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Development of Student Worksheets Based on *Project Based Learning* on Renewable Energy Material for Senior High School

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ABSTRACT. Based on a questionnaire analysis conducted at SMAN 9 Banda Aceh, it was found that renewable energy material in class uses learning media such as modules, Power Point, Student Worksheets, but teachers only learn from printed books without any practicum. The teaching and learning process still focuses on using non-experimental student worksheets. The aim of this research is to design, determine the feasibility and response of students to Project Based Learning Student Worksheets on renewable energy material for Senior High School. The method used in this research is R&D based on a 4D model. The instruments used in this research consisted of validation sheets and student response sheets. Based on the results of the material expert's assessment, the percentage was 96.61% and the media expert's assessment was 91.07%, including in the very feasible category. Based on the results of the student response sheet to the Student Worksheet based on Project Based Learning on renewable energy material for Senior High School, a percentage result of 94.54% was obtained, including in the very interested category. From this it can be concluded that Student Worksheets based on Project Based Learning are very feasible and practical to use.

1. Introduction

Learning physics is at the core of our understanding of natural phenomena and the materials around us. Through this learning we explore the material world in space and time, gain deep insight into physics concepts, and hone critical thinking skills to solve everyday problems (Yusuf, 2023).

One strategy that has proven effective in improving learning is the use of media, with Student Worksheets as one of the main tools (Ane, 2023). Student Worksheets act as facilitators that make it easier for students and teachers in the learning process, providing space for exploration and development of understanding and basic skills (Febriannisa et al, 2023).

However, the available student worksheets are often limited in concept coverage and do not encourage student creativity. Learning that is dominated by non-experimental student worksheets tends to be monotonous, not providing opportunities for students to be actively involved in the learning process.

Based on the results of research and needs analysis at SMAN 9 Banda Aceh, renewable energy material is a challenge for students. Teachers often face difficulties in teaching this material creatively, resulting in minimal understanding among students. In this context, a promising learning model has emerged: Project Based Learning.

Project Based Learning is a learning model that utilizes projects as a tool to develop students' attitudes, knowledge and skills. Through Project Based Learning, students not only understand concepts theoretically, but also apply them in real life contexts so that learning becomes more meaningful and sustainable (Budi, 2023).

In overcoming these challenges, the Project Based Learning learning model emerged which uses projects as a means to develop students' knowledge and skills. Through Project Based Learning, students not only understand concepts, but also apply them in real world situations so that learning becomes more meaningful.

Therefore, developing Student Worksheets based on Project Based Learning is an interesting solution to improve physics learning. Research on "Development of Student Worksheets Based on Project Based Learning on Renewable Energy Material for Senior High School" is important to carry out considering its positive potential in increasing student motivation and skills.

2. RESEARCH METHOD

This research is part of the R&D (Research and Development) stage, an important approach in product development and innovation in the education sector. In this context, the focus is the development of Student Worksheets with a Project Based Learning approach for physics learning, especially on the topic of Renewable Energy for class X students.

The development approach applied is the 4-D model, namely a systematic method that includes the Define, Design, Development and Disseminate stages (Maydiantoro, 2021). However, the main focus of this research is at the product development stage, where student worksheets will be prepared and formatted according to the needs of effective learning.

In the development process, Student Worksheets will go through a series of validations by physics education experts. Input provided by experts will be an important basis for improving Student Worksheets so that they meet the desired validity standards. After the Student Worksheet is deemed valid, the next step is to test it in the classroom context at SMAN 9 Banda Aceh.

The trial was carried out in two stages, namely a limited trial with 20 participants to get an initial response, and a field trial with 10 participants to assess the practicality of the Student Worksheet more broadly. Through instruments in the form of validation sheets and student response questionnaires, data will be collected and analyzed to evaluate the effectiveness and practicality of the Student Worksheets being developed. Data validity analysis is used to manage data obtained through validation sheets with the formula (Widoyoko, 2009):

$$\bar{x} = \frac{\sum x}{n}$$

Dimana:
$\bar{x}$ = Average Value
Σx = Total score for each assessment aspect
n = Number of questions

