DEVELOPMENT OF LEARNING DEVICES MATHEMATICS USES THE TEAMS GAMES TOURNAMENT MODEL TO IMPROVE STUDENTS 'PROBLEM SOLVING AND SELF-EFFICACY ABILITIES

Abdul Rasyid Fadhlan Khair [1], Hamidah Nasution[2], Asmin [3]
[1,2,3] Mathematics Education Program, Postgraduate School, State University of Medan
Jl. Willem Iskandar Pasar V, Medan, Indonesia
Correspondence Email: abdlrasyid57@gmail.com

Abstract

This research is a research on the development of mathematics learning tools with the Teams Games Tournament model to improve students' problem-solving abilities and self-efficacy. The teaching materials were designed so that they meet the valid, practical, and effective criteria. This research was conducted at MTs PAB-1 Helvetia Medan, Indonesia. The first step of this research is to analyze the level of validity, practicality, and effectiveness of learning tools based on realistic approaches assisted by Geogebra in improving students 'mathematical connection skills and students' mathematical creative thinking.

The findings of this study are: (1) RME-based teaching materials have met valid, practical, and effective criteria in improving students' mathematical problem-solving abilities and student self-efficacy, (2) Improved problem solving using the Team Games Tournament model of learning tools that have been developed seen from the N-gain value in the first trial of 0.4 increased to 0.6 in the second trial, (3) Increased student self-efficacy after learning using the Team Games Tournament model of learning tools that have been developed based on the KAM category has increased from Trial I to trial II, in the high group it increased by 95% to 103%, in the moderate group it increased by 71% to 84%. In the low group, 55% increased to 62%. Judging from the average achievement of students' self-efficacy in the first trial of 74.15%, it increased to 84.5% in the second trial.

Keywords: Teams games tournament, mathematical problem solving skills (MCS), self-efficacy, mathematics teaching tools.

1. Introduction

Education is an important field in determining the quality of a nation's education can be received from both the academic environment and society. School is an academic environment for obtaining formal education. Formal education, namely the existence of subjects given at the school and regulated by the curriculum. According to Trianto (2011) that, "education aims to develop the potential of students to become human beings who believe and believe in one God, have a noble character, are healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens".

According to NCTM (2000) "problem solving means moving in a task for which the solution method is not known in advance". Mathematical problem solving ability itself is not only a goal in learning mathematics, but also something that is very meaningful in everyday life (Pinter, 2012), and in the world of work being problem solving ability can provide benefits (NCTM, 2000). Therefore learning must be developed to educate students in order to be aware of and solve the problems they face (Balim, 2009).

In formal education, mathematics is one of the areas studied by students. Mathematics is a language that represents a series of meanings from the statements we want to convey. Students are expected to use mathematics and mathematical thinking patterns in everyday life, and learn various types of science that emphasize logical rules and the ability to apply mathematics (Saragih & Napitupulu, 2015). In other words, students are expected to be able to achieve High Order Thinking Ability or Higher Order Thinking Skills

(HOTS). From the description above, it is clear that mathematics is very important to be studied, cultivated and mastered in the field of education such as in school.

Therefore, mathematics lessons at MTs PAB-1 Helvetia are expected to be studied correctly and precisely in the learning process so that the benefits of mathematics can actually be used and applied in the student's life. According to Ibrahim (Trianto, 2011) the devices used in the learning process are called learning tools. The learning tools needed in managing the teaching and learning process can be in the form of: syllabus, lesson plans (RPP), student worksheets (LKPD), evaluation instruments or learning outcomes tests (THB), teacher books, and student textbooks.

However, in reality designing an ideal, quality and understandable syllabus and lesson plan is not easy. Sometimes the lesson plans that have been designed by the teacher are not in accordance with their implementation in the classroom due to the emergence of unexpected student responses. So the teacher must prepare several possibilities that will occur during the teaching and learning process so that student responses that appear are not neglected, the teacher must be better prepared to deal with all the possibilities that will occur. In addition, the presentation of the LKPD also seemed monotonous, less varied and contained only question material, and the learning outcome tests that were often given by the teacher were not in accordance with the ability to be achieved.

