

Development of a math puzzle module to increase students' interest in learning and understanding of mathematical concepts

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Abstract. The learning process can run effectively and efficiently if you use teaching materials that suit the needs of students. This research is to develop teaching materials, namely a mathematics module equipped with crossword puzzles and concept maps that will be filled in by the students themselves as an illustration of the students' conceptual understanding of what they are learning. The method used consists of five stages, including; (1) research and information collecting, (2) planning, (3) develop preliminary form of product, (4) main product revision, (5) main field testing. The results of the analysis of the validation sheet obtained an average value of 75.25% of media experts and 86.85% of material experts. The result of the highest student interest in learning is 70% for the use of the math puzzle module. The results of understanding the concept can be seen from the N-gain value obtained by 42%. Based on these results it can be said that the math puzzle module is suitable for use as a medium for learning mathematics.

Introduction

Modules are teaching materials that are systematically designed based on a certain curriculum and are packaged in the smallest learning unit and allow them to be studied independently in a certain time unit so that students master the competencies being taught [1]. The learning module is the smallest unit of teaching and learning program, which is studied by students themselves individually or taught by students to themselves [2,3].

Modules are a way of organizing subject matter that takes into account the function of education [4]. The strategy of organizing learning materials contains sequencing which refers to making a sequence of presentation of subject matter, and synthesizing which refers to an effort to show students the relationship between facts, concepts, procedures and principles contained in the learning material [5].

The principle of learning objectives is for students to successfully master the learning material according to predetermined indicators [6]. This is because in the class there are students with different abilities, it is necessary to organize the material, so that all students can achieve and master the subject matter according to the objectives set within the time provided [7]. In addition to organizing learning materials, it is also necessary to pay attention to teaching methods that are tailored to the individual person [8]. The form of implementing this teaching method is to divide learning materials into learning units, each of which includes one or more subjects [9]. The parts of the learning material are called modules [10].

The learning module is one of the learning materials that students can use independently [11]. A good module must be structured in a systematic, attractive, and clear manner [12]. Modules can be used anytime and anywhere according to student needs [13]. Modules are teaching materials arranged

systematically and attractively which include material content, methods and evaluations that can be used independently to achieve the expected competencies with the following characteristics of the learning module: 1) Self instructional, students are able to teach themselves, independent of parties other; 2) Self contained, all learning material from one unit of competence that is learned is contained in one intact module; 3) Stand alone, the developed module does not depend on other media or does not have to be used together with other media; 4) Adaptive, the module should have high adaptive power to the development of science and technology; 5) User friendly, the module should also meet the rules of being friendly / familiar with the wearer; 6) Consistency, consistency in the use of fonts, spacing and layout [14–16].

Based on some of the definitions of the module above, it can be concluded that the learning module is a form of teaching material that is packaged systematically and attractively so that it is easy to learn independently. The use of modules as learning facilities or resources has been widely applied and developed, with the aim of a) shortening the time needed by students to master the lesson task; and b) to provide as much time as is required by the student within the limits possible for carrying out an orderly education [17–19].

Modules can be studied anywhere. The length of time a module is used is not certain, although in the module packaging it also states the time it takes to learn certain materials [20,21]. The freedom for students to manage the time is very flexible, can be several minutes or several hours, and can be done separately or given variations with other methods [22]. The benefit of the crossword puzzle module is that it increases the activity and learning outcomes of students because in completing crossword puzzles, a clear, relaxed and calm mind condition will make the brain's memory stronger, so that memory is also increased [23]. Therefore, a teacher must be able to prepare appropriate teaching materials in every learning activity in class. Improving the quality of the learning process can be done by making learning innovations through learning media [24]. The success of the learning process can be seen from the level of student achievement which can be measured from the aspect of understanding students' mathematical concepts [25].

Understanding mathematical concepts is one of the important goals in learning mathematics [26]. This gives an understanding that the material taught to students is not just memorizing or remembering the concept being learned but is able to restate a concept that has been learned. With understanding, students can better understand the concept of the subject matter itself. Understanding the concept is also a very important aspect of learning, because by understanding the concept students can develop their abilities in any subject matter [27].

Understanding the concept is the main basis in learning mathematics [28]. Learning mathematics requires an understanding of concepts, these concepts will give birth to theorems or formulas. In order for concepts and theorems to be applied to other situations, it is necessary to have skills in using these concepts and theorems. Therefore, mathematics learning must be emphasized towards understanding the concept [29].

