DEVELOPMENT OF MATHEMATICAL MODULES OF ALGEBRA MATERIAL BASED ON LEARNING CYCLE MODEL FOR STUDENTS IN CLASS VII

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ABSTRACT

Mathematics learning media can help students understand abstract mathematical concepts, but the availability of learning media in school is still limited. This research aims to develop mathematics learning media in the form of learning model module learning cycle on algebra material for Junior High School Students in Grade VII, which is decent to apply in the process of learning mathematics. This research includes research development that using research and development methods, which consists of ten stages: potential and problem, data collection, product design, design validation, design revision, product trial, product revision, trial usage, product revision, and mass production. The object of this research is learning media that is a mathematics module, and the subjects are material experts, media experts, and students of State Junior High School 13 Tanjung Jabung Timur (SMPN 13 Tanjung Jabung Timur) and State Junior High School 21 Tanjung Jabung Timur (SMPN 21 Tanjung Jabung Timur). The data collection techniques are interviews, questionnaires, and observations. The data analysis technique uses a Likert analysis. The learning media product developed has been assessed and validated by three learning material experts and 3 mathematics learning media experts. The learning material experts' assessment results obtained with an average value of 97.67 indicate the category is very decent. The assessment results of learning media experts obtained with an average value of 61.33 indicate the category is decent. The assessment results of student responses obtained with an average value of 134.6105 show a very decent category. Based on these results, it can be concluded that the learning media, which is developed, is decent to apply in the learning mathematics process.

Keywords: Mathematics learning media, Module, Learning Cycle, Research and Development, Algebra

INTRODUCTION

The quality of education is a central issue of education today. This is because educational outcomes in Indonesia are still far from the set standards. Other facts also show that Indonesian students' competitiveness is still far below that of other countries, including ASEAN countries. Indonesia's participation in international studies Trends in International Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA) since 1999 also shows that the achievements of Indonesian children are not encouraging. The PISA Mathematics, Science, and Language in 2009 showed that almost all Indonesian students only mastered lessons up to level 3, while many other countries reached level 4.5, even 6. The results of the VIII grade Mathematics TIMSS in 2012 showed that more than 95% of Indonesian students are only able to reach the intermediate level, while almost 50% of Taiwanese students can reach the high and advanced level (Ratumanan: 2015).

To improve education in Indonesia, changes are needed in the learning system. Learning conducted by teachers in Indonesia, in general, is still centered on the teacher. This is caused by an inadequate understanding and learning paradigm that is not by the actions that should be taken. Research shows that differences in learning paradigms have an impact on student learning outcomes. Comparison of TIMSS and PISA test results in several test periods shows that students in Japan obtain much higher results than students in Germany and America. Teachers in America believe that learning occurs by gradually mastering the material, so learning needs to be done little by minimizing mistakes. Meanwhile,

teachers in Japan believe that students will learn well if they begin by trying to solve them and then discuss them to solve them.

In the teaching and learning process, two important elements must be considered: the learning model and the learning media. The two elements are related to one another. The use of a learning model positively affects the type of learning media. Learning media in question are humans, objects, animals, plants, or factual events that enable students to obtain knowledge, skills, and attitudes. The selection of learning models must be by the objectives of teaching. Each learning model has specific characteristics with the advantages and disadvantages of each, and there is no single learning model that is considered the best among the existing learning models. Therefore, in teaching, various models can be used, according to the material to be taught. Maybe some of us have heard the term module. Maybe we never know and hold the teaching material. However, to be able to make this teaching material, it is not enough to know its shape. However, we also need to know how to make and develop it so that we can make excellent module teaching materials. To improve the teaching and learning process, it is necessary to develop mathematical modules based on the learning cycle learning model. Because this model can solidify and provide understanding to students as a whole on mathematical concepts, this is done through the stages inside the mathematics module based on the interrelated learning cycle learning model. Repetition in these stages can overcome the possibility of misunderstanding the concept of students.

Based on the results of the interview on Thursday, 18 August 2016. Ms. Jumsinah S.Pd, as a mathematics teacher at SMP N 13 Tanjung Jabung Timur, stated that for mathematics subjects, students 'understanding of mathematical concepts is still low, and students' enthusiasm for learning is still low still lacking. Besides that, based on an interview on Saturday, 20 August 2016. Tri Harnani S.Pd as a mathematics teacher at SMP N 21 Tanjung Jabung Timur, stated the same thing, understanding concepts, and enthusiastic students became a huge problem. The authors looked at teaching materials used in learning in the two schools using textbooks from the results of observations to the school. However, the textbooks students use do not help teaching and learning. Because textbooks are less attractive, so students prefer to wait for explanations from the teacher. Teachers also only use the lecture and assignment methods so that students become less active.

