Teaching materials of algebraic equation

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Abstract: The purpose of this paper is to know the effectiveness of teaching materials algebraic equation. This type of research used experimental method. The population in this study is all students of mathematics education who take numerical method in sarjanawiyata tamansiswa of university; the sample is taken using cluster random sampling. Instrument used in this research is test and questionnaire. The test is used to know the problem solving ability and achievement, while the questionnaire is used to know the student's response on the teaching materials. Data Analysis technique of quantitative used Wilcoxon test, while the qualitative data used grounded theory. Based on the results of the test can be concluded that the development of teaching materials can improve the ability to solve problems and achievement.

1. Introduction

One of the reasons for the low students’ achievement caused by the less ability in solving math. It can be shown that learners to solve math problems steps used to solve problems are incomplete/uncompleted and unsystematic, usually students simply write down the steps to implement the plan while the step of understanding, planning and looking back answers rarely written [1]. Though Ability to solve the problem is a basic ability of a person in solving a problem that involves critical thinking, logical, systematic, formulate concepts and capital success for students in solving mathematical problems, develop their ideas, and prepare yourself to face a problem in daily life –day

To solve a mathematical problem requires a systematic way or steps to make the process of solving the problem become easy and focused. One way to solve the problem is from Polya principle ie understand the problem, devise a plan make a plan, carry out our plan, and look back at the completed solution [2]. The Understand the problem stage refers to an understanding of what is known, what is asked, or whether sufficient, insufficient, exaggerated or contradictory conditions to seek out are asked [2-4]. In the make a plan stage or make a plan refers to how the related settlement strategy. A problem cannot be solved properly without good planning [4, 5]. The planning to solve the problem depends largely on the creative experience of students in making the settlement of a problem, the more varied their experience, the more creative the students tend to be in developing the problem solving plan [6]. At the stage of making plans, students can formulate mathematical problems or develop mathematical models, implement strategies to solve problems, find connections between concepts or theories that support each other and look for the formulas needed to solve problems, in addition students need to know first some math problem solving strategies to solve the problem can be done more
effectively [2], students can take Polya's heuristics to see if, by modifying the conditions in the problem, new, more accessible problems may lead to which can be used as a springboard to break the original [5].

Carry out our plan stage, which referred to this stage is students are ready to do the calculation with all kinds of necessary data including the concepts and formulas or equations as appropriate [2, 4, 5]. Students will examine each of the steps outlined in the plan and write in detail to make sure each step is correct, the student must be able to form a more standard problematic system, in the sense that the formulas to be used are ready-to-use formulas according to what is used in the matter. In the last stage of the look back at the completed solution, the student will look back at the answer to make sure that the answer to the problem is correct. This step is important to check whether the results obtained are in accordance with the provisions and there is no contradiction to the question [1, 2, 4, 5].

In solving the problem, learners sometimes do not write down what is known and asked of the problem faced. So educators are difficult to guess, whether these learners have understood the problems faced or not. If the educator states that the learner has not understood the problem, the learner is able to solve the problem correctly. But if the educator declares that the learner understands the problem, the learner has not written down what is known and what is being asked. This implies that there are student habits such as not writing down what is known and what is being asked in understanding the problem. In addition, learners are sometimes unable to tell what steps to take to resolve the problem. Learners do not understand the steps to be taken to plan to solve the problem. Sufficient requirement and sufficient conditions in resolving already can illustrate the plan is sometimes not done by the investigators. In the step of re-examining the answers, learners almost entirely do not perform the process. Learners assume that this step makes the time to solve the problem is wasting time. At the re-examination stage is the lowest-weighted stage in the classification of thinking levels, so most learners do not perform the check-back stage in solving the problem [7].

Teaching materials have a very important position in learning, namely as a representation of the explanation of educators in front of the class [8]. On the other hand, teaching materials are positioned as tools or means to achieve competence [9]. So the preparation of teaching materials should be guided Competence to be achieved. Teaching materials are prepared without a guided competence, certainly will not provide many benefits to learners. The making of teaching materials is part of the innovation development process in education. The teaching materials used should not always be conventional but as educators, at least take action to improve the paradigm, perspective, thinking, attitudes, habits, professionalism, and behavior in teaching. Such as the development of teaching materials CELMI (Cellular Explorer Learning Movie Instruction) is a mobile-based learning media, where the development of this media is background by the misuse of the mobile telephone which is increasingly rampant done by students [10]. Thus the educators provide innovation in making teaching materials because it will impact on the smooth activities of learning students so as not to tend to feel bored.

