solving requires the ability to process information to make certain decisions [5].

Based on the results of observations that have been made in the Senior High School number 1 of Bengkulu city, it is known that the curriculum used in Senior High School number 1 of Bengkulu city
is the 2013 curriculum, but in its implementation there are still some shortcomings. Teachers still use conventional methods in teaching so that teachers are actively involved while students only hear teacher explanations in the process of physics learning in class, teaching materials used by teachers and students in the form of printed books and rarely use LKPD. In the process of learning physics, students are not too enthusiastic in following the learning process, therefore very few students respond to the teacher during the learning process.

The results of the needs analysis in 3 of Senior High School of Bengkulu city were Senior High School number 5 of Bengkulu city, Senior High School number 6 of Bengkulu city, and Senior High School number 1 of Bengkulu city, which is intended for class XII physics teachers and XII science students, it was known that in the physics learning process teachers only printed books or modules as teaching materials, and according to them, an additional teaching material is needed. The teacher feels interested in using LKPD in the classroom learning process. They also revealed that HOTS-oriented physical LKPDs on Electromagnetic Induction material are very much needed as additional teaching materials when they teach. This is in line with the statement of students of class XII Science in 3 schools which stated that they only used printed books in the learning process. In addition students need additional learning materials other than printed books so that they no longer have difficulty in understanding physics material, based on the results of the information analysis needs sheet most students are interested in using LKPD in the learning process on electromagnetic induction material.

The research conducted by Nadhuroh on the development of student worksheets (LKPD) based on Higher Order Thinking skills (HOTS) in thermodynamic material, the design of the model developed was using HOTS indicators in the form of analyzing, distinguishing, organizing, connecting, evaluating, and create [6]. Then, a similar study was also conducted by Azizah on the development of multiple intelligence physics student worksheets (LKPD) on fluid material to improve high-level thinking skills of high school / MA students in class XI. The design of the development model contains 8 intelligences namely linguistic, logical-mathematical, visual-spatial, kinesthetic, musical, interpersonal, intrapersonal, and naturalist. With high-level thinking skills used based on Bloom's taxonomy, ability involves the process of analysis, evaluation, and creation [7].

Based on the description above, it is deemed necessary to conduct a study entitled "Development of LKPD (Student Worksheet) HOTS-Oriented Physics with a Problem Solving Model on Electromagnetic Induction Material". The purpose of this study is to develop valid Student Worksheets oriented to Higher Order Thinking Skills (HOTS) with a problem solving model on electromagnetic induction material.

2. Methods
The method used in this study is the R & D method. R & D (Research and Development) method is a research method used to produce certain products and test the effectiveness of these products [8]. The method used is level 1 R & D design (researching without testing). There are five research and development research steps in type 1 design, namely 1) potential and problems, 2) literature study and information collection, 3) product design, 4) design validation, and 5) tested designs [9]. Further explanation of the research steps can be seen in Figure 1.

![Figure 1. Research steps for R & D level 1 (only research but do not produce and test).](image-url)
potential and problems. The next instrument is a questionnaire sheet used for internal testing of product design.

In the level 1 research and development there are three stages of data analysis. The first stage is carried out when conducting research to explore the potential and problems that exist in the object being examined. Data analysis at this stage is in the form of qualitative data analysis. The second stage is the analysis of data based on the research used to find out what products need to be developed, data analysis at this stage is in the form of qualitative data. Data analysis in the third stage is an analysis of internal design or design testing using a Likert scale to translate the questionnaire into qualitative data.

The step taken in the validation of the LKPD is to provide an expert assessment of each component of the aspect of assessing the eligibility of the LKPD. Calculate the assessment score of each component with the choice of answers according to the criteria. The scoring criteria given in the validation sheet of the LKPD assessment are a range of scores 1, 2, 3 and 4. Each score in each item has been given a rubric to be able to choose a score between 1 and 4. Then calculate the overall value with the formula:

\[ P = \frac{n}{N} \times 100\% \]  

(1)

Criteria for evaluating the average score and percentage according to Rizal (2018), can be seen in Table 1.

| Percentage (%) | Criteria       |
|----------------|----------------|
| ≤ 25           | Very less      |
| 26-50          | Less           |
| 51-75          | Good           |
| 76-100         | Very good      |

The developed LKPD can be said to be good / feasible if it meets the eligibility criteria for contents with a percentage of ≥ 51% [10].

3. Results and discussion

3.1. Potential and problems

The potential stage and problems are observed. On the observation sheet there are several aspects observed. The results of observations at Senior High School number 1 of Bengkulu City are as follows: a) The curriculum used in Senior High School number 1 of Bengkulu City is the 2013 curriculum. b) Teachers still use conventional methods in teaching so that teachers are actively involved while students only hear teacher explanations in the learning process in the classroom. c) Teaching materials used by teachers and students in the form of printed books and rarely use LKPD. d) In the physics learning process students are not too enthusiastic in following the learning process, therefore very few students respond to the teacher during the learning process.

