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The Development of Inquiry-Based Worksheets (LKPD) on Fluid Dynamics for Senior High School Student

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ABSTRACT. The understanding of physics concepts among students in the learning process has not been fully achieved. One of the efforts can be undertaken to achieve this goal is by providing appropriate teaching materials that can facilitate students' comprehension of these concepts. Therefore, the researcher conducted a study aimed at developing teaching materials in the form of Student Worksheets (LKPD) based on inquiry on the topic of fluid dynamics for senior high school students with the method of Research and Development (R&D), following the EDDIE model.

After designed, the LKPD was validated by four lecturers, two of them as material experts and the others as media experts. The validation was carried out by using a set of validation instrument to assess the validity of the LKPD. The validation data then became a basis of feasibility assessment of the LKPD. Additionally, the researcher assessed the students' responses to the developed LKPD using a questionnaire. The data obtained from this research were qualitative and later transformed into quantitative data.

The results of this research showed that the LKPD received a 93.33% score for the material aspect and 96.83% for the media aspect, both of which fall into the very feasible to be used. Furthermore, 82.75% of students responded positively to the LKPD.

1. Introduction

Physics is one of the subjects taught in schools. Starting from elementary school, the concepts of physics are introduced in natural science (IPA) subject. One of the objectives of learning physics is to understand the universe and how nature works. Often, physics is fundamental for studying broader concepts. Moreover, physics education may cultivate the thinking abilities of students which can be used in solving everyday life problems. As a discipline, physics plays a crucial role in mastering Science and Technology. Therefore, knowledge of physics must be taught in such a way that enables students to enhance their knowledge and skills, which are expected to be applied in solving various problems.

However, in reality, there are still numerous challenges in physics teaching and learning. The challenges may come from many different aspects and may be influenced by many different factors. Various studies have shown that learning outcomes are influenced by both internal and external factors, which aligns with what was conveyed by Rusman (2012). Among these internal and external factors are the teaching methods and models employed by teachers, as well as the utilization of learning resources or media that may not be optimal and contextual. This finding corresponds with the discoveries of Samudra et al. (2014). Improper teaching methods applied or learning medias utilized in teaching and learning process can decrease the motivation among students, where in the end this may result low student learning outcomes.

SMA Negeri 1 Badar encounters the same issue in implementing physics teaching and learning, where the learning is still below the expected standards. This fact was discovered after the researcher conducted initial observations and needs analysis. During direct interviews with teachers at the school, they emphasized the need for innovative ideas, including the use of Student Worksheets (LKPD). It is hoped that this LKPD can enhance students' engagement in the teaching and learning process, as they were previously passive learners. As stated by Saputri (2020), LKPDs are highly effective in improving students' attitudes, skills, and knowledge. Consequently, the researcher developed an Inquiry-Based Student Worksheet (LKPD) to assist the teaching and learning process at the school. This teaching material can be combined with one of the inquiry-based learning approaches. Inquiry can be defined as questioning, examination, or investigation. It is a common process through which humans seek or understand information. The content of the LKPD focuses on various activities that students must carry out, guided by a sequence of questions and accompanied by experiments that lead them to conduct scientific actions as part of an inquiry-based learning to reach an understanding of concepts that students need to discover on their own with the guidance of educators (Nuayi, 2020; Sari et al., 2020; Suplemen et al., 2017).

Based on the above explanation, the researcher is interested in developing an LKPD on the topic of fluid dynamics entitled "The Development of Inquiry-Based Worksheet (LKPD) on Fluid Dynamics for Senior High School Students" with a case study at SMA Negeri 1 Badar, Aceh Tenggara Regency, Aceh Province.