Converting the average value obtained into a value with criteria is by using the formula:

$$Percentage = \frac{Average\ score\ of\ all\ aspects}{Highest\ score\ of\ assessment} \times 100\%$$

Table 1. Egibility criteria for student worksheets Based on project based learning

No.	Value	Criteria	Decision
1.	81,25 < x ≤ 100	Very Worthy	If all the items in the elements assessed are very suitable and there are no shortcomings with the Student Worksheets, then it can be used as teaching material for students.
2.	62,50 < x ≤ 81,25	Worthy	If all the items in the elements are assessed as appropriate, even though there are a few shortcomings and the Student Worksheets needs to be revised, it can be used as teaching material for students.
3.	43,75 < x ≤ 62,50	Not Worthy	If all the items in the elements are considered inappropriate, there are a few deficiencies or many deficiencies, then it is necessary to improve the Student Worksheets so that it can be used as teaching material for students.
4.	25,00 < x ≤ 43,75	Not Feasible	If all the items in the elements assessed are not appropriate and there are deficiencies in the Student Worksheets, they must be corrected so that they can be used as teaching materials for students.

The results of the Project Based Learning-based Student Worksheet practicum were obtained from the results of student questionnaire responses to the Student Worksheet. Practicality data is analyzed in percentage (%) using the following formula:

$$Percentage = \frac{Average\ score\ of\ all\ aspects}{Highest\ score\ of\ assessment} \times 100\%$$

Table 2. Student Response Assessment Criteria

Value	Criteria	Decision
81,25<x≤ 100	Very interested	4
62,50<x≤81,25	Interested	3
43,75<x≤62,50	Less interested	2
25,00<x ≤43,75	Not interested	1

3. RESULTS AND DISCUSSION

This research is included in the category of development research or R&D (Research and Development). The R&D model used adapts the 4D Models concept which includes four main stages, namely Definition, Design, Development and Dissemination (Maydiantoro, 2021).

At the Definition stage, there are five steps carried out. First, initial analysis is used to identify the main problems in physics learning. Second, student analysis is carried out to understand the characteristics of students in the class. Third, task analysis is used to sort teaching materials based on core and basic competencies, and formulate indicators. Fourth, concept analysis was carried out to compile a concept map systematically. Finally, learning objectives are formulated based on learning outcomes regarding renewable energy.

The Design Stage aims to prepare a prototype of the Student Worksheet by selecting a teaching material format that is in accordance with the Project Based Learning approach. Includes sections such as introduction, basic competencies, concept maps, introduction explaining physics learning, learning motivation, problem identification, strategy, product planning, production process, presentation, and evaluation. Then the initial design of the learning tools resulted in an initial design containing Student Worksheets based on Project Based Learning.

At the Development stage, the initial draft that has been prepared is validated by media experts and material experts. This validation aims to test the validity of the Student Worksheets that have been prepared. The results of this validation are used to get input from the validator, which will later be used to make revisions and improvements so that the resulting Student Worksheet is valid. The results of this validation are based on input from media and material experts and can be interpreted in table 3 below.

Table 3. Data Results Percentage of Material Expert Validators and Media Experts

No.	Validator	Percentage	Eligibility criteria
1.	Material Expert	96,61%	Very Worthy
2.	Media Expert	91,07%	Very Worthy
Average Score		93,84 %	Very Worthy

Evaluation results from material expert validators show that the overall quality of Project Based Learning physics student worksheets based on 3 assessment aspects has an average score of 96.61, including in the "very good" category. Meanwhile, the results of the media expert validator evaluation show that the overall quality of Project Based Learning Physics Student Worksheets based on 2 assessment aspects has an average score of 91.07 which is considered "very suitable" for use in the learning process. This confirms that the Student Worksheet has met the required validity criteria, so that it can be used effectively in learning.

