



Development of Project Based Learning Modules On Materials Static Fluids for Class of XI Senior High School

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ABSTRACT

One of the factors that affect the quality of education is the lack of availability of teaching materials. Based on observations that have been made, it was found that the teaching materials used in learning were worksheets and textbooks, there was no use of laboratories, the lack of active role of students in learning, and material that was difficult for them to understand contained static fluids, especially in an enclosed space. This research and development aim to see the design and also feasibility level of the module from the perspective of media experts and material experts. The method used is research and development (R&D) concerning the 4D model with 4 stages, namely define, design, development, and disseminate. The subjects in this study were media design experts and material experts. The instrument used in this study was a validation questionnaire given to media experts and material experts. Validation questionnaire related to the suitability of the material and the suitability of the design of the product being developed. Data from the instrument validation sheet were analyzed using a Likert scale. The results of the media expert validation obtained an average score of 3.825 with a feasibility percentage of 95.625% in the very feasible category, while the results of the material expert validation obtained an average score of 3.7 with a feasibility percentage of 92.5% in the very feasible category.

Keywords: Module, Project Based Learning (PjBL), Static Fluid

INTRODUCTION

Many factors affect the quality of education in Indonesia, one of which is the limited availability of teaching materials in learning. There are lots of teaching materials that can be used in the learning process, but what is often used are textbooks. The use of textbooks requires students to study under the guidance of educators by requiring all students to complete a learning activity at the same time even though each student has a different grasping power and level of understanding. This causes some students to lack understanding of the learning materials being taught so the development of teaching materials in the form of modules is one of the solutions to overcome these problems (Astuti, 2019; Ahdan, 2020; Safitri, 2021).

Modules are teaching materials in the form of books. In the module, there are units of teaching materials that are written in material packages and are equipped with how to use independent learning so that students can learn independently, without or with teacher guidance (Asrial., et al, 2020). The module is a learning unit smallest in the curriculum that students can learn individually. In studying the module, students must complete a module unit before entering the next module unit (Savitri, et al, 2022; Surahman, 2020). This means that students must understand the previous material in the module before moving on to the next material in another module. Modules can be developed for existing material in physics subjects. According to Trianto, physics is a scientific discipline that discusses natural phenomena and their causes, which in the study are divided into two, namely processes and products (Kususa, et al, 2017).

Physics is a subject that cannot be separated from its practice in life so physics learning is very suitable to be applied with project-based learning models. Project-based learning is a learning model that applies innovative, creative, contextual learning and provides opportunities for students to be more active in producing a work (Nugroho., et al, 2020).

Problem of Research

Based on the results of observations at SMAN 1 Darussalam on October 14, 2021, that in the teaching and learning process still focuses on using non-experimental worksheets with delivery using the lecture method, there is no use of laboratories to show the application of concepts so that learning becomes monotonous, boring and lacks student involvement in learning. . This makes the development of physics-based learning modules project-based learning to be one solution that is considered effective in solving the problem. In addition, the results of the needs analysis found that the material that is difficult for students is static fluid material with the dominant reason that static fluid material will be the basis for dynamic fluid material.

Research on the development of PjBL-based modules had previously been carried out by Novianto, et al (2018) concluded that the PjBL-based physics modules developed had appropriate criteria, both in terms of content and presentation feasibility aspects, and feasibility aspects. language, the feasibility of PjBL learning aspects, and the feasibility of graphics with an average score of 3.8 or in the very good category. In addition, students' learning creativity also increased with a gain value of 0.46 or in the moderate category when the learning process was applied using PjBL-based physics modules on static fluid materials. The results of this study indicate that learning using the PjBL-based physics module gives positive results so that it is feasible to use it in the learning process.

Another study by Hasanah, et al (2018) found that the -based physics module project-based learning on the material temperature and heat in validation by the material validator with a value of 2.9 in the good category, the media validator 3.6 in the very good category, the learning validator 3.0 in the good category and the language validator 3.8 in the very good category. And the results of the peer reviewer validation scored 2.9 in the good category. The

results of the use test by students of class X MIA MA Al Islam Surakarta were very satisfying, with a score of 3.6 in the very good category. This shows that the module developed by the researcher is feasible to use.