Therefore we need a mathematical module that can help students more easily understand mathematical material. Mathematical modules based on the learning cycle learning model might be an alternative to this problem. Structuring the structure of the mathematics module must be considered to be exciting and be able to facilitate students in understanding mathematical material. The algebra material was chosen because the junior high school students still did not understand the algebra concept well. Because of this lack of understanding, many students at the next level are confused when they are replaced with another variable. Therefore, a good understanding is needed so that the algebra material becomes easy to understand, and there is no misunderstanding of the concept.

METHODS

This study uses a research and development model or research and development. Research and development methods are research methods used to produce certain products and test the effectiveness of these products. Research and development that produce certain products for administration, education, and other social fields are still low. Many specific products in the field of education and society need to be developed and produced through research and development. So that the development of teaching materials in this module is designed with research and development methods. The development procedure is the steps that must be taken to produce the product. To produce an excellent product design is needed in development. Therefore, in determining the procedure for developing modules based on the learning cycle learning model, the writer considers the expert media developer's opinion. Sugiyono (2016: 298) illustrates the steps of research and development in the following figure.

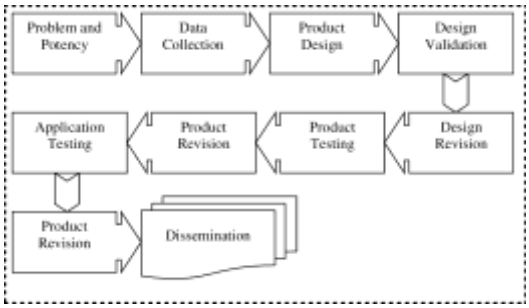

Figure 1. Steps for Using Research and Development (Sugiyono, 2016: 298)

From this picture, the following steps can be explained by research and development.

1. Potential and Problems. Research can depart from the existence of potential or problems. Potential is everything that will have added value when utilized. The problem is the deviation between what is expected and what happens. All potentials will develop into problems if we cannot utilize these potentials. However, problems can also be made potential if we can make use of them.
2. Information Collection. After the potentials and problems can be shown in fact and up to date, then it is necessary to gather various information that can be used as material for planning certain products that are expected to overcome the problem.
3. Product Design. The products produced in research and development are various. In the field of education, the products produced are expected to be relevant to the needs and improve the quality of education in a better direction. Product design must be a tangible or initial product. The initial product is tentative (uncertain) because it will still be refined through several pilot activities. In this study, researchers will develop a mathematical learning media in the form of module teaching materials.
4. Design Validation. Design validation is a process of activities to assess whether the product design, in this case, a new work system will rationally be more effective than the old one or not. It is said rationally because validation here is still an evaluation based on rational thought, not field facts. Product validation can be done by presenting several experts or experienced experts to evaluate the product being designed. Each expert is asked to assess the design so that the weaknesses and strengths can be further identified. Design validation can be done in a discussion forum. Before the discussion, the researcher presented the research process until the design was discovered, the following advantages.
5. Design improvements. After the product design, validated through discussions with experts and other experts, the weaknesses will be identified. The weakness is then tried to be reduced by improving the design. In charge of improving the design are researchers who want to produce the product.
6. Product Trial. According to Sugiyono (2016: 302), Product designs that have been made cannot be directly tested but must be made first, produce goods, and be tested. However, in the field of administration or social product design, such a new work system can be directly tested. In this research, the product produced is in the form of goods that cannot be directly tested but must be made first.
7. Product Revision. After the product trial is carried out, there may be weaknesses, if there is a need to be repaired immediately. After it has been repaired, it can be mass-produced, or used in an extensive work system.
8. Trial Usage. After testing the product successfully, and there may be revisions that are not too important, the product can then be applied in real conditions for a broad scope. In the operation of these products, it must still be assessed deficiencies or obstacles that arise for further improvement.
9. Product Revision. This product revision is done if, in the use of real conditions, there are shortcomings and weaknesses. In the usage test, the product manufacturer should always evaluate how the product is performing.
10. Mass Product Manufacture. Making this mass production is done if the product that has been tested is declared effective and feasible for mass production. In this study, researchers did not produce mass-

produced modules because the data needed by researchers had been obtained until the trial phase of usage.

In this study, product trials were carried out through 10 stages in the development procedure. The experimental subjects in this development research consisted of media experts, material experts, and eighth-grade students of East Tanjung Jabung N 13 Middle School and East Tanjung Jabung N 21 Middle School. The data used in this study are qualitative and quantitative. This development research uses several data collection techniques, namely: interviews, observation, and questionnaires. The research data were obtained using the following data collection instruments: Material Expert Questionnaire, Media Expert Questionnaire, and Student Response Questionnaire.

