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DEVELOPMENT OF PROJECT-BASED LEARNING *(PJBL)* BASED MATHEMATICS MODULES ON COMPARISON MATERIALS

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Abstract

Learning process that takes place definitely requires a teaching material. Teaching materials are needed that can facilitate student in ongoing learnings processed. One planner and designedly learnings experiences to helped student's masters' learnings of them is using the learnings method in the forms of the learnings module. Modules is a formed of teachings materials that's is packages in a complete and systematically manners whichever containing a set of objectively. The module is arranged Project Based Learning (PjBL) method. The purposes of this studying are to determine the validitys and Practicalities of the developer's mathematics modules. The types of researchers conducted was Research and Development (R&D) used the ADDIE models developments methods (analysist, designed, developments, implementations, and evaluations). Location This researcher took place at SMP Plus Al Hadi with class VII students as researchers subjects. The datas analysist techniques uses is Quantitative in the former of validity analysist and practicality analysis. The resulted of the researchers shows that's the developed module is valid and practical. The mathematics modules declare validates bases on the Validations resulting from media's exports and materials experts. The resulted of validation by media's expert's Obtained a value of 75% (valid) and the resulted of Validation by materials expert's Obtained a value of 82.69% (valid). After beings validates, the modules are then texted on students to find out the Practicality of the module. There trials were carrier outs in two's states, nameless a limiters scale trial and a large-scale trial. In the limiter trials phases, a value of 84.58% (p-tactical) was obtained and in the large-scale trial stage, a value of 86.29% (very practical) was obtained. Thusly, it's Can's he concludes that's the developed PjBL-based mathematics module it's suitably fors used in learnings.

Keywords: Math Module, Project Based Learning (PjBL), ADDIE

INTRODUCTION

Education is a real and designed effort to create learning situations and learning mechanisms so that students are able to actively improve their abilities (Suparyanto and Rosad, 2020). Intermediary learning is able to develop quality human resources (Fitri et al, 2023). One of the majors that is missing in education is mathematics. Mathematics as a subject that includes a lot of contemplation earnestly, both contemplation with reason, application or use of formulas or suitability when calculating (Kurniawati, 2018). In mathematics learning, it is likely to experience several obstacles. Usually, these obstacles are influenced by internal and external factors. The internal factors are the lack of interest in students learning mathematics, low intelligence and lack of motivation to learn, then the external factors are less innovative learning media and conducive classes. (Andri et al., 2020).

Efforts that can be carried out to solve problems in learning are by providing teaching materials in the form of modules to help the learning process. Modules are

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teaching materials that contain learning, specifically designed to achieve preset learning targets and can create students to learn independently (Siregar, 2022). The module is prepared using a learning method, namely the Project Based Learning Method (PjBL). PjBL is a learning mechanism in which students are constantly involved in the creation of a program. (Sari & Angreni, 2018).

Research conducted by (Astriani, L., & Akmalia, S, 2022) shows that the development of PjBL-Based Modules is feasible to be used in learning according to the results of validity tests and practicality tests. In the validity test by linguists, materials and media experts, scores of 96% (very valid), 96% (very valid) and 98% (very valid) were obtained. Meanwhile, in the practicality test by small groups and large groups, scores of 96% (very practical) and 97% (very practical) were obtained.

In accordance with the description of the problem and speculation studies that have been described above, the development of a Project-Based Learning-based mathematics module aims to find the value of validity and practicality of the mathematics module. The application of Project-Based Learning-based mathematics modules is expected to facilitate students in the learning process. This module can also complement the teaching materials needed by students in the ongoing learning mechanism.

RESEARCH METHODS

This research is classified as *Research and Development* (R&D) research. (R&D) is a research technique that realizes new updates both in the form of new items and the development of existing items to be better for learning targets (Raraswaty, 2021). This research is carried out to produce a valid and practical product so that it can be used in learning.

