Development of a Mathematics Module Based on a Scientific Learning Approach at SMP Negeri 8 Padangsidimpuan

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Abstract

This study aims to develop a learning device product with a valid, effective, and practical scientific learning approach. The learning tools developed include: mathematics modules, learning implementation plans, and student activity sheets.This research is a development research that uses a modified 4D device development model design according to ThiagarajanSemmel and Semmel. The subjects in this study were class VII-4 students of SMP Negeri 8 Padangsidimpuan.In this study, the stages carried out were only to produce the final product and were not widely implemented. The results of the study show that learning tools with a scientific approach are valid, effective and practical.From the results of the development test: (1) the mathematics module based on a scientific learning approach meets the validity criteria based on experts, (2) the mathematics module based on a scientific learning approach meets the criteria for effective use based on observations of achieving the ideal percentage of time, and fulfills the classical completeness result of ≥ 85 % of the test subjects, and from the results of observations of the teacher's ability to manage learning, and (3) the mathematics module based on a scientific learning approach meets practical criteria based on teacher and student response questionnaires.

Keywords: *Development; Mathematics Module Based on Scientific Learning Approach; Scientific Approach.*

Abstrak

Penelitian ini bertujuan untuk mengembangkan suatu produk perangkat pembelajaran dengan pendekatan pembelajaran saintifik yang valid, efektif, dan praktis. Perangkat pembelajaran yang dikembangkan meliputi: modul matematika, rencana pelaksanaan pembelajaran, dan lembar kegiatan siswa. Penelitian ini merupakan penelitian pengembangan yang menggunakan rancangan model pengembangan perangkat 4D menurut Thiagarajan Semmel dan Semmel yang telah dimodifikasi. Subjek dalam penelitian ini adalah siswa kelas VII-4 SMP Negeri 8 Padangsidimpuan. Dalam penelitian ini, tahapan yang dilakukan hanya sampai menghasilkan produk final dan tidak dilakukan implementasi secara luas. Hasil penelitian menunjukkan bahwa perangkat pembelajaran dengan pendekatan saintifik telah valid, efektif, dan praktis. Dari hasil uji pengembangan: (1) modul matematika berbasis pendekatan pembelajaran saintifik memenuhi kriteria kevalidan berdasarkan para ahli, (2) modul matematika berbasis pendekatan pembelajaran saintifik memenuhi kriteria efektif digunakan berdasarkan hasil pengamatan pencapaian persentase waktu ideal, dan memenuhi hasil ketuntasan klasikal yaitu ≥ 85% dari subjek

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uji coba, dan dari hasil observasi kemampuan guru mengelola pembelajaran, serta (3) modul matematika berbasis pendekatan pembelajaran saintifik memenuhi kriteria praktis berdasakan angket respon guru dan siswa.

Kata Kunci: Pengembangan; Modul Matematika Berbasis Pendekatan Pembelajaran Saintifik; Pendekatan Saintifik.

INTRODUCTION

The teacher's ability to design teaching processes in the classroom is related to the professionalism of teachers as educators who have pedagogical competence. In addition to teachers being required to develop their own abilities both in terms of knowledge, teachers are also expected to be able to develop professional competencies, including being able to produce quality Human Resources (HR) loaded with knowledge, attitudes, and skills to face the ever-evolving world.

By creating a quality learning process and preparing a teaching and learning process design, in guiding the growth of a good learning process and optimal learning outcomes. One of the competencies that a teacher needs to have in carrying out his duties is developing teaching materials. The development of teaching materials is important for teachers so that learning is more effective, efficient, and not confusing from the competencies they want to achieve.

The competence to develop teaching materials should ideally have been well mastered by teachers, but in reality there are still many teachers who have not mastered them, teachers still experience difficulties in compiling teaching materials that are in accordance with learning objectives so that in carrying out the learning process there are still many conventional ones. The influence of this conventional learning includes more dominant teacher activity and conversely students are less active because they are more likely to be listeners.

This is reinforced by data from the identification of aspects of the implementation of the SMP/MTs PUSKUR teaching and learning activities, which state that the learning methods in the classroom are less varied, teachers tend to always use the lecture method (Nasional, 2007). Relying on the teaching and learning process on the teacher causes a lack of growth in the development of

an attitude of independent learning in students (Arriany, 2020). Learning should be currently developed so that it is student-centered or student-centered which involves student activity and directs students to explore the potential that exists within them (Herawati, 2018).