2. RESEARCH METHOD

The development of Student Worksheets (LKPD) is part of research and development, also known as Research and Development (R&D). The purpose of research using this method is to produce a specific product and test its effectiveness. In this type of R&D research, there are several development models, and in this case, the researcher refers to the ADDIE development model. The ADDIE development model consists of several stages: Analysis, Design, Development, Implementation, and Evaluation (Sugiyono, 2011).

a. Analysis Stage

The Analysis stage is conducted to determine the objectives and direction of developing a product. The needs analysis is the initial step in conducting this LKPD development research. Needs analysis can be carried out in various ways, one of which is through initial observation in schools and interviews with teachers. The initial observation was carried out to identify the constraints in the learning process, such as limited time and students' difficulties in understanding the material because they only listen to the explanation from the

teacher without any laboratory experiments. The researcher also conducted a needs analysis by distributing questionnaires to Grade IX science students, containing several questions about major topics that are difficult for them to understand during that semester. Additionally, in this stage, the researcher determined the learning indicators that align with the basic competencies (KD) of the topic chosen by the students, namely the Fluid Dynamics. For senior high school, the topic of Fluid Dynamics is covered by several sub-topics such as the Definition of Fluid Dynamics, the Principle of Continuity, and Bernoulli's Law. They are parts of Basic Competencies (KD) 3.4, which is to apply the principles of fluid dynamics in technology. Based on this KD, learning indicators were developed, including conducting experiments related to the basic laws of fluid dynamics in everyday life and creating experiment reports on the principles of continuity and Bernoulli's law.

b. Design Stage

After the analysis, the next stage is the design stage, where the researcher designed the Student Worksheets (LKPD). The LKPD includes an orientation to the problem, problem formulation, hypothesis formulation, data collection, hypothesis testing, and conclusion. The developed LKPD contains three experiment titles. The language used in designing this LKPD is simple and easy to be understood by the students. The development of this LKPD is to encourage the students more active, as also mentioned by Triantoro (2010), and help them understand the material better. Therefore, the researcher designs an inquiry-based LKPD.

c. Development Stage

The development stage comes after the LKPD design. This stage aims to assess the validity of the designed LKPD for use. After development and receiving constructive feedback from several validators, the LKPD will be revised until it becomes feasible to be used in teaching and learning process.

d. Implementation Stage

In this stage, product testing is carried out to collect data and determine the feasibility of the LKPD. The product testing was conducted on a small scale (small groups). The product testing involves six students from SMA Negeri 1 Badar. The students were explained of the LKPD and conducted experiments following the given procedures. Afterward, the students were given a questionnaire to express their response to the LKPD, and the responses were collected individually.

e. Evaluation Stage

If the LKPD is considered still less valid in this evaluation stage, it will be re-revised until to become entirely valid for use and the results from product testing will be considered as revision material so that the LKPD becomes valid for use in the learning process at the school. After conducting product testing on six students, the LKPD on Fluid Dynamics is deemed feasible for implementation in the teaching and learning process.

The research subjects in this study are four lecturers, two of them are material experts and two are media experts. The material and media experts are competent lecturers from UIN Ar-Raniry Banda Aceh in their respective fields. The material experts assess the LKPD in terms of material aspects, while the media experts assess it from the media aspect, using a validation sheet as an instrument. After the development is completed, the LKPD is tested on students at SMA Negeri 1 Badar to assess their response to the LKPD by questionnaire.

The data in this study are obtained from the validation results by four validators and the responses of several students to the LKPD. The validation sheet consists of written statements and contains several questions developed from the indicators of the validity of an LKPD in terms of both material and media aspects. The validator's assessment is then measured using a Likert scale, resulting in quantitative data that can be analyzed statistically. Each item's answer in the validation sheet consists of choices "Highly Valid" (4), "Valid" (3), "Moderately Valid" (2), and "Not Valid" (1). For more detail, the scores are presented as in Table 3.1.

Table 3.1: Validation Score

Score	Classification
1	Invalid
2	Less Valid
3	Valid
4	Very Valid

Source: Widoyoko (2012)

The recapitulation or summarization of the validation score resulted in the percentage which was then converted to the validity of every sub-aspect of material and media aspects based on the criteria as shown in Table 3.2.