Based on the description above, it can be concluded that conceptual understanding is the ability to interpret, estimate, understand and understand material concepts after being studied, as well as being able to grasp the meaning of the material that has been studied. Thus students have the ability to translate, interpret, and conclude a mathematical concept based on the formation of their own knowledge, not the result of memorizing [30].

From this description, it can be understood that the ability to understand mathematical concepts wants students to be able to use or apply what they have understood into learning activities. If students already have a good understanding, then the student is ready to give definite answers to statements or problems in learning. As for several indicators that show understanding of the concept, among others (1) The ability of students to re-express what has been communicated to him. (2) The student's ability to classify an object according to its type based on the properties contained in the material. (3) The ability of students to be able to distinguish between examples and not examples of material. (4) The ability of students to assess which requirements are necessary and which are sufficient conditions related to a material concept [31–33].

Experimental Method

This research is a Research and Development (R&D) research in the form of a research procedure carried out by creating a certain product and testing the effectiveness of the product. This study was designed using 5 development steps. The following research design is shown in Figure 1 below [34].

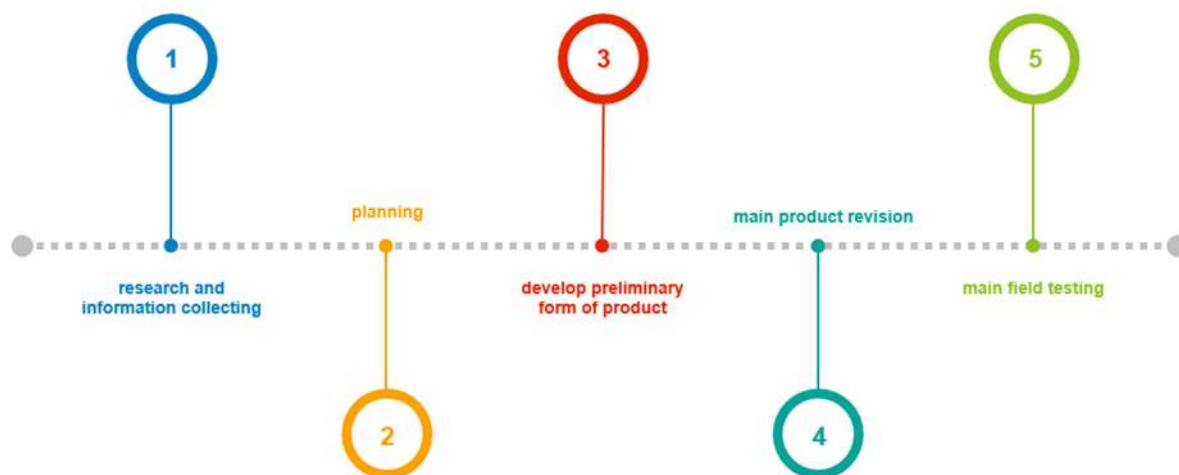


Figure 1. Research method

The sample in this study were 10 male students and 10 female students who were at Madrasah Tsanawiyah Darul Irfan, Serang-Banten Indonesia. The instruments used were validated first by media experts and material experts. The validation used for media experts was a questionnaire consisting of 32 statements. Validation for material experts using a questionnaire consisting of 30 statements.

Data collection techniques were carried out by tests and questionnaires. The test instrument used was in the form of pre-test and post-test to determine students' understanding of the concept of learning mathematics by using a mathematics module that had been made by the researcher. Meanwhile, the interest in learning questionnaire is used to measure students' interest in learning after learning that has been done by researchers.

Result and Discussion

3.1 Research and information collecting

At this stage, conducting interviews with math teachers at MTs schools. Darul Irfan class IX. The results of the interview were based on the results of the students' daily tests, which according to the teacher, that many students still lacked understanding of mathematical concepts so that during daily tests students could not do the questions well. To find out students' interest in learning before the research was conducted, interviews were conducted with class IX B students at MTs schools. Darul Irfan. Based on the results of the interview, the dominant students felt boredom in learning mathematics so that many students did not like learning mathematics.

3.2 Planning

The planning stage is the researcher analyzes the material concepts used by the developer in the module. Students generally do not like mathematics because they do not understand the concepts of the material. As a result, students consider mathematics to be one of the difficult subjects and students' lack of interest in mathematics. Therefore, the researcher provides an alternative by developing a mathematics learning module equipped with crossword puzzles and concept maps as teaching materials that will be used in learning activities.