To overcome this problem, it is necessary to improve the learning design, especially the improvement of the teaching materials used. One of them is by making teaching materials of their own design. Teaching materials are one of the supports to achieve learning objectives. Teaching materials can be interpreted as materials or subject matter that are arranged in a complete and systematic manner based on the learning principles used by teachers and students in the learning process. Teaching materials are systematic, meaning they are arranged sequentially to make it easier for students to learn. During the learning process, of course students need interesting teaching materials as a tool used as a source of learning information so that it is necessary to develop teaching materials with interesting innovations so that students are enthusiastic and happy to learn (Ula, 2018).

Therefore teaching materials are very important to be developed as an effort to improve the quality of learning. Teaching materials basically have a role, both for teachers, students, and in learning activities. According to Widodo in Magdalena states that teaching materials are a set of learning tools or tools that contain learning materials, methods, limitations, and ways of evaluating that are designed systematically and attractively in order to achieve the expected goals, namely achieving competence and subcompetence with all its complexity (Magdalena et al., 2020).

Therefore, the development of teaching materials is important for teachers to improve the quality and efficiency of learning. The developed teaching materials have an important role for both teachers and students. Teaching materials in general are basically all materials (whether information, tools, or text) that are systematically arranged to present a full figure of the competencies that will be mastered by students and used in the learning process with the aim of planning and reviewing the implementation of learning. For example: textbooks,

modules, *handout*, worksheets, models or mockups, audio teaching materials, and interactive teaching materials (Prastowo, 2014).

Competence in developing teaching materials, especially modules, needs to be owned by teachers, considering that teaching materials will make the learning process more effective and efficient. The reason for the researcher choosing modules to be developed rather than student books/textbooks based on Rosidah (in Handayani) states the differences between textbooks/modules and textbooks include "raising interest in reading; written and designed for students, communicative writing style, arranged based on flexible learning patterns" (Handayani, 2015). In line with that, Mudarwan stated that the differences between textbooks and modules are not only in format, layout and appearance, but also in the orientation and approach used in preparation (Sari et al., 2021).

The development of teaching materials in the form of modules must be implemented in daily learning practices in educational units. However, daily learning practices in schools are still experiencing various problems with regard to the learning devices used to operate the course of learning.

The problems of learning tools used by teachers in schools are (1) many indicators and learning objectives formulated by teachers still tend to have low cognitive, affective, and psychomotor abilities, (2) teaching materials used by teachers still tend to be cognitiveistic, (3) utilization of resources and media that are still lacking, (4) conventional learning models that are widely applied by teachers so that they do not trigger student activity, and (5) process assessment is also not running optimally due to limited ability to develop assessment instruments" (Akbar, 2013).

The results of monitoring and interviews with 5 mathematics teachers as well as questions and answers with several students assisted by these teachers obtained data regarding the completeness of teaching materials in learning, namely the completeness of printed teaching materials, 5 teachers of SMP Negeri 8 Padangsidimpuan it can be concluded that the completeness of teaching materials for teachers should have been fulfilled, it's just not optimal. Learning Implementation Plans (RPP) are designed only once a year for learning for a year

which has implications for the use of a learning approach that is repeated without regard to the educational demands and characteristics of students.

Teachers also tend to use textbooks from publishers as the only source of learning in class and have not developed and used LKS (Student Activity Sheets) optimally. None of the teachers developed and used mathematics modules in learning. In addition, several teachers at SMP Negeri 8 Padangsidimpuan said that students' abilities and speed in understanding the material presented varied. The learning motivation of students in class VII is low. This is evidenced by the students who passed the KKM (Minimum Completeness Criteria) only around 10 people out of 28 people in one class. Of the 10 existing VII grades, only 1 class had the motivation to learn. In addition to teaching materials, approaches also need to be carried out by the teacher in delivering learning material. A learner-centered learning approach and actively involving students will make learning more meaningful (Putri, 2023).