Based on the explanation above, where the learning tools developed were not entirely designed by the teacher but there was interference from other people, so it was often not in accordance with the characteristics of the students as targets. The purpose of developing learning tools is to produce a product that can help students in the learning process in the classroom, where the product can achieve the desired learning goals, especially in improving students' mathematical abilities. Therefore, Nieveen (1999) states that a learning device is said to be good if it meets the quality aspects which include: validity, practicality, and effectiveness.

The development of this learning tool refers to the development research model suggested by Thiagarajan, Semmel and Semmel (Trianto, 2013) which is a 4D model which consists of 4 stages, namely: Define, Design, Develop, and Desseminate. In writing this proposal, the writing will discuss problem-solving abilities and self-efficacy. According to Pamungkas and Masduki (2013) the ability to solve mathematical problems is the ability students must have to be able to understand problems, plan solutions, solve problems, and re-examine the results of a given mathematical problem.

In addition to arranging learning tools properly, things that must be considered to improve students' problem-solving abilities and self-efficacy and reduce the level of difficulty of students in understanding mathematics material is to use a learning device. As stated by Nusantara (2003) that in delivering abstract subject matter, a teacher needs teaching aids or teaching aids to clarify, simplify concepts or even achieve the desired teaching goals. The difficulty of reasoning mathematical material can be simplified by using learning tools.

According to this, Bandura (in Isnaini, 2011) accurate self-assessment is very important, because the right positive feelings about cell-efficacy can enhance achievement, believe in ability. Develops internal motivation, and enables students to reach challenging goals. Self-efficacy can affect mathematics achievement, this is confirmed by the opinion of Bandura, Barbaranelli, Caprara & Pastorelli, 1996; Fast et al, Pajares, 2005 (Dalam Gilar, 2013) "Self-efficacy, a person's belief of their capabalities, has been shown to influence a student's mathematical achievement".

One way to solve the problem is by using an appropriate learning model. One of the learning models used is the Teams Games Tournament (TGT) model. In accordance with the 2013 curriculum that puts forward the Scientific approach where students find mathematical concepts of problems.

Slavin (2005) argues that in TGT teammates will help each other in preparing for the game by studying activity sheets and explaining problems to each other, but when students are playing games, their friends should not help. This is to ensure individual responsibility has occurred. This TGT learning model is expected to create a new atmosphere in learning that is fun and can improve high-level communication skills.

To bridge this, the researcher tries to combine learning tools using the Teams Games Tournament model to improve students' mathematical problem solving skills and Self Efficacy. Based on the description above, the researcher is interested in conducting a research entitled "**Developing Mathematics Learning**

Tools Using Teams Games Tournament Model to Improve Students' Problem Solving Ability and Self-efficacy".

2. Theoretical Framework

the theories that form the basis of this research include problem solving skill, *self efficacy*, model teams games tournament (TGT) learning, and mathematics teaching tools.

2.1 Problem Solving Skill

Problem solving skills are closely related to mathematics achievement, such as the results of the 2003 PISA analysis by Scherer and Beckmann (2014) which states: "math and science competence significantly contributes to problem solving across countries". The quote states that math and science competencies significantly contribute to problem solving in all countries.

Hudojo (2005) states that a mathematical problem is someone who does not have certain rules / laws that can immediately be used to find answers to a mathematical question "

Polya (1973) classifies mathematical problems into two groups, namely: "... problems 'to find' and problems 'to prove'. The aim of a problem to find, is a certain object, the unknown of the problem. The aim of a problem to prove is to show conclusively that a certain clearly stated assertion is true, or else to show that it is false. "This means the problem" to find ": aims to find a particular object that is not known from the problem. Meanwhile, the problem "to prove" aims to decide the truth of a statement, prove it and refute it.

Furthermore, the conditions for a problem for a student are: (1) the question faced by a student must be understood by the student, but the question must be a challenge for him to answer and (2) the question cannot be answered with routine procedures already known to the students.