Quantifying data is a step to change the qualitative data in the questionnaire into quantitative data by giving a score. The provisions are as follows

Table 1. Rules for Scoring

Information	**Score**
Very decent	5
Eligible	4
Decent enough	3
Not feasible	2
Very Inadequate	1

After the data is collected, the researcher determines the average using the formula:

$$\bar{X} = \frac{\sum_{i=1}^{n} x_i}{n}$$

With:

$\bar{X}$: Mean Score

$\sum_{i=1}^{n} x_i$: Total Score

n: Number of evaluators

The average score is converted into a qualitative value according to the criteria of the ideal rating category. According to Sukarjo (2006: 53), the criteria for the ideal evaluation category with the following conditions:

Table 2. Guidelines for Assessment Criteria

Score Range *(i)*	**Category**
$\bar{X} > (\bar{X}_i + 1{,}8 \times sb_i)$	Very decent
$(\bar{X}_i + 0{,}6 \times sb_i) < \bar{X} \leq (\bar{X}_i + 1{,}8 \times sb_i)$	Eligible
$(\bar{X}_i - 0{,}6 \times sb_i) < \bar{X} \leq (\bar{X}_i + 0{,}6 \times sb_i)$	Decent enough
$(\bar{X}_i - 1{,}8 \times sb_i) < \bar{X} \leq (\bar{X}_i - 0{,}6 \times sb_i)$	Not feasible
$\bar{X} \leq (\bar{X}_i - 1{,}8 \times sb_i)$	Very Inadequate

The percentage criteria for the ideal assessment category by material experts, media experts, student responses, and overall grades are as follows:

Table 3. Questionnaire Assessment of Material Expert

Score Range *(i)*	**Category**
$X > 92{,}4$	Very decent
$74{,}8 < X \leq 92{,}4$	Eligible
$57{,}2 < X \leq 74{,}8$	Decent enough
$39{,}6 < X \leq 57{,}2$	Not feasible
$X \leq 39{,}6$	Very Inadequate

Table 4. Questionnaire Assessment of Media Expert

Score Range *(i)*	Category
$X > 63$	Very decent
$51 < X \leq 63$	Eligible
$39 < X \leq 51$	Decent enough
$27 < X \leq 39$	Not feasible
$X \leq 27$	Very Inadequate

Table 5. Student Questionnaire Assessment

Score Range *(i)*	Category
$X > 126$	Very decent
$102 < X \leq 126$	Eligible
$78 < X \leq 102$	Decent enough
$54 < X \leq 78$	Not feasible
$X \leq 54$	Very Inadequate

RESULTS AND DISCUSSION

In this research and development, preliminary research is carried out by gathering information about mathematics problems in students of SMPN 13 Tanjung Jabung Timur and SMPN 21 Tanjung Jabung Timur. After conducting preliminary research, researchers conducted reference studies on algebraic material. In this activity, the researchers determined the scope of material presented in the module based on discussions with supervisors, mathematics teachers at SMPN 13 Tanjung Jabung Timur, and mathematics teachers at SMPN 21 Tanjung Jabung Timur. To develop these products, researchers conducted several stages, namely:

a. Determine CS, BC, and Indicators of the material to be presented
b. Draft the module
c. Do a module that will be validated
d. Arrange instruments

The initial product validation is intended to provide input for product improvement before product testing is conducted to students. Material experts, media experts, and teachers as education practitioners, provide an assessment of the module through an assessment sheet. Trial 1 was conducted at SMPN 13 Tanjung Jabung Timur class VIIC on 8 April 2017 and at SMPN 21 Tanjung Jabung Timur class VIIA on 20 April 2017 with the number of respondents each school five students. In this large class trial, the researcher began the trial at SMPN 21 Tanjung Jabung Timur. The trial was conducted in class VIIA on 20 April 2017. The number of respondents was 26 students, and the researcher continued the trial use for large classes at SMPN 13 Tanjung Jabung Timur. This trial was conducted in class VIIC on the 22nd. The number of respondents was 16 students.

Analysis of assessment questionnaire from material aspects:

Table 6. Rating of Material Aspects

No.	Assessment	Score
1	Sumargiyani	97
2	Jumsinah, S.Pd	103
3	Tri Harnani, S.Pd	93
Total		293
Mean		97,67
Quantitative Data Criteria (positive statement)		Very worthy

Based on the results of the product quality research above, it shows that the product produced in the form of a learning cycle learning model module on the subject of algebra for VII grade SMP / MTs is assessed from the material aspects included in the criteria very feasible to use.