Based on the analysis of the characteristics of students who are passive, student learning outcomes are low, there must be improvement in learning in order to overcome the passive attitude of students by making modules that are combined with learning approaches that suit the needs of students so that learning is more meaningful (*meaningfull*).

An effective and good learning approach to use in the process learning mathematics quite a lot. However, if you want to develop mathematics learning that emphasizes cognitive, affective, and psychomotor aspects, one of the learning approaches that can be used is a scientific learning approach. A scientific learning approach can be applied to learning mathematics to improve intellectual abilities, especially students' higher order thinking skills.

According to Gagne, by developing science skills children will be made creative, and able to learn science at a higher level in a shorter time. By using acquired processing skills, students will be able to find and develop their own facts and concepts as well as grow and develop their own facts and concepts as well as grow and develop attitudes and values (Sujarwanta, 2012).

Science learning objectives will be achieved if there is successful assessment of cognitive, affective, and psychomotor aspects. Cognitive aspects are matters relating to knowledge, understanding, and intellectual skills, affective aspects are closely related to attitudes and emotions, and psychomotor aspects are related to skills. These three aspects are in line with the nature of science which must be reviewed in terms of products, processes, and scientific attitudes. Mastery of these aspects in students can be seen from the learning outcomes.

Scientific method it has the characteristic *doing science*". This method makes it easier for teachers or curriculum developers to improve the learning process, namely by breaking down the process into detailed steps or stages that contain instructions for the rest of carrying out learning activities (PSIKOMOTORIK, n.d.).

The scientific approach in learning as intended includes observing, asking, reasoning, trying, forming networks for all subjects. Implementation of the 2013 Curriculum in learning with a scientific approach is a learning process designed in such a way that students actively construct concepts, laws or principles through the stages of observing (to identify or find problems), formulate problems, propose or formulate hypotheses, collect data by various techniques, analyze data, draw conclusions and communicate the "found" concepts, laws or principles (Hosnan, 2014).

Modules are teaching materials that are systematically and interestingly arranged which include material content, methods, and evaluations that can be used independently. The same thing was expressed by Robinson, J, W, and Crittenden, W, B, that what is said with the module is "*it's a packet of teaching materials consisting of behavioral objectives, a sequence of learning activities, and provisions for evaluation*" (Robinson Jr & Crittenden, 1972).

The module is basically a printed teaching material that is arranged systematically using language that is easily understood by students according to their level of knowledge and age so that they can study independently with minimal assistance or guidance from the teacher or without the teacher present. Then with modules, students can also measure their own level of mastery of the

material discussed in each one module unit so that if they have mastered it, they can continue on to the next level module unit (Al Azka et al., 2019). And conversely, if students are not able, they will be asked to repeat and study again. Meanwhile, to assess whether or not a module is good or meaningful is determined by whether or not the module is used by students in learning activities. Teaching materials are all forms of materials used to assist educators or instructors in carrying out teaching and learning activities in class (Gilis, 2019).

The availability of modules can assist students in obtaining information about learning materials. In addition, students can develop optimally according to differences in ability, potential and learning speed of each. Students can adjust to the unique way of learning each. In terms of learning theory, this module teaching system opens more possibilities or opportunities in the use of various ways of learning (*multi-method*) and various media (*multi-media*), so that individual differences and uniqueness, for example differences in responding can be served.

Develop teaching tools that can be used both in online and face-to-face learning, so that they can help students better understand mathematical material independently or in groups easily, and are able to improve their learning abilities, this is part of innovation implemented in a mathematical connection (Hamidah, 2022).

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The advantage gained from learning by implementing modules is to foster student learning motivation because it makes it easier to obtain learning

information, students can find out which parts of the material module have been successful and which parts of the material they have not succeeded in, and obtain more in-depth subject matter. In turn, their learning outcomes can be improved as optimally as possible in terms of quality and quantity.

RESEARCH METHODS

Types of research

This type of research is development research using the Thiagarajan, Semmel and Semmel learning device development model, namely the 4-D model (define, design, develop, disseminate) which has been modified. The learning tools that will be developed in this study include mathematics modules based on a scientific learning approach, Learning Implementation Plans (RPP), Student Activity Sheets (LKS). In addition, research instruments were also developed which consisted of: student math results test sheets, student activity observation sheets, learning management observation sheets, student response sheets, and learning device validation sheets.

