

The Development of Mathematics Learning Devices Based on Numbered Heads Together to Improve the Problem Solving Skills for Students Grade VII Junior High School

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Abstract – The purpose of this study is to produce learning devices that are valid, practical and effective based on cooperative learning model, numbered heads together (NHT) type. NHT is a learning model where every student in a heterogeneous group has a different number. Seeing the typical type of NHT is the numbering of each student so that the type of NHT is suitable for students to be more responsible for the subject matter. The development model used is the Plomp development model, which consists of three phases. The tools to be developed are the lesson plans (known as RPP) and student worksheets (known as LKPD). The results of this study were RPP and LKPD was valid, practical, and effective.

Keywords – Numbered Heads Together Model and Mathematical Problem Solving Skills.

I. INTRODUCTION

Education is an important aspect for human because it can create skilled, creative and innovative human resources. One of subjects which is taught in education process is mathematics. It is a knowledge that has closely related with daily life and has important role in various disciplines, so it becomes one of knowledge used in daily life.

However, Indonesia achievement especially in mathematics field in all level of education is still weak [1-12]. It is related to the research result which is done by PISA. PISA is an international study about achievement in reading, math, and science literacy of students at 15 years old which is held by OECD started on 2000 until 2018, placed Indonesia in 39 position from 41 countries in 2000, 38 from 40 countries in 2003, 50 from 57 countries in 2006, 61 from 65 countries

in 2009, 64 from 65 countries in 2012, 67 from 76 countries in 2015 and 75 from 80 countries in 2018 [8].

Beside from the result of assessment of PISA, the lows of mathematics ability of students in elementary and junior high school can be observed from the research result by TIMSS in 1995, 1999, 2003, 2007, 2011 and 2015. Table 1 is showed the score of TIMMS and Indonesia students' achievement position as internationally.

Table 1. Indonesian students performance in mathematics and science

Year	Score	Rank	Number of Participant Countries	International Average Score
2003	411	35	46	467
2007	397	36	49	500
2011	386	38	42	500
2015	397	44	49	500

Sumber: <https://timssandpirls.bc.edu>

Analysis of the results of the PISA and TIMSS studies shows that Indonesian students were weak in mathematical reasoning, problem solving, and mathematical communication. This shows that the development of various mathematical competencies has not been reached optimally. One of the mathematics learning competencies that still needs attention is problem solving (PS) ability. PS is part of a very important mathematics curriculum because in the learning process students are able to gain experience using knowledge and skills that have been possessed to be applied to solve non-routine problems [13]. PS is the ability to think at a high level to find solutions to problems encountered by using the knowledge they have. Student activities related to the standard PS process are: (1) using a PS approach, (2) formulate problems in daily life, (3) implementing strategies to solve routine and non-routine problems, (4) verifying and interpreting the results [14].

Several studies conducted by Dharma [15], Eviyanti [16], Ulya [17], Sumartini [18] and Simamora [19] showed that the Indonesian' students problem solving ability is still low. This matter was also supported based on interviews with mathematics teachers in grade VII of SMP Negeri 5 Kota Solok, it was obtained that students' problem-solving abilities were still low especially in solving story problems. They are still not familiar with non-routine questions. In learning, they only use printed books as a source of learning. This makes students have minimum knowledge, because there are no other learning resources. This makes the ability of students is still low, especially the ability to solve problems.

One learning model that can improve students' PS skills is NHT. NHT prioritizes the cooperation of students to achieve learning goals and NHT are developed to achieve three learning objectives namely learning outcomes, diversity acceptance, and social skills development [20]. In NHT, each student in a heterogeneous group has a different number. Seeing the typical type of NHT is the numbering of each

student so that the type of NHT is suitable for students to be more responsible for the subject matter because all students have the same opportunity to be called to explain the results of thinking together in the group.

Implementation of learning activities based on an approach must be on a good plan. Learning tools are things that must be prepared by the teacher before carrying out learning activities. Learning tools can be in the form of lesson plans (known as RPP) and student worksheets (known as LKPD). RPP is a teacher's guide in implementing learning to fit the expected goals. Meanwhile, LKPD is a guide for students in learning activities. Based on the description above, the NHT model is described in the mathematics learning tool in the form of RPP and LKPD. The designed learning device is expected to have an impact on the PS ability of students in grade vii junior high school on mathematics learning.

II. METHOD

This study is a research and development (R & D). In this R &D, mathematical learning devices will be developed were RPP and LKPD for the seventh grade of junior high school second semester material based on NHT to improve students' PS abilities. R &D is a process or step to develop new products or improve existing products that can be accounted for [21]. R &D is a research method used to produce certain products and test the effectiveness of their products [22].

The R &D model used is the Plomp model. This model consists of three stages of development, namely preliminary research (needs analysis, curriculum analysis, and concept analysis), development phase (the process of designing and developing learning devices), and assessment phase (evaluation for the quality of final prototype) [23].