This research was carried out at SMP Plus Al Hadi Banjararum Rengel Tuban. The object of this research is the development of *a Project-Based Learning* (PjBL) based mathematics module. The subjects in this research are 31 educators and students of class VII of SMP Plus Al Hadi Banjararum Rengel Tuban. Techniques in collecting indications are in the form of interviews and questionnaire distribution. Meanwhile, the research instruments are in the form of expert validation (media experts and material experts) and product trials (limited scale and large scale). Indication analysis techniques are carried out to understand the validity and practicality of the module. The data received came from the validity sheet of material experts, validity of media experts and practicality questionnaire tests by students. Then the criteria for validity and practicality are calculated and determined with references adopted from (Suastika & Rahmawati, 2019) as follows:

$$Presentase\ Nilai = \frac{Jumlah\ nilai}{Nilai\ maksimal} \times 100\%$$

Table 1. Validity and Practicality Criteria

Presentase (%)	Criterion
$85 \leq X \leq 100$	Very valid
$75 \leq X < 85$	Valid
$60 \leq X < 74$	Quite valid
$39 \leq X < 59$	Invalid
$0 \leq X < 39$	Invalid

The development model used is the ADDIE development model. The ADDIE model has five stages of development, namely: *analysis, design, developmen,*

implementations, and evaluations (Barlenti &; Hasan, 2017). The analysis stage in the development of mathematics modules is to carry out needs analysis, teaching material analysis and curriculum analysis. Efforts were made to see the initial data in the form of interviews with grade VII students of SMP Plus Al Hadi.

The design stage is to design the shape of the mathematics module that can be improved. In this stage, creating a description of the content of the mathematics module to be developed, including designing the module cover and the content of the mathematics module itself. This design stage also designs learning objectives, material descriptions, question descriptions, evaluation mechanisms and designing module perfection devices.

The development stage is the process of making the design a reality. The step of this stage is to plan and qualify the teaching materials to be developed. As well as other terms include the function of determining, determining the right learning methods and strategies with the material to be developed in the mathematics module. Then the validation was carried out by two experts, namely material experts and media experts.

The implementation stage is real action to implement the learning scheme that has been created in the mathematics module. In this stage, limited-scale trials and large-scale trials were carried out. The trial was carried out to obtain data related to the effectiveness of the use of mathematics modules.

The evaluation stage is the evaluation mechanism for the mathematics module. In this stage, it can be understood whether or not the mathematics module that has been developed is appropriate. Evaluation is very urgent, because with the evaluation the researcher can understand the shortcomings and advantages of the mathematics module, so that the researcher can improve the mathematics module.

RESULTS AND DISCUSSION

This research realizes an item in the form of a *project-based learning* mathematics module using ADDIE development, the following are the stages of ADDIE development research.

Analysis

The analysis stage is carried out by describing the needs, teaching materials and applicable curriculum. The results of the needs analysis obtained data that students at SMP Plus Al Hadi need valid and practical teaching materials and are able to provide student facilities in learning according to the needs and abilities of students.

The results of the analysis of teaching materials show that the teaching materials used in mathematics learning at SMP Plus Al Hadi are in the form of LKS books. The advantage of the LKS is that it contains a summary of the material and practice questions to understand students' skills. The summary of the material makes it easier for students to focus on what is being learned because it does not spread everywhere. The disadvantage is that the material in the LKS is not elaborated extensively, so educators need additional books in the learning process.

The results of the curriculum analysis showed that the curriculum applied at Al Hadi Plus Junior High School was the 2013 curriculum. In addition, the researcher also seeks information about materials that are suitable for development in the PjBL-based module, namely comparative materials in grade VII, basic competencies, learning indicators and learning objectives.

Design (Design Stage)