Research subject

The trial was carried out in class VII SMP in the even semester of the 2022/2023 academic year by selecting one class as the research subject, namely class VII-4 with a total of 28 students.

Field Trial Design

The trial design that will be used in the development of learning tools is to conduct field trials twice. The first field trial was conducted to see whether the learning tools that had been previously developed were effective or not. If in the first trial, the learning device has not been categorized as effective, then a revision of the device is carried out which is then carried out in a second field trial. on the second trial.

Development of Research Instruments

1. Learning Outcome Test

The learning outcomes test instrument is used to assess the quality of student learning outcomes after completing learning with four learning implementation plans (RPP). THB with social arithmetic material in the form of an essay test. THB was developed by researchers with reference to indicators of learning outcomes that have been formulated.

2. Observation Sheet

To determine the quality of the process, observations were made on: student activity, the teacher's ability to manage learning, and student responses. This observation was carried out using an observation sheet. Each of these observation sheets will be explained one by one as follows:

(a) Student Activity Observation Sheet

This instrument is used to obtain data about student activities during learning by using learning tools made through a scientific learning approach.

(b) Observation sheet of the teacher's ability to manage learning

This instrument is used to obtain data about the teacher's ability to implement learning activities using learning tools through a scientific learning approach. Observations were made during the learning process (from the beginning of learning to the end of learning) and observations were made by 2 observers.

(c) Student Response Questionnaire

Student response questionnaires are used to measure students' opinions of current (new/not new), and preferences (happy/unsatisfied) regarding learning devices through a scientific learning approach.

3. Validation Sheet

This instrument is used to obtain data regarding the opinions of experts (validators) on the learning tools that have been compiled, so that they become a reference or guideline in revising the learning tools.

RESULTS AND DISCUSSION

Based on the results of the analysis and discussion in this study, the results are presented as follows:

The learning tools developed include: math modules, lesson plans, and student activity sheets that have been tested and found to be effective. This is because the learning tools that have been developed meet the effectiveness criteria previously described. Following are the results of the effectiveness of learning devices analyzed based on the criteria; The level of the teacher's ability to manage learning using learning tools based on a scientific learning approach can already be said to be effective, because the average teacher's ability to manage learning has reached the minimum criteria, namely the good category.

a. Student activities during the learning process using learning tools based on a scientific learning approach are already in the criteria for limiting the effectiveness of learning.
b. Student responses to components of learning tools based on scientific learning approaches and the learning process have reached the practical category, which is equal to 3.31.

The conclusion of the results of students' mathematics learning tests in the first and second field trials, namely: the level of completeness of students' mathematics learning outcomes using learning tools based on a scientific learning approach, namely classically, is 85.71%. The following explanation is

1. Effectiveness of Learning Devices

Learning devices are said to be effective, if they meet the following indicators: classical student learning outcomes, the teacher's ability to manage learning, student activity.

a. Completeness of Student Learning Outcomes

In the first field trial the students' mathematics learning achievement test results were still below 85%. Whereas in the second field trial, completeness had reached the classical completeness criteria of 85.71%.

b. Teacher Ability to Manage Learning

The teacher's ability to manage learning is said to be effective if it is in the good category. In the first field trial, the teacher's ability to manage learning was still in the fairly good category, so revisions and a second field trial were needed. In the second field trial, the teacher's ability to manage learning was in the good category. To see the effectiveness of the teacher's ability to manage learning, researchers made observations during the research process.

c. Student Activity

Student activity was measured by observing several students who already represented high, medium and low student groups. Observation of student activity was carried out during the research process. In the first and second field trials, student activities were already in the minimal category of the effectiveness of student activities.

2. Practicality of Learning Devices

The learning device is said to be practical if the student's response reaches the practical category. Student responses can be measured using student questionnaire sheets. Student responses are related to their interest in the learning tools that have been developed and how the teacher manages learning. Giving student response sheets is done at the end of the learning process in each meeting. In the first field trial, student responses were still in the not practical category while in the second field trial, student responses had reached the practical category of 3.31. The image below is the cover of the module that has been developed.