Tabble 3.2: Criteria for Feasibility of LKPD (modified)

No	Percentage	Criteria	Indicator
1	81,26 < x ≤ 100	Very Feasible	If all items in the assessed elements are deemed highly suitable and there are no shortcomings with the teaching materials, it can be used as a Student Worksheet for the learners.
2	62,51 < x ≤ 81,25	Feasible	If all items are assessed as appropriate, despite some minor shortcomings that require improvement through the development of the Student Worksheet (LKPD), it can still be used as a learning material for the students.
3	43,76 < x ≤ 62,50	Less Feasible	If all items in the elements are assessed as not very suitable, with either a few or many shortcomings found in this product, and it requires justification to be used as a Student Worksheet (LKPD).
4	25 25,00 < x ≤ 43,75	Not Feasible	If each item in the elements is assessed as unsuitable and there are numerous shortcomings with this product, it requires substantial justification to be used as a Student Worksheet (LKPD).

Source: Wagiran (2014)

3. RESULTS AND DISCUSSION

The Student Worksheet (LKPD) was developed based on an inquiry approach. Inquiry-based learning provides students with more opportunities to discover knowledge and problem-solving skills on their own. This method can enhance the understanding of concepts, making Physics learning more meaningful. After the development process, the worksheet was then validated by experts. The results obtained from the validation process are as follows:

a. Material Expert Assessment

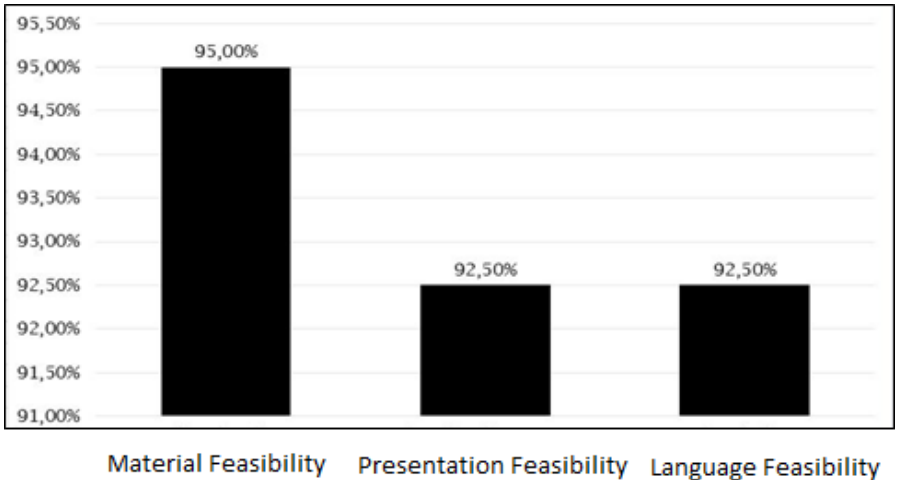

Figure 1. Feasibility of LKPD for material aspect

In assessing the feasibility in the material aspect, it is further divided into three sub-aspects: material feasibility, Presentation feasibility, and Language feasibility. Based on the obtained data, they were analyzed and presented in Figure 1. In the figure, it can be observed that the first sub-aspect, Material, achieved a feasibility percentage of 95.00%, followed by the second sub-aspect, Presentation, with a feasibility percentage of 92.50%, and lastly, the Language sub-aspect attained a feasibility percentage of 92.50% as well. These three sub-aspects were then analyzed as a whole for the material aspect, where the overall feasibility level reached 93.33%. Consequently, it can be concluded that in terms of material, this Learning Media (LKPD) is highly feasible for use in physics teaching and learning, especially during practical activities.

b. Media Expert Assessment

In assessing the feasibility in the Media aspect, it is further divided into three sub-aspects: Size, Cover Design, and Material Design of the Learning Media (LKPD). Based on the obtained data, they were analyzed and presented in Figure 2. In the figure, it can be observed that the first sub-aspect, LKPD Size, achieved a feasibility percentage of 100%, followed by the second sub-aspect, LKPD Cover Design, with a feasibility percentage of 93.75%, and lastly, the Material Design sub-aspect of LKPD attained a feasibility percentage of 90.50%. These three sub-aspects were then analyzed as a whole for the media aspect, where the overall feasibility level reached 94.75%. Consequently, it can be concluded that in terms of media or design, this LKPD is also highly feasible for use in physics learning, specifically in the topic of fluid dynamics.