Based on some expert opinions about the problems that have been stated above, it can be concluded that a mathematical problem is a mathematical question or problem that cannot be solved by a routine procedure that is known to the actor or has no rules that can be used to immediately find a solution to the problem.

The problem arises because of a gap between what is expected and reality, between what is owned and what is needed, between what is known that is related to a particular problem and what one wants to know. Therefore, this gap must be addressed immediately. The process of how to overcome this gap is called problem solving.

Polya (1973) states that problem solving is one of the high-level aspects, as a process of accepting problems and solving them. This is in line with Lestari & Yudhanegara (2015) which states that problem solving ability is the ability to solve routine, non-routine, non-applied, applied non-routine, and non-applied non-routine problems in the field of mathematics.

Students' mathematical problem solving ability can be defined as the student's ability to understand problems, plan problem-solving strategies, carry out the selected solution strategy, and re-examine problem solving to further make solutions in other ways or develop problem solving when students face math problems (Kuzle, 2013; Polya, 1973; Szetela & Nicol, 1992).

2.2 *Self Efficacy*

Mathematics learning plays a role in forming quality Human Resources (HR). Many studies have been conducted and the results show that understanding mathematics does not only depend on cognitive structures, but also on motivational and emotional factors such as beliefs, attitudes, and anxiety. As one aspect of belief that is very important in supporting mathematics learning achievement is self-efficacy.

According to Bandura (2009) self-efficacy is the belief that a person feels about an ability to compose and complete the actions needed to regulate future situations. Individuals with high self-efficacy will choose to do more effort and be more persistent. Self-efficacy has an important role in regulating one's motivation. A person who believes in his abilities has high motivation and strives for success. According to Woolfolk (2009), this self-efficacy arises when students handle challenging and meaningful tasks with the support they need in order to be successful.

2.3 Model Pembelajaran *Teams Games Tournament* (TGT)

Teams games tournament (TGT) type cooperative learning model can be used in a variety of subjects, from the exact sciences, social sciences and languages from basic education (SD, SMP) to higher education. The Teams Games Tournament (TGT) cooperative model does not require special supporting facilities such as special equipment or rooms. Apart from being easy to apply, TGT also involves the activities of all students to obtain the desired results (Trianto, 2010).

This TGT type of cooperative learning model adds a dimension of joy obtained from the use of games. Slavin (2005) states that some teachers choose the TGT cooperative learning model because of the fun and activity factors. Teammates will help each other in preparing for the game by studying the activity sheet and explaining each other's problems, but when students are playing in the game, their friends should not help, ensuring that individual responsibility has occurred.

2.4 Development of Teaching tools

According to Syahrir (2016: 437) learning tools are anything that can enable teachers and students to carry out the learning process according to the curriculum. In line with this opinion, Trianto (2011: 201) states "learning tools are devices used in the learning process". Some of the learning tools needed include lesson plans, syllabus, LAS, books and evaluation tools. Furthermore, it can be said that the learning device using a realistic approach is a learning device which includes learning steps using a realistic approach, where the initial problem presented is a contextual problem. In its implementation, the learning device consists of various components depending on the needs of each person (teacher).

3. Research Methods

The research methods consist of research design, subject of the research, data collection techniques, validity and reliability of the data, and data analysis.

3.1 Research Design

Based on the formulation of the problem and the stated research objectives, this research is categorized into the types of development research. This research uses a 4-D development model (define, design, develop, and disseminate) by Thiagarajan, Semmel and Semmel (1974) by developing learning tools with a problem-based learning model. This development is carried out to produce learning tools using the Teams Games Tournament (TGT) model which will then be tested in class using the design of The One-Class Pretest-Posttest Design, by not using a comparison class but already using the initial test so that the magnitude of the increase in problem solving abilities and Student self-efficacy can be known with certainty.

3.2 Subject of The Research

The subjects in this study were students of Madrasah Tsanawiyah Negeri 2 Medan for the 2019/2020 school year.