The module design is structured based on the module cover, module content

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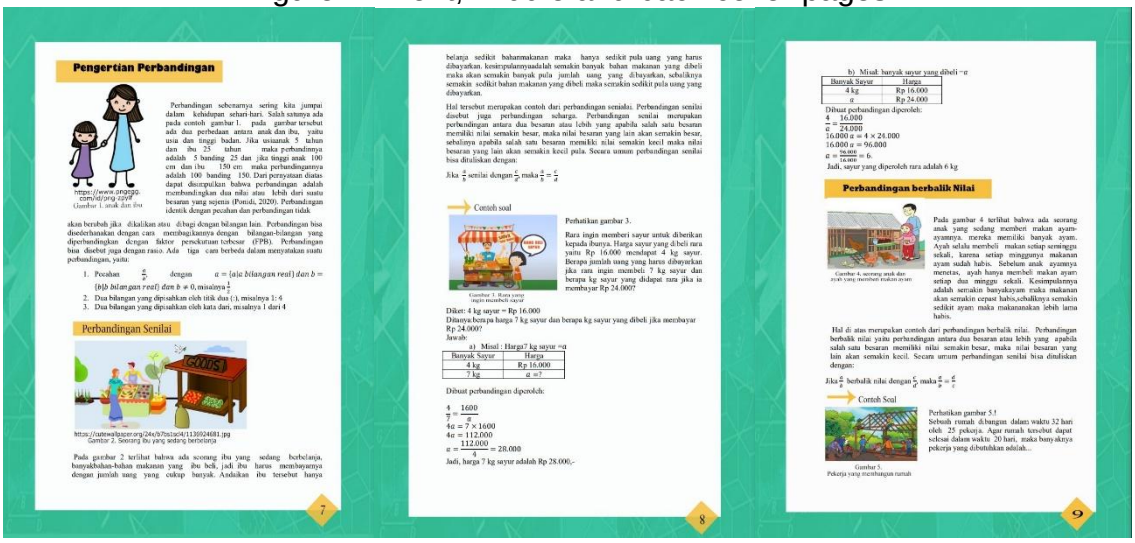
and module layout. This module is designed as well as possible, using a cover designed with a combination of colors, images (illustrations), appropriate shapes and font sizes, and using images that coincide with the material, so that students are more comfortable reading the module, and use language that is easily understood by the module user. This is intended so that the module user is able to know in detail the content or material available in the module. The module design developed includes the design of the front and back cover, foreword, table of contents, instructions for using the module, PjBL learning stages, basic competencies, indicators, learning objectives, comparison materials, project assignments, practice questions, answer keys, profile of the supervisor and bibliography. Here is a drawing of the initial design of the PjBL-based module design:

Figure 1. Front, Middle and back cover pages



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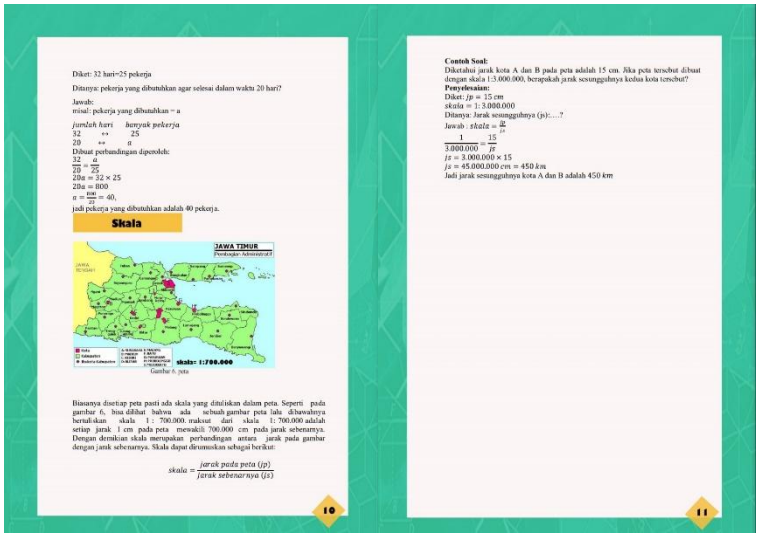

Figure 2. Material

Figure 3. Project tasks

Development (Tahap Pengembangan)

The development stage is the stage of planning the modules as a perfect unit. In this stage, the researcher creates a draft module that coincides with the indications that have been obtained at the indication analysis stage. After making a module draft, the researcher then validates the items that will be validated by media experts and material experts, both of which are lecturers of the UNUGIRI Mathematics Education Study Program. An indication of the results of the validation of the media agreement can be observed in table 2.

Table 2. Media expert validation results

Yes	Assessment Aspects	Value
1	Simplicity	6
2	Alignment	6
3	Balance	12
4	Shape	6
5	Color	9
6	Language	6

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Total Values	**44**
Percentage of Grades	**75%**
Category	**Valid**

In accordance with Table 2, it can be seen that the results of validation by media experts obtained a total score of 45 with a score percentage of 75% of the valid category. Meanwhile, the indication of the results of validation by material experts can be observed in table 3.

Table 3. Subject matter expert validation results

Yes	Assessment Aspects	Value
1	Content quality	19
2	Quality of learning	13
3	Display Quality	11
	Total Values	**43**
	Percentage of Grades	**82,69%**
	Category	**Valid**

In accordance with table 3, it can be observed that the results of the validation of material experts obtained a score of 43 with a score percentage of 82.69% of the valid category.