The difference between research and development that the researchers did with previous research lies in the preparation of materials and designs in the development of the module. In addition, the research on the print module designed by the researcher included the addition of video media in the form of barcodes which can be scanned and go straight to the video playback.

Research focus

Modules are teaching materials that are compiled from a learning unit and are equipped with independent learning instructions without forgetting the learning objectives. This makes it easier for students to achieve learning objectives because they only focus on one unit of material chapters as in the module design. One model that is suitable for the physics learning process is the PjBL model.

Project Based Learning is a learning model that actively involves students in learning by making activities and projects to present the results through several stages. Project-based learning models provide advantages, namely providing meaningful knowledge, improving planning and design skills, and building knowledge through experiences that take place in a collaborative work atmosphere (Rati, et al, 2017).

One material that fits the PjBL model is a static fluid material, especially in an enclosed space. A static fluid in an enclosed space is a fluid that is at rest and exerts pressure on an enclosed space. Static fluid in an enclosed space consists of hydrostatic pressure, Pascal's law, and Archimedes' law.

The focus of the problems that will be discussed in this study is regarding the design of PjBL-based physics learning modules on closed-space static fluid materials and assessing the feasibility level of developing PjBL-based physics learning modules on closed-space static fluid materials.

METHODOLOGY OF RESEARCH

General Background of Research

This research design uses research and development methods (*Research and Development*). Research and development is a research method used to design and produce a product suitable for use in society. Things that can produce certain products are used for research that needs analysis and to test the effectiveness of these products so that they can function in the wider community (Sugiyono, 2013).

The product produced in this research is a physics learning module based on Project Based Learning (PjBL) on static fluid material using a 4-D (Four-D) development model, namely define, design, develop, and distribute (Irman, 2020).

Subject of Research

The process of research and product development involves several subjects as below, namely:

1. Media Design Expert (Validator)

Media design experts are lecturers of informatics engineering education at UIN Ar-Raniry who are competent in the field of media. This media design expert will be the validator to assess the suitability of the media and design and provide comments and input on product design. This assessment and input are intended so that the product that has been made reaches perfection it is suitable for use by students.

2. Material Expert (Validator)

Material experts in the field of study are Physics education lecturers at UIN Ar-Raniry and physics subject teachers in high school who are experienced and competent. The appointment of this material expert was chosen with the consideration that the validator can assess the content and material of the module and provide comments aimed at improving the module before it is disseminated.

Instruments and Procedures

1. Research instrument

A research instrument is a measuring tool in research. The instrument used in this study was a validation questionnaire which was distributed to media experts and material experts. The validation questionnaire related to the suitability of the material and the suitability of the design on the product developed has 4 answer options according to the content of the question as shown in the table below (Kesumayanti dan Putra, 2017).

Table 1. Assessment Score Against Eligibility

Score	Answer Options
1	Strongly Disagree
2	Disagree
3	Agree
4	Strongly agree

a. Assessment Instruments For Material Experts

Instruments for material experts are in the form of validation questionnaires with assessment aspects related to the feasibility of content, material presentation components, and linguistic components of the developed product. Furthermore, the data obtained will be used to determine whether or not the product developed is feasible and input in product revisions is used as material for product improvement.

b. Assessment Instruments For Media Design Experts

The assessment instrument for media experts is in the form of a validation questionnaire with assessment aspects related to module size, module cover design, and module design for the developed module. Furthermore, the data obtained will be used to determine whether or not the product developed is feasible and the input in product revisions is used as material for product improvement.

2. Research procedure

The procedure used is adapted to the research and development model used. At the validation stage by media design experts and materials experts, the initial prototype of the module that has been designed is given to media design experts and material experts to be assessed and given comments as module improvements. Furthermore, the module that has been revised according to the comments of the experts and deserves to be disseminated will be distributed to students.

Data analysis

The data that has been collected from the validation sheet instrument that has been filled out by the expert validators are then analyzed and used as an improvement for the module that has been made to determine the feasibility level of the module. The data from the instrument validation sheet were analyzed using a Likert scale. The Likert scale is used to measure the attitudes, opinions, and perceptions of a person or group of people (Sugiyono, 2018).

The Likert scale in the form of a questionnaire has 4 answer choices. Assessment data by material experts and design experts will show the feasibility value of the teaching materials that have been developed. Then the data becomes a guideline for revising the teaching materials that have been developed, then analyzed to determine the feasibility.