3.3 Data Collection Technique

Learning devices are assessed based on the criteria Nieveen (1999) suggests criteria in assessing the quality of learning based on three aspects, namely: validity, practicality, and effectiveness. To measure the validity, practicality and effectiveness of mathematics learning tools, a research instrument was compiled and developed.

3.4 Validity and Reliability

Validity is a characteristic that must be possessed by the mathematical connection ability test and the mathematical creative thinking ability test, as well as the completeness of teaching materials, namely the Learning Implementation Plan (RPP), Student Activity Sheet (LAS), and Student Book (BS). This validation sheet contains the components assessed including: format, language, illustrations, and content. The reliability of the research instrument was obtained through the Cronbach alpha test.

3.5 Data Analysis

The data analysis technique used in this research is descriptive analysis. The data obtained were analyzed and directed to answer the question whether the learning tools with the TGT model developed met valid, effective, and practical criteria for developing connection and creative thinking skills for junior high school students. Data on the improvement of mathematical problem solving abilities is determined based on the normalized gain index from Hake (1999).

4. Result and Discussion

4.1 Result

a. Data on the Test Results of Mathematic Problem Solving Abilities

Data posttest of students' mathematical problem solving skills presented in Table 1 below.

Table 1. Data Improvement of Students' Mathematical Connection Skills

	Test I	Test II	Difference
The Highest score	87,5	97,5	10
Average	73,3	80,1	6,8
The Lowest Value	60,0	65,0	5

From Table 1, it shows that the average mathematical problem solving ability of students in the results of the posttest I is 73.3. And the average mathematical connection ability of students on the results of the posttest II was 80.1. This shows that the average increase in the mathematical connection ability of students from experiment I to experiment II is 6.8.

The improvement of students' mathematical connection ability in the first trial will be seen through the N-Gain from the pretest and posttest results of the mathematical connection ability in the first trial. And the increase in students' mathematical connection ability in the second trial will be seen through the N-Gain from the pretest and posttest results of the mathematical connection ability in the second trial. The results of the N-Gain calculation on the mathematical connection ability can be seen in the following table:

Table. 2 Summary of N-Gain Results Mathematical Connection Capability

Range	Test I		Test II	
	Interpretation	Total Students	Interpretation	Total Students
$g \leq 0,3$	Low	7	Low	0
$0,3 < g \leq 0,7$	Middle	17	Middle	24
$g > 0,7$	High	2	High	2

Based on table 2. above, it can be seen that students who got an N-Gain score in the first trial in the range> 0.7 or experienced an increase in mathematical connection skills with the "High" category as many as 2 people, students who experienced an increase in mathematical connection ability with the category There were 17 people who had an N-Gain score of $0.3 <g \leq 0.7$ and 7 students who had an improved mathematical connection ability in the "Low" category or got an N-Gain score $g \leq 0.3$ were obtained. So, the average gain in the first trial was 0.4 in the medium category.

And for the second trial it can be seen that there were 2 students who got N-Gain scores in the range> 0.7 or experienced an increase in mathematical connection skills in the "High" category. There were 24 students who experienced an increase in mathematical connection skills in the "moderate" category or got an N-Gain score of $0.3 <g \leq 0.7$ and there were no students who experienced an increase in mathematical connection skills in the "Low" category or got an N-score. Gain $g \leq 0$. So, the average gain in the second trial was 0.6 in the medium category.

b. Data S*elf Efficacy*

Based on the results of trial I and trial II, it was obtained the results of the student's Self Efficacy questionnaire. A questionnaire is given at the end of each meeting which aims to see students' Self Efficacy. The data obtained from the results of the Self Efficacy questionnaire from experiment I and experiment II were analyzed to determine the increase in students 'Self Efficacy by comparing the students' average scores obtained from the results of the Self Efficacy questionnaire from experiment I and experiment II. The description of the increase in student Self Efficacy after the application of the developed problem-based learning model is shown in Table 2 below.