3.2. Literature study and information collection

The second stage that was carried out in this research was literature study and information gathering. Literature studies were conducted to find supporters of the implementation of this study. The product developed in this study is HOTS-oriented physics LKPD. The research by Nadhuroh (2018) entitled "Development of Student Worksheets (LKPD) Based on Higher Order Thinking Skills (HOTS) on Thermodynamic Materials" suggests that HOTS-based LKPDs provide solutions for schools in the learning process and support the 2013 curriculum that puts students active in class during the teaching learning process [6]. Based on existing literature, it can be said that LKPD can be developed as a medium for active learning and can direct students to solve physics problems through problem solving steps.
The collection of information in this study used a sheet of information collection that was distributed to 3 high schools in the Bengkulu city, namely Senior High School number 5 of Bengkulu City, Senior High School number 6 of Bengkulu City, and Senior High School number 1 of Bengkulu City, which was intended for XII grade physics teachers and XII science students. Based on the results of the needs analysis, it is known that in the physics learning process in the 3 schools, teachers only use printed books or modules as instructional materials, and according to them, an additional teaching material is needed. The teacher feels interested in using LKPD in the classroom learning process. They also revealed that HOTS-oriented physical LKPDs on Electromagnetic Induction material are very much needed as additional teaching materials when they teach. This is in line with the statement of 24 of 30 XII science students in 3 schools who stated that they only used printed books in the learning process, and 6 other students answered them using modules. In addition 30 students said they needed additional learning materials besides printed books so that they no longer had difficulty in understanding physics material, based on the results of the information sheet analysis needs 29 of 30 students needed LKPD in the learning process on electromagnetic induction material.

3.3. Product design

The initial design obtained from the results of Nadhuroh's research, has several weaknesses, namely the LKPD created using only HOTS indicators analyzing, evaluating and creating and incomplete LKPD components. Based on the shortcomings found, HOTS-oriented physics LKPD was developed by using problem solving models with a framework such as Figure 2.

3.4. Design validation

After HOTS-oriented physical framework and LKPD designs with problem solving models have been developed, the design validation phase is carried out. This stage was conducted to determine the validity of HOTS-oriented physics LKPD with problem solving models developed. The validity test for this product was carried out by 3 expert judgments (Lecturers) namely Drs. Irwan Koto, M.A, Ph.D (Expert 1) Dr. Henny Johan, S.Si, M.Pd (Expert 2) and Dr. Iwan Setiawan, S.Si, M.Sc (Expert 3) besides that the validation for this product was also carried out by 3 practitioners (High School Teacher) namely Syafril Effendi M.Pd (Practitioner 1), Vera Anggreani, M.Pd.Si (Practitioner 2) Rosmiati, M.Pd.Si (Practitioner 3).

Based on the total results of the validity test aspects of presentation, content and language, conducted by 3 expert judgment and 3 practitioners, it can be concluded that the physics LKPD is...
HOTS oriented with the problem solving model that has been developed classified as very good with an average percentage which is 76.9% of 100%. This means HOTS-oriented physics LKPD with problem solving models have met the aspects of presentation, content and language. The conclusion of the total results of the validity test of physics-oriented LKPD is HOTS with a problem solving model by expert judgment and practitioners can be seen in Table 2.

Table 2. The final results of the validity test.

| Aspect       | Average Value | Category     |
|--------------|---------------|--------------|
| Presentation | 76.3%         | Very good    |
| Content      | 74.4%         | Good         |
| Language     | 80.1%         | Very good    |
| Average      | 76.9%         | Very good    |

3.5. Tested design
The final stage of product development in this study is the tested design phase. At this stage revisions are made based on suggestions from the Validator. Revisions made are in the aspect of contents where there is a typing error, adding information to the equation, adding number equations, adding image captions, correcting questions in data analysis, adding observations to the experimental procedure.

After physics-oriented LKPD HOTS with a problem solving model was revised, the LKPD has become a tested design which is the final product of research and development research with a level 1 design. This is in accordance with the statement mentioned by Sugiyono, after being assessed by experts and improved, the products developed have become proven designs [9].

4. Conclusion
Based on internal testing by expert and practitioner judgment, the developed LKPD was included in the feasible category and was a tested design because it received a positive response with a percentage for the presentation aspect that is 76.3% with a very good category, for the content aspect getting a percentage of 74.4% with categories good, and for language aspects 80.1% with very good categories. Based on the limitations of the products developed, the suggestions for this study are as follows: 1. The developed LKPD should include all indicators in the HOTS aspect which include (HOTS as transfer), (HOTS as critical thinking) and (HOTS as problem solving). 2. For further development, the final product of this study can be tested externally using research and development research type design level 2 (testing without research).

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