III. RESULT AND DISCUSSION

3.1 Initial investigation phase

The initial investigation phase aims to determine the basic problems that occur in learning mathematics in class. This is needed to develop mathematics learning tools that will be made. Activities in the initial investigation phase begin with a needs and concept analysis and literature review. The description of the results of the initial investigation is as follows.

Analysis of needs and concepts in this study is based on the rationality of the need to develop learning tools based on the NHT type of cooperative learning model, analyzing IQ, BC and analyzing the characteristics of students (including

cognitive and age levels), so that the learning tools produced are in accordance with the characteristics of students. the results of interviews with grade VII mathematics teachers at SMP Negeri 5 Kota Solok obtained information that teachers have not fully used learning tools optimally. The teacher only uses textbooks as a learning resource. Then students work on the exercises in the textbook in accordance with what is taught by the teacher. If the practice questions given by the teacher are different, then the students are confused and cannot work on the exercise.

Literature review is conducted to analyze theories and concepts related to the development of learning tools based on the NHT type cooperative learning model. Based on the results of the analysis of the literature review, theories, concepts and materials are needed in the learning process. Aspects used as a reference for reconstructing learning tools based on the NHT type of cooperative learning model, namely: (1) NHT type cooperative learning model, (2) Development model; Plomp model, (3) Learning tools; consists of RPP and LKPD, (4) Mathematics learning materials semester 2.

3.2 development or prototyping phase

RPP is designed as a guide for teachers in learning activities in class. RPP components are designed based on Ministry of Education Regulation No. 22 Year 2016. The components of the lesson plan include: (1) school identity, (2) class / semester, (3) main material, (4) time allocation, (5) learning objectives, (6) basic competency and indicators of competency achievement, (7) Learning material, (8) Learning methods, (9) Learning resources, (10) Learning steps are carried out through preliminary, core, and closing stages, (11) Assessment of learning outcomes. Learning activities presented in the RPP refer to NHT-based cooperative learning models that are integrated in LKPD based on NHT-type cooperative learning models.

LKPD is designed based on the NHT type of cooperative learning model and has several components namely the title listed on the cover page, sub-headings, KI, KD, indicators, learning objectives, LKPD instructions, problems, and exercises. LKPD has an interesting picture in accordance with the problem to be solved. LKPD is designed with a variety of colors and bright, like green, pink, yellow, and so on. This aims to arouse students' interest in using LKPD, because in general students like bright colors.

LKPD begins with questions or problems that aim to help students to relate the observed phenomena to the material to be taught. LKPD uses simple and communicative language in

accordance with the level of communication of students, so that the presentation of the material on LKPD can be understood properly. The sentence used by LKPD is in accordance with the general guidelines of Indonesian spelling (PUEBI). The type of writing that is widely used in LKPD is the Times New Roman typeface.

Before the experts validate, self-evaluation of the learning tool that has been designed using the self evaluation instrument is done first. For RPP, the aspects evaluated are the RPP component aspects, the NHT principles, and the NHT component. After evaluating, it is obtained that the lesson plan that has been designed has fulfilled the aspects that have been determined and corrected the sentences that are still not good. For LKPD, the aspects that were evaluated were the steps of the open ended approach, the use of language, presentation of images, and suitability of questions to practice problem solving skills. After the evaluation, the LKPD was revised. Revisions were made to the LKPD, namely, adding questions in accordance with indicators of PS ability and improving the layout of writing and drawing on LKPD. The revised results are then consulted and discussed with experts.

Before being tested on one-to-one activities, the learning devices were validated by 5 validators, consisting of mathematics lecturers, Indonesian language lecturers, education technology lecturers. After the validation process was completed, improvements were made to the RPP and LKPD according to the validator's suggestions. The results of the revision of prototype 1 is called prototype 2.

One to one evaluation activity was carried out by giving LKPD to 3 students of class vii in Solok City Junior High School who came from high ability, medium ability, and low ability. The three students were asked to read and understand LKPD, then interviews were conducted to find out the practicality of LKPD. The results of the interview analysis illustrate that the presentation of LKPD is already interesting and easily understood by students. After the LKPD revision process was completed, improvements were made to prototype 2 according to the results of the one to one evaluation. The revised results of prototype 2 are called prototype 3. Then a small group evaluation is carried out.

The small group evaluation activity was carried out by applying the RPP and LKPD in mathematics learning to 6 students of class VII in Solok city, divided into two groups. This small group evaluation was carried out 8 times. At the end of the meeting, students are given a questionnaire in response to the mathematics learning tool.

3.3 assessment phase

One indicator to see the effectiveness of learning tools is the learning achievement test. In this study, tests were conducted to see the impact of the use of mathematics learning tools based on the NHT to improve students' PS abilities. The test material tested was the seventh grade junior high school class VII material entitled rectangles and triangles. The tests given are questions that are designed according to indicators of problem solving ability.

Before the test is done, it is first validated by two mathematics lecturers to see the suitability of the questions with indicators of PS ability. After the test is valid, the test is