Analysis of the assessment questionnaire from the media aspect:

Table 7. Evaluation of Media Aspects

No.	Assessment	Score
1	Syariful Fahmi, M.Pd.	56
2	Jumsinah, S.Pd	61
3	Tri Harnani, S.Pd	63
Total		180
Mean		60
Quantitative Data Criteria (positive statement)		Worthy

Based on the results of the product quality research above, it shows that the product produced in the form of a learning cycle learning model module on the subject of algebra for VII grade SMP / MTs was assessed from the aspect of the media included in the criteria for use.

Analysis of student response questionnaire

Table 8. Results of Student Response Questionnaire

No.	Assessment	Score
1	SMPN 13 Tanjung Jabung Timur	68,1875
2	SMPN 21 Tanjung Jabung Timur	66,423
	The average number of two schools	134,6105
	Quantitative Data Criteria (positive statement)	Very worthy

Based on the calculation results of the student response questionnaire above, it shows that the product produced in the form of a learning cycle learning module on the subject of algebra for VII / SMP grade VII is included in the very feasible criteria.

In this validation process, learning media products have been revised twice. The revision was made after obtaining input from material experts and media experts. The following is input and follow-up from the validation carried out. Input from material experts:

1) Writing adjusted to enhanced spelling.
2) The module features are enlarged
3) The opening illustration of students' insights on page 1 is changed according to daily life
4) The first person pronoun you is replaced by you
5) Understanding directly given without asking by the teacher
6) The results of the discussion are given a student response inducement
7) The addition, subtraction, multiplication, division, and rank of the algebraic form are given their points
8) Examples of multiplication are quickly removed
9) Questions replace exercise 3
10) Give concepts to:
    a) Addition and subtraction of algebraic forms
    b) Multiplication and division of algebraic fractions

Input from media experts

1) Improvements to the front cover add based on LC, SMP / MTs, and P.Mat - FKIP - UAD
2) Improvements to the back cover on the compiler profile are added who are familiar in the call caraka, and email
3) Change the font on the bottom module logo
4) The image on the module feature is enlarged
5) On page 1 the text was changed to text form

6) Give the title at the top according to the sub-chapter discussed
7) Pictures are given source information
8) Example questions are changed to text form
9) Give space to each paragraph
10) The lid is removed
11) Outline summary

This developed module changed from the initial design after being revised twice, both in terms of material and media. The amendment was revised in such a way that it has the following arrangement:

1. Front cover module
2. Module identity
    a. Author page
    b. Foreword
    c. Table of contents
    d. Study Instructions
    e. Module features
    f. Concept maps
    g. Competency Standards and Basic Competencies
3. Fill in the module
    a. Chapter Title
    b. Basic competence of students
    c. Apperception
    d. Sub-chapter title
    e. Material description
    f. Student discussion
    g. Problems example
    h. Student exercise
    i. Final evaluation of students
4. Summary
5. Motivation
6. Bibliography
7. Back cover module

CONCLUSION

The conclusions obtained from this research development are:

1. Planning to develop the module using the learning cycle learning model on the subject of algebra for the seventh-grade students of SMP / MTs Semester 1 has gone through the stages of development:
    a. This development begins with gathering information. In gathering information, researchers conduct interviews with teachers, analyze curriculum, and compile a module that needs a map.
    b. Then proceed to the next stage, which is to design the module. Review CS/BC and design according to the steps in the book Arranging Modules (Teaching Materials for Teacher Preparation in Teaching).
    c. The next step is validation. The modules that have been developed have gone through a series of validations, including those that have been validated by Ahmad Dahlan University material expert lecturer, Mrs. Dra. Sumargiyani M.Pd, media expert lecturer, Mr. Syariful Fahmi, M.Pd, and education practitioners, namely mathematics teacher at SMPN 13 Tanjung Jabung Timur, and at SMPN 21 Tanjung Jabung Timur, a large class trial at SMPN 13 Tanjung Jabung Timur. After that, the product was tested at two schools. In this trial, it was conducted four times, namely a small class trial of five students at SMPN 13 Tanjung Jabung Timur, and at SMPN 21 Tanjung Jabung Timur, a large class trial at SMPN 13 Tanjung Jabung Timur, and at SMPN 21 Tanjung Jabung Timur.

2. The module product's feasibility uses the learning cycle learning model on the subject of algebra for the seventh-grade students of SMP / MTs developed in the feasible category to be used in the learning process. Based on the average calculation as follows:
   a. Analysis of assessment data by material experts and educational practitioners obtained an average score of 97.67, which is included in the criteria very feasible to use for learning.
   b. Analysis of assessment data by media experts obtained an average score of 61.33 in the criteria suitable for learning.
   c. Analysis of student response data between the two schools obtained an average score of 134.6105, which was included in the very feasible criteria.

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