The module also contains (1) the teacher's guide, which contains instructions for the teacher to teach efficiently and provides an explanation of the types of activities that must be carried out by students, time to complete the module, learning tools that must be used and evaluation clues. (2) Student activity sheets, containing lessons that must be mastered by students, the composition of the material in

accordance with the instructional objectives to be achieved. Arranged step by step to make it easier for students to learn. (3) The work sheet functions to evaluate or correct the results of student work by themselves, if there are mistakes in the process, students can review their work again. (4) The test sheet is an evaluation tool for pursuing success that has been formulated in the module. (5) The key to the success of the test is a means of correcting the assessment that will be carried out by the students themselves.

3.3 Develop preliminary form of product

The module design is designed as attractive as possible so that students' interest in learning arises a sense of curiosity about the contents of the module. Therefore, the cover module, the first page of each chapter and the paper color for each chapter are specially designed. The content of the module is designed with the type of explanation of mathematical concepts using discovery techniques. In the first discussion, students are given examples of questions about problems in everyday life so that students can easily understand mathematical concepts. In the concept map design, the researcher made it only with the guide to making a concept map of a material, students who would fill in the concept map after studying the previous material landed from the concept map students' understanding of concepts could be described.

The math puzzle module developed is a math module for grade IX students on the material of congruence and congruence, building curved side spaces, statistics and opportunities developed with crossword puzzles and concept maps that students complete themselves as an exercise in understanding the concept. The module design is designed as attractive as possible on the first page of each chapter, namely with cartoon dialogues whose aim is to attract students' interest and the color of the paper used in each chapter is different. In the practice questions in the form of crossword puzzles in the form of questions of understanding mathematical concepts.

3.4 Main product revision

At this stage it is made validated by material experts and instructional media experts. An expert who validates is someone who has at least 5 years of experience in their respective fields. Figure 2 below shows the results of product validation for the math puzzle module.

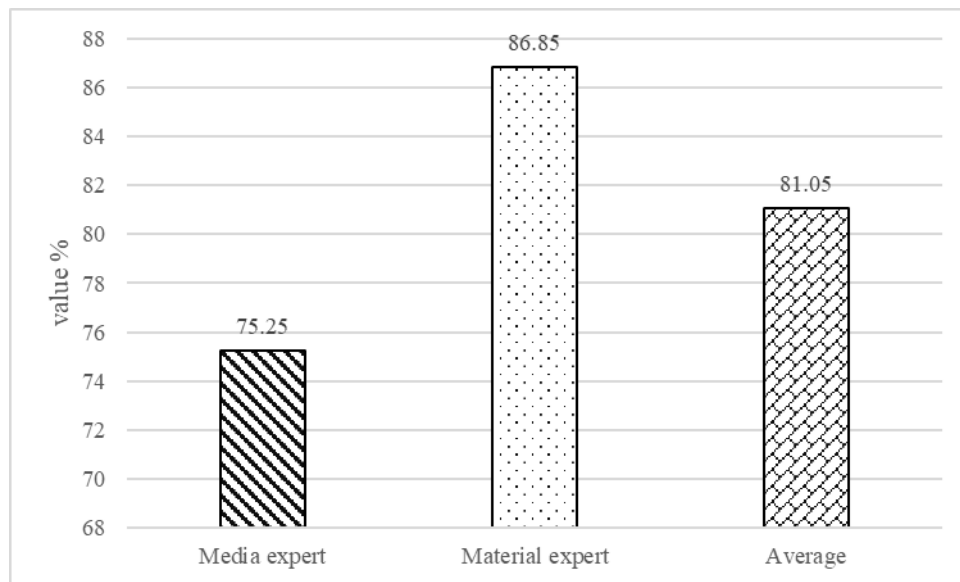


Figure 2. Result validation expert

3.5 Main field testing

The results of the student interest test on the use of the math puzzle module can be seen in Figure 3 below.