Table 2. Results of the Mathematic Self-efficacy Questionnaire for Each Indicator

No	Self-efficacy indicator	Average of each Indicator	
		Tes I	**Tes II**
1	Task Difficulty Level (*Level*)	2,48	2,82
2	Degree of stability, confidence or hope (*strength*)	2,60	2,95
3	Broad field of behavior (*generality)*	2,61	3,06

Table 2. shows that in the first trial the average score on the indicator of the difficulty level of the task (Level) is 2.48; the average value on the indicator of the degree of stability, confidence or hope (strength) is 2.60; and the average value on the indicator of the difficulty level of the task (level) is 2.61. Whereas in the second trial it can be seen that the average value on the indicator of the difficulty level of the task (Level) is 2.82, the average value on the indicator of the degree of stability, confidence or expectation (strength) is 2.95 and the average value on the broad indicator of behavior (generality) is 3.06. Based on these results it can be concluded that the students' Self Efficacy after using the developed problem-based learning model increased from trial I to trial II.

4.2. Discussion

a. Learning Tool Development

Student responses to all aspects, especially to learning devices, namely students' opinions on learning components consisting of student books, student activity sheets, and problem-solving ability tests and self-efficacy questionnaires were above 80%. that is 95.02%.

b. Problem solving skill

As stated earlier, what is meant by problem solving ability is the ability to overcome mathematical difficulties by combining previously obtained mathematical concepts and rules to achieve the desired goals.

Improved problem-solving skills using the Team Games Tournament model learning tool that has been developed seen from the N-gain value of 0.6 means that it is in the "medium" category. The N-Gain value of the problem-solving ability indicator for each was 0.68; 0.67 and 0.27. So the indicator with the highest increase is the first indicator with an N-gain value of 0.68, namely: understanding the problem.

Overall the N-Gain results obtained from the results of trial I to trial II experienced an increase in problem-solving abilities using the Team Games Tournament model learning tool that had been developed in the "medium" category. The N-Gain value of the problem-solving ability indicator in the second trial were 0.68 respectively; 0.67 and 0.27.

The ability to solve problems can be increased because the devices applied to students have met the criteria for good quality learning tools, the learning devices used are good and with the implementation of the Team Games Tournament model of learning, the student's problem solving ability increases.

c. *Self-Efficacy*

The average score of students 'self-efficacy in the first trial was 74.15, while the average score of the students' self-efficacy in the second trial was 84.5. Based on these data, overall student self-efficacy in trial II was better than in trial I. If this result is related to the conclusion of Bandura's (1997) opinion which states that student self-efficacy refers to belief in a person's ability to organize and implement a series of actions needed to manage prospective situations, so in general students in trial II were more confident and diligent in doing math tasks than students in trial I.

From the data obtained, it shows that the number of students who experience increased self-efficacy in each category of KAM (high, medium and low) has no difference. In the first trial, the number of students in the high group was 6 students as well as after the second trial. In Trial I, the number of students in the moderate group was 15 students as well as after the second trial and in the first trial the number of students in the low group was 5 students as well as after the second trial. This means that the increase is only seen in the average self-efficacy ability of students from trial I to trial II, there is no visible increase in the number of students based on the KAM category (high, medium and low).

Conclusions can be drawn with respect to the description of student self-efficacy that can be revealed, namely from the mean score of each indicator there is an increase from trial I to trial II.

This is in line with research conducted by Moma (2014) which resulted in the self-efficacy of students who received generative learning better than students who received conventional learning because students in generative learning were more confident and diligent in doing math tasks than learning. conventional.

5. Conclusion

1) The Team Games Tournament model of learning tools to improve students' problem-solving abilities and self-efficacy developed meets the criteria of being valid, practical and effective.
2) Improved problem-solving abilities using the Team Games Tournament model learning tool that has been developed 3. seen from the N-gain value in the first trial of 0.4, it increased to 0.6 in the second trial, meaning that it was in the "medium" category.
3) The increase in student self-efficacy after learning using the Team Games Tournament model learning tool that has been developed based on the KAM category has increased from trial I to trial II, in the high group it is 95% increased to 103%, In the moderate group it is 71% increased to 84 %. In the low group, 55% increased to 62%. Judging from the average achievement of students' self-efficacy in the first trial of 74.15%, it increased to 84.5% in the second trial.

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