Along with the increasingly modern education system and the growing demands, not infrequently schools still use conventional ways in implementing the learning process. Learning in a conventional way is usually done in solitary, meaning that the learning process that starts from planning, implementation, to the evaluation of student learning done by one teacher [11]. Planning is done by the teacher is usually in the form of preparing books or materials that almost the same as the previous year. This is can be showed by lesson plan that will be used during the learning process are still the same as in previous years and teachers do not have the motivation to prepare a good lesson plan so that in the preparation the lesson plan is not serious [12]. Whereas the preparation of lesson plan should at least adjust the characteristics of learners. So if the teacher is still using the same RPP with previous years then the teacher is indirectly learners are considered the same characteristics, whereas humans born into the world have unique differences [11].

There are several weakness of mathematics learning in Indonesian schools. The first is the low ability of teachers to use varied teaching methods. The second is the teaching ability of teachers only limited to answer the questions. The third is the teacher does not want to change the learning that is already considered correct and effective. And the last is teacher uses only conventional learning regardless the thinking aspect of learners [13].

To produce an active, easy to understand, and fun learning for the students, a learning model is needed that enables students to participate actively in the learning process, a learning process that enables students to participate actively during the learning process and interested students can be created by learning using the
device [14]. One of the learning tools are that often used during the learning process such as teaching materials or textbooks.

Based on the result of previous research, it is found that the result of the validation test of algebra equation obtained by the average of 4.38 with very good category [11], the result of the validation is necessary to conduct experimental research or limited research in order to know the effectiveness of teaching materials equation algebra that has been developed. Based on these problems, the purpose of this article is to find out the material algebraic equations that have been developed to improve the ability to solve problems and learning achievements.

2. Method

The method used in this research is experimental research model, as a follow-up research from RND in the previous year. Population is the whole subject of research [15], so the population in this study is all students of mathematics education who take numerical method in sarjanawiyata tamansiswa of university. The sampling technique used in this study is simple random, where the opportunity to take students who take the courses of numerical methods as research samples are the same. Of the students who took the numerical method taken as many as 58 students who are used as research samples.

The instrument used in this study is test. The test is used to obtain data about the ability to solve problems and learning achievement. Scoring capability problem solving refers to predetermined indicators that students can understand the problem, students can plan to solve problems, students can implement plans to solve problems, and students do the examination of the answers to the matter [16, 17]. The type of evaluation is described in table 1, and scoring learning achievement refers to the predefined ideal answer model.

| Polya Principle         | Score | Indicators                                                                 |
|-------------------------|-------|-----------------------------------------------------------------------------|
| Understand the problem  | 0     | Student does not write anything so the student does not understand the       |
|                         | 1     | Student writes the data/concept/knowledge that is not related to the        |
|                         | 2     | Student only write or reveal what is known or what is asked only            |
|                         | 3     | Student is able to write down or reveal what is known and asked of the      |
| Devise a plan           | 0     | Students do not tell or write steps to solve the problem                    |
| make a plan             | 1     | Students tell or write steps to solve the problem but not coherent          |
|                         | 2     | Students write down sufficient terms and conditions necessary or            |
|                         | 0     | Students are not able to implement the plan that has been made,             |
|                         | 1     | Students implement the plan that has been made, but the error of the        |
|                         | 2     | Students implemented the plan that has been made, but there are            |
|                         | 3     | Students do the plan that has been made, using the correct troubleshooting |
|                         | 4     | Students do the plan that has been made, using the steps to solve the      |
| Look back at the completed solution | 0 | Student does not conduct a re-examination of the answers,                |
|                         | 1     | Student re-examines the answers.                                          |
To test the proposed hypothesis using non-parametric test statistic with Wilcoxon test. The hypothesis proposed in this study is that there is an increase in learning achievement and problem-solving skills in the students after using algebra equation development result materials.

3. Result and discussion

3.1. Result

The result of previous research is obtained that the average of validation result of teaching material is 4.38 with very good category, so that the developed teaching material needs to be tested [11]. Then next learning materials development result is called algebraic equation.

| Problem-solving skills | Achievement |
|------------------------|-------------|
| Man-Whitney U          | 569.000     |
| Wilcoxon W             | 2280.000    |
| Z                      | -6.159      |
| Asymp. Sig             | 0.000       |

Based on the result of statistical calculation (Table 2), there are two findings. The first is about student achievement on algebraic equation it is found that Mann-Whitney U is 1285.000; Wilcoxon W of 2996.000; $Z_{obs}$ of -2.194 with a significance of 0.028. Based on these results it can be decided that there are differences in student achievement on algebraic equation before and after using the development result of teaching materials. The second is about students' ability to solve algebraic equations, Mann-Whitney U is 569.000; Wilcoxon W for 2280.000; $Z_{obs}$ of -6.112 with a significance of 0.000. Based on these results it can be decided that there are differences in the ability of students in solving algebraic equation problems before and after using the development result of teaching materials.