Figure 1. Cover of the Scientific Approach Learning Module

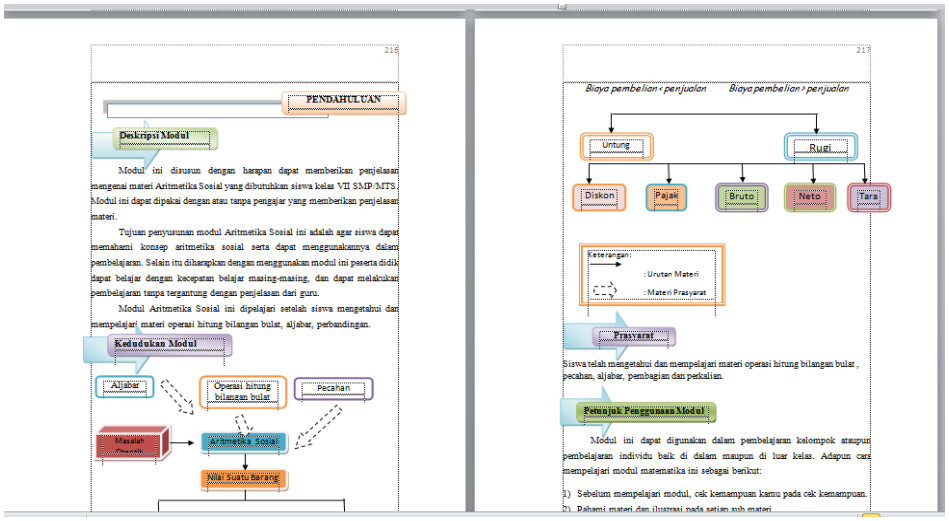

Figure 2. Cover the introductory part of the module

After going through the revision process of self-evaluation, expert review, small group evaluation, application of learning tools based on a scientific approach using modules to facilitate and maximize student learning outcomes in absorbing arithmetic material in the form of lesson plans and modules, it has been practically seen from student responses that have reached the practical category, namely of 3.31, the learning modules and devices are said to be practical. As an example of activities in the module presented in Figure 3 as follows:

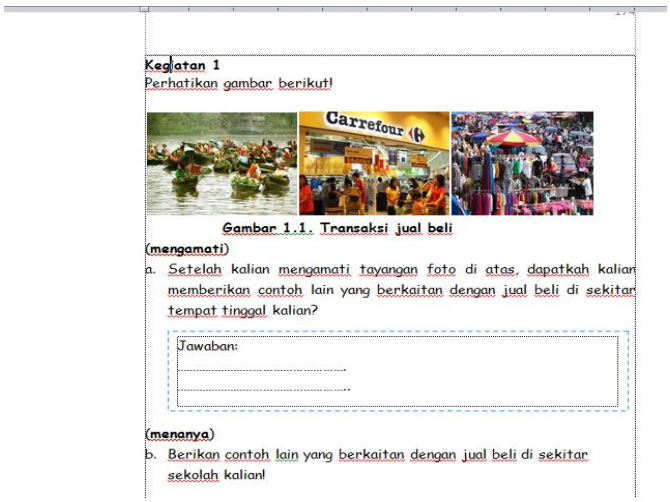

Figure 3. Modules with Learning Activity Steps Based on a Scientific Approach

From the activities above, we can get that the activities in the module always contain indicators of a scientific learning approach that are linked to arithmetic material in class VII. This is packaged in activities based on a scientific approach. For this reason, it is hoped that modules designed in this way can achieve complete learning outcomes.

CONCLUSION

The product validity of developing a mathematics module based on a scientific learning approach is included in the valid category. Modules and learning tools are declared valid by the validator team. The effectiveness of the product of developing a mathematics module based on scientific learning approach meets the criteria of effectiveness based on: The completeness of student learning outcomes using a mathematics module based on a classical scientific learning approach is 85.71%. The level of active activity of students using mathematics modules based on a scientific learning approach has met the specified ideal time tolerance criteria. The level of the teacher's ability to manage learning using mathematics modules based on a scientific learning approach has achieved good criteria.

The practicality of the mathematics module based on a scientific learning approach has met the practical criteria, as can be seen from the student responses that have reached the practical category, which is equal to 3.31, so the modules and learning tools are said to be practical.

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