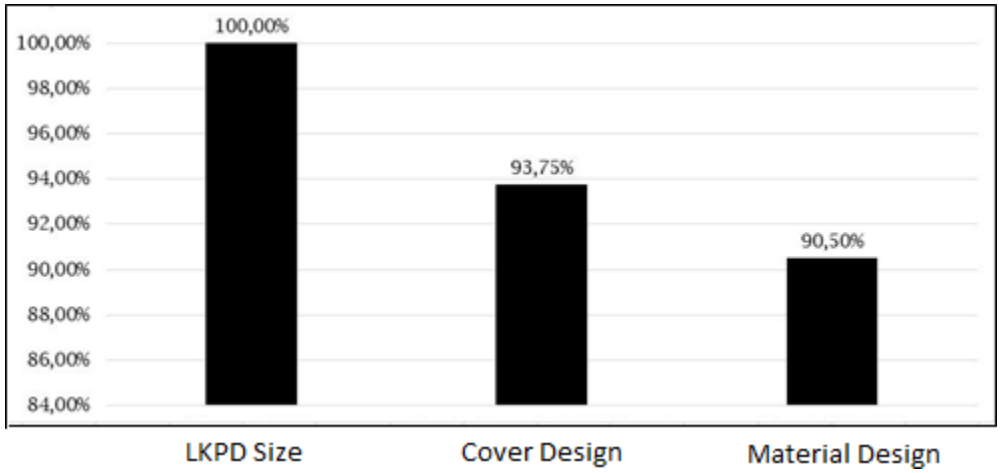

Figure 2. Feasibility of LKPD for media aspect

From the analysis of both aspects, which are Material and Media, of the developed product, the Inquiry-based Learning Media (LKPD) for Fluid Dynamics, the overall average score obtained is 94.75%, which falls into the "very feasible" category.

c. Students Response

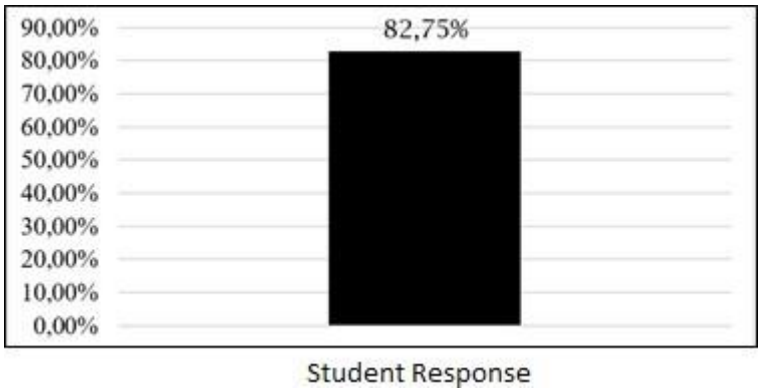

Figure 3. Student responses to the developed LKPD

The results of the student responses to the developed LKPD (Inquiry-based Learning Media) can be seen in Figure 3. Student responses are essential to assess the extent to which the LKPD is user-friendly for students. Additionally, these responses help measure how well students understand the language and instructions within the LKPD. Moreover, evaluating the attractiveness of the design from the students' perspective provides valuable insights as they are the end-users of the LKPD. These responses serve as valuable inputs for the further development of the LKPD.

In Figure 3, it can be observed that the student response is highly positive, reaching 82.75%. Therefore, it can be concluded that the developed LKPD is both usable and appealing to students. Consequently, the researcher hopes that the utilization of the LKPD will increase students' interest and facilitate a better understanding of physics concepts.

Thus, based on the assessment by experts on media and material, along with the response from students, the development of the Inquiry-based Learning Media (LKPD) is highly feasible for use and has received positive feedback from the students.

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Author Contributions

AN collected data, analysed the data, and wrote the original manuscript. MAW analysed data and wrote the revised manuscript. MN supervised the research outcomes.

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