In accordance with the validation of media experts and material experts, it can be concluded that the Project-Based Learning-based mathematics modules developed are classified as valid. Then the module is suitable to be tested for students.

Implementation (Tahap Implementasi)

Mathematics modules that have been assessed as feasible, so that tests can be carried out with students. The trial was carried out in grade VII of SMP Plus Al Hadi, the trial was carried out 2 times, namely a limited scale trial and a large-scale trial. The limited-scale trial was carried out to 5 grade VII students of SMP Plus Al Hadi on July 1, 2023. This trial was carried out so that students could see and read the set using the developed modules so that students could provide practical insights by filling out questionnaires. The acquisition of a limited-scale trial indication analysis obtained a total score of 203, while the maximum value of the assessment was 240, so the percentage of practicality was calculated with a practicality value formula and determined the practicality criteria. The calculation of practicality values is as follows:

$$Nilai = \frac{jumlah\ nilai\ yang\ diperoleh}{jumlah\ nilai\ maksimal} \times 100\%$$

$$Nilai = \frac{203}{240} \times 100\% = 84{,}58\%$$

Based on this calculation, the results of the module practicality assessment were obtained of 84.58%. The percentage of these values is included in the range $75 \leq X < 85$, so the practicality of PjBL-based mathematics modules is practical. While the limited-scale trial was carried out to 26 grade VII students of SMP Plus Al Hadi on July 4, 2023. This trial was carried out with the aim of entrusting the analysis

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of the indications that have been carried out to determine the practicality of the developed mathematics module. Results of large-scale trial data analysis obtained the amount of the value of all indicators of the Examiner is 1,077. While the maximum value of the assessment is 1,248, the percentage of practicality is calculated with the formula of the practicality value and determines the criteria for practicality. The calculation of practicality values is as follows:

$$Nilai = \frac{jumlah\ nilai\ yang\ diperoleh}{jumlah\ nilai\ maksimal} \times 100\%$$

$$Nilai = \frac{1.077}{1.248} \times 100\% = 86{,}29\%$$

Based on this calculation, the results of the module practicality assessment were obtained of 86.29%. The percentage of these values is included in the range $85 \leq X \leq 100$, so the practicality of the PjBL-based mathematics module is very practical. Thus, the PjBL-based mathematics module developed is included in the category of being very practical and suitable to be used as teaching material for learning in schools.

Evaluation (Tahap Evaluasi)

The evaluation stage functions to understand the appropriateness of the PJBL-based mathematics module that has been developed. Feasibility in this case includes the validity and practicality of the module. The validity in question is the validity based on the validation of media experts and the validation of material experts where a percentage of 75% of media validation and a percentage of 82.69% of material validation are obtained. Therefore, from the results of the percentage of the score, it can be concluded that the validation assessment by the expert team of the mathematics module is valid and has been appropriately used. Meanwhile, the practicality in question is the assessment carried out by students on the mathematics module. This assessment was carried out in 2 stages, namely a limited-scale trial and a large-scale trial. From the results of the limited trial, a score percentage of 84.56% was obtained with practical qualifications and the results of large-scale trials obtained a score percentage of 86.15% with very practical qualifications. Therefore, from the results of the practicality assessment, it can be concluded that the practicality assessment by students of the mathematics module is very practical and has been appropriately used.

CONCLUSION

A mathematics module is said to be valid if it has been validated by media experts and material experts, who then the validator explains that the module developed has valid criteria and there are no more revisions. The modules developed by the researcher were validated by media experts and obtained a total Score 45 and the percentage of the total value of 75% and validated by material experts obtained a total score of 43 with a percentage of 82.69%. The percentage of the score is included in the range $75 \leq X < 85$ then the results of the validation of the PjBL-based mathematics module are valid. Practical modules are modules that have been tested by students and receive practical criteria. The modules developed by the researcher were tested which were carried out in 2 stages, namely a limited-scale trial and a large-scale trial. The results of the limited-scale trial obtained were 84.58%. What is the value in the range

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$75 \leq X < 85$ with practical criteria. The results of large-scale trials obtained by the artist were 86.29%. This number is in the range $85 \leq X \leq 100$ with very practical criteria. In accordance with these results, the mathematics module developed by the researcher is appropriate to be used in learning.

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