Table 3. Descriptive statistic

| Problem solving skills | Minimum | Maximum | Mean  | Variance |
|------------------------|---------|---------|-------|----------|
| Before                 | 10      | 32      | 21.97 | 24.74    |
| After                  | 21      | 35      | 27.84 | 12.27    |
| Achievement            |         |         |       |          |
| Before                 | 22      | 80      | 58.52 | 257.17   |
| After                  | 16      | 100     | 67.48 | 651.38   |

Based on Table 3, there are two conclusions. The first is the average score of student achievement before and after using the teaching materials of the development result, it can be concluded that student achievement after using the better teaching materials when compared before using the materials development results. Based on these results it can be decided that teaching materials algebraic equations of development results can improve student achievement. The second is the average score of students' ability in solving algebraic equation problems before and after using teaching materials of development result, it can be concluded that the ability of students in solving algebraic equation problem after using better teaching materials when compared before using development result material. Based on these results it can be decided that the teaching materials algebraic equations of development results can improve students' ability in solving algebraic equation problems

3.2. Discussion

In learning mathematics, problem solving is an importance thing to be instilled to learners. There are several reasons that problem solving becomes important and becomes one of the basic skills of a
person in solving math problems. First, problem solving cannot be separated in everyday life, with the ability to solve problems that can be used to provide solutions or answers to problems faced more analytical so that someone can be a problem solver. In other words, when students are trained to solve problems, learners will be able to make decisions, because learners have become skilled about how to gather relevant information, analyze information, and be aware of the need to re-examine the results that have been obtained. Second, in mathematics learning, problem solving can be used to formulate concepts, develop ideas or ideas, and capital success for students in solving mathematical problems, because a concept or principle will be meaningful if it can be applied in problem solving. Third, the mathematical standards in schools should include standard content and process standards. Process standards include problem solving, reasoning and verification, interconnection, communication, and representation [18]. Fourth, one of the objectives of learning mathematics in Indonesia is that students are expected to foster critical thinking skills, logical, systematic, accurate, effective, and efficient in solving problems [19]. Achieving or not the purpose of mathematics learning one of them can be seen from the success learners in understanding mathematics and utilizing this understanding to solve mathematical problems as well as other sciences.

Improving the ability to solve problems for learners in learning mathematics is one of the tasks of an educator. One of the factors that influence the ability of learners in solving mathematical problems is the factor from outside the students such as the model of learning used by educators during the learning process. To produce active learning, easy to understand, and fun for students needed a model of learning that makes students actively participate in the learning process, the learning process that makes students actively participate during the learning process and interested students can be created by learning using the learning tools [14].

Students who are interested and actively participate in the learning process leads to better learning achievement when compared with passive learners and not interested in the learning process [11]. At least the learning achievement of learners who are interested and active will increase, when compared with passive learners. This is because learners increasingly understand the concepts of material delivered by educators if the student is not passive in receiving material submitted by the teacher [20].

Achievement and problem solving skills are largely determined by the quality of learning. The quality of learning is determined by the teaching materials used by teachers and learners [21]. Development of teaching materials is one form of learning process activities to improve or improve the quality of ongoing learning. The use of teaching materials in the learning process is one way to overcome the passive learning situation. Learners will be helped in the learning process by using teaching materials, helping educators to reduce material presentation time and increase mentoring time for learners, help educational institutions in completing the curriculum and achieve instructional goals with the time available [22].

The results of previous research indicate that learning tools in the form of teaching materials that have been developed are able to provide potential (positive) impact on the achievement of learning mathematics [23], and positively influence the activity and process skill to learner’s achievement and the influence of activity and process skill together equal to achievement of 39% [13].

Test can be used to evaluate various aspects of teaching. Measurement of the effectiveness of learning should always be associated with the achievement of learning objectives. One of the indicators that can be used to define the effectiveness of learning is the carefulness of behavioral acquisition [24, 25]. Conscientious mastery of learned behavior, also often referred to as a performance error rate, can be used as an indicator to define the effectiveness of learning. The more accurately the students master the learned behavior, the more effective the lesson has been, the smaller the error rate, the more effective the lesson will be.

Referring to that opinion, the effectiveness of learning can be measured by providing a set of tests to learners. The test is used to measure the extent of learners' skills or mastery of the learner's material in understanding mathematics. Because one of the objects of this study is the ability of students in solving problems and achievement of learning, the skills or competencies that must-have is that
students are able to solve or solve mathematical problems faced by learners so that learners have a good learning achievement.

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4. Conclusion
In the previous research it was found that the teaching materials of algebraic equations that have been developed are validated by the experts, while the results of the learning material obtained the average score of 4.38 in the very good category. Based on limited trial, it found that teaching materials of algebraic equations can improve the students’ problem solving ability and learning achievement.

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