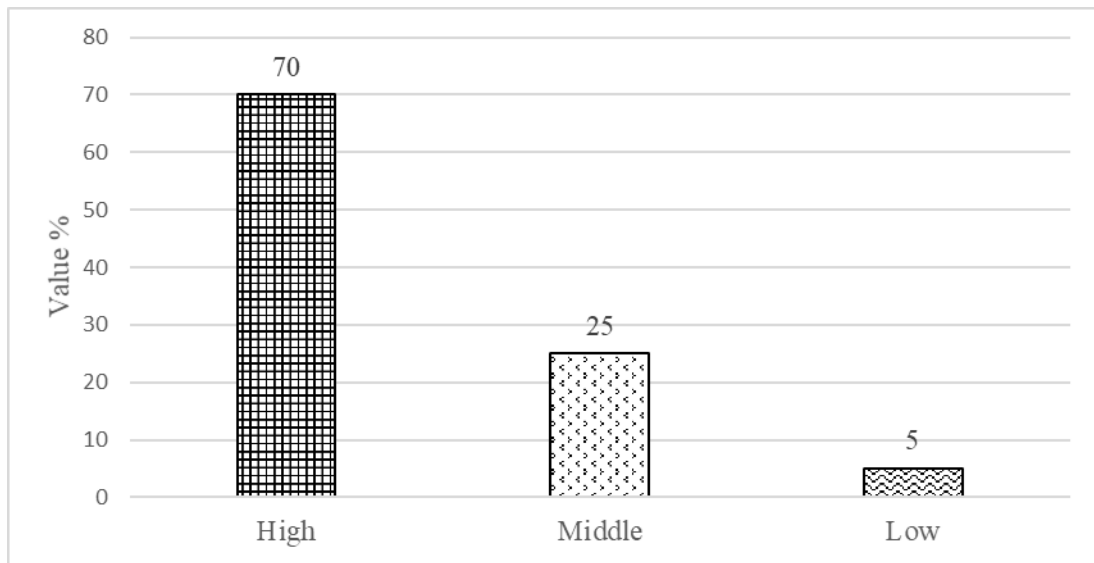


Figure 3. . Results of student interest in learning

Based on these results, the math puzzle module can increase students' interest in learning. Furthermore, the results of the effectiveness test on the use of the math puzzle module by looking at the changes in the n-gain value. These results are learning outcomes in the aspect of conceptual understanding. Figure 4 below shows the change in value due to the use of the math puzzle module.

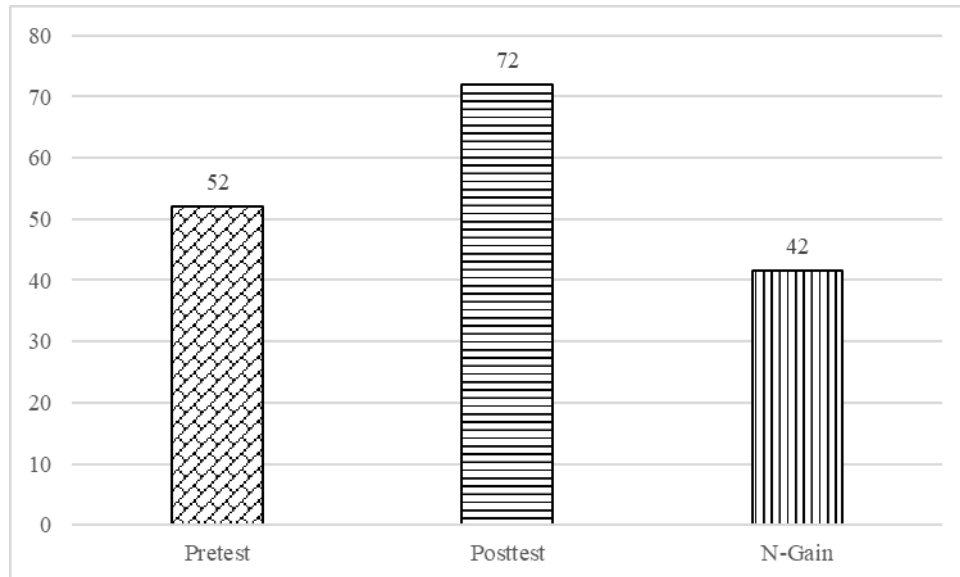


Figure 4. N-gain concept ability mathematics

The results of the data analysis showed that there was a difference between the pretest and posttest scores. The n-gain result gets a value of 42% so it is in the good category. This means that the use of mathematical puzzle modules can improve understanding of mathematical concepts, in this case, especially the materials of congruence and congruence. This happens because the use of the math puzzle module will increase students' interest in learning.

During the learning process using the math puzzle module, the teacher serves to help student learning. The learning process occurs depending on the student's own personality, because this math puzzle

module has presented a number of knowledge that must be learned by students. If students have high interest in learning, learning can be completed quickly without having to wait for students who learn slowly, likewise those who are slow will not feel rushed by students who are fast learning, so it is hoped that the learning process is in demand by students and students do not feel bored [35,36].

Conclusion

The use of math puzzle modules on similarity and congruence material at MTs Darul Irfan class IX, Serang Banten Indonesia received a good response, based on the results of learning interest and the results of media experts and material experts with respective scores of 70%, 75.25% and 86.85%. Furthermore, understanding of mathematical concepts is in the good category, based on the 42% n-gain result.

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