After being revised based on input from the validator, a limited trial was carried out with the aim of knowing student responses and assessing product quality, as material for improving the Student Worksheet being developed. The results of this trial were obtained through response questionnaires filled out by students. The student response questionnaire in the limited field trial used a Likert model scale with 4 options, namely "very interested", "interested", "not interested", and "not interested". Analysis of the student response questionnaire will be presented in Figure 1 below:

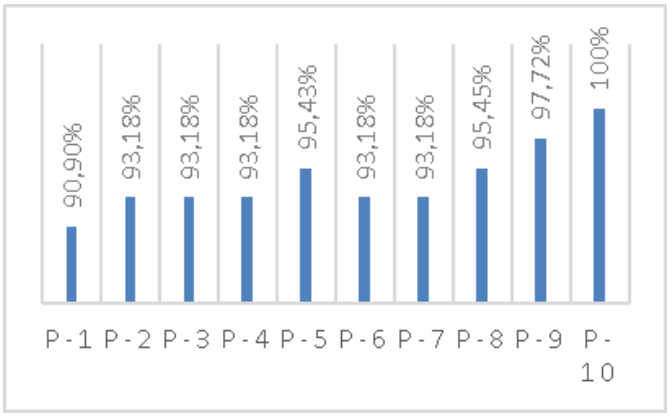

Figure 1 Student Response

The results from Figure 4.1 show that the Student Worksheet based on Project Based Learning was rated in the "very interested" category. With an average total percentage score of 94.54%, it can be concluded that Student Worksheets based on Project Based Learning are very suitable for use in physics learning.

The dissemination stage is the final stage of the research and development process. At this stage, the product developed, namely the Student Worksheet based on Project Based Learning, was distributed by giving it to the physics teacher at SMAN 9 Banda Aceh where the research was conducted. This was done after the researcher succeeded in producing a Student Worksheet that met the required standards of validity and practicality.

4. CONCLUSIONS

Based on the results of research and Development of Student Worksheets Based on Project Based Learning on Renewable Energy Material for Senior High School, several conclusions can be drawn.

1. The design for developing Student Worksheets follows the 4D model which includes the stages of Definition, Planning, Development and Dissemination. This design involved using Canva for the cover and background design, as well as Microsoft Word for the body text.
2. The suitability of this Student Worksheet is assessed by 2 material expert validators and 2 media expert validators. The assessment results show that the criteria are very feasible with a percentage of 96.61% from material experts and 91.07% from media experts.
3. Student responses to this Student Worksheet were very positive with a percentage of 94.54% showing high interest in studying it in physics learning. Thus, Student Worksheets based on Project Based Learning on renewable energy material are suitable for use in the learning context for Senior High School.

Thank-you note

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Author Involvement

TS designed Student Worksheets, designed tools and instruments, carried out data acquisition and analysis and wrote the original manuscript. FA guides and revises things that are inappropriate in the research.

Reference

Albet Maydiantoro. 2021. Model-Model Penelitian Pengembangan (R&D). (Lampung: FKIP Universitas). Dikutip dari Thiagarajan. 1974. Metode Pengembangan 4D. (Makasar: Pasca Sarjana UNM).

Anas Sudjono. 2015. *Pengantar Statistik Pendidikan*. (Jakarta: Rajawali Pers).

Arikunto. 2010. *Evaluasi Program Pendidikan; Pedoman Teoritis Praktis bagi Praktisi Pendidikan*. (Jakarta: Bumi Aksara).

Dini Febriannisa dan Ardi. 2023. Meta-Analisis Pengembangan Lembar Kerja Peserta Didik Berbasis Project Based Learning (PjBL). *Jurnal Pendidikan Tambusai.* Vol 7(2), 14826.

Sihono Setyo Budi. 2023. "Penerapan Model *Project Based Learning* (PjBL) Untuk Meningkatkan Prestasi dan Kemandirian Belajar Siswa Pada Mata Pelajaran Keterampilan Di Kelas X IPA 2." *Jurnal Inovasi Penelitian Tindakan Kelas dan Sekolah*. Vol. 3(3), 213.

Wagiran. 2014. *Metodelogi Penelitian Pendidikan (Teori dan Implementasi)*. (Yogyakarta: Deepublish)

Widoyoko. 2009. *Evaluasi Program Pembelajaran*. (Yogyakarta: Pustaka).

Yusniati H. Muh. Yusuf. 2023. *Sejarah Perkembangan Fisika*. (Nusa Tenggara Timur: Tangguh Denara Jaya).