Kesumayanti dan Putra (2017) states that the total feasibility assessment score can be calculated using the following formula:

$$\text{Percentage of Eligibility (P)} = \frac{\text{total score data collection}}{\text{ideal maximum score}} \times 100\%$$

The suitability data is used to determine the level of feasibility of the resulting product. The values obtained in the validation questionnaire assessment of material experts and design

experts are then averaged and converted in the form of statements to determine the feasibility of the product being developed. The conversion of scores into statements according to Damayanti (2018) can be seen in the following table:

Table 2. Conversion of Assessment Score to Eligibility

Percentage (%)	Answer Options
0-40	Very Less Worthy
41-60	Less worthy
61-80	Worthy
81-100	Very Worthy

RESULTS AND DISCUSSION

This study uses a 4D model to develop a product in the form of a module. There are 4 stages of 4D, namely define, develop and disseminate designs. At stage define researchers analyze and collect information related to the product to be developed. Staged design researchers began to design the module by adjusting the material with a project-based learning model. In addition, the module is designed to be as attractive as possible with the addition of motivational words, not monotonous with a combination of colors and character placement, as well as the addition of media barcodes to help students and at this stage the initial prototype of the module is complete. For stage development, the prototype of the module was assessed and developed again according to the suggestions from the validator so that the module is suitable for distribution, and at this stage dissemination module is distributed.

The development of project-based physics learning modules on static fluid materials has been assessed by two materials experts and two media design experts at the development. Several aspects were assessed in the development of the module by material experts, namely aspects of content feasibility, presentation feasibility aspects, and linguistic aspects while material design experts assessed several aspects, namely module size, design cover module, and module design. The data from the validation results are then searched for the percentage of eligibility and converted into a statement based on the percentage value of the feasibility. The results of the validation by media design experts and materials experts will be discussed below.

1. Results of validation by media design experts

As for the results of the validation by media design experts, the data collection score was 153 from the ideal maximum score of 160. The average score for each questionnaire statement was 3.825 out of 20 assessment statements in the media validation questionnaire. For the percentage of feasibility from the point of view of media design experts, namely:

$$\text{Percentage of Eligibility (P)} = \frac{\text{total score data collection}}{\text{ideal maximum score}} \times 100\%$$

$$\text{Percentage of Eligibility (P)} = \frac{153}{160} \times 100\%$$

$$\text{Percentage of Eligibility (P)} = 95.625\%$$

Then the results of the feasibility percentage are converted into table 2. Then it is found that the PjBL-based learning module on static fluid material for class XI SMA/MA is categorized as very feasible according to the views of media design experts.

2. Validation Results by Material Experts

The results of the validation by material experts obtained a data collection score of 111 from the ideal maximum number of votes is 120. The average score per statement item in the questionnaire is 3.7 out of 15 statements of material validation questionnaire assessment items. While the calculation of the percentage score of the feasibility of the material is as below.

$$\text{Percentage of Eligibility (P)} = \frac{\text{total score data collection}}{\text{ideal maximum score}} \times 100\%$$

$$\text{Percentage of Eligibility (P)} = \frac{111}{120} \times 100\%$$

$$\text{Percentage of Eligibility (P)} = 92.5\%$$

Then the percentage value of eligibility is converted into table 2 and the 92.5% value is in the 81-100% value range which is categorized as very feasible. So the material feasibility category is very feasible.

This is following the results of research conducted by Triantoro (2022) who found that the practicality of the module in the implementation aspect of the module resulted in an average score of implementation of all Project Based Learning syntaxes which was 79.65% (good).

CONCLUSION

Based on learning module design project-based learning the static fluid material is made as attractive as possible with adjustments between the material and learning models as well as the addition of media that can help students. In addition, the development of this module uses a 4D model, namely define, design, develop, and disseminate.

Based on the results of the feasibility assessment seen from the media design aspect, the average score was 3.825 with the percentage of feasibility being 95.625%, resulting in a very feasible category. Meanwhile, in terms of aspects of the feasibility assessment of the material from the results of material validation, the average score is 3.7 with a feasibility percentage of 92.5% and produces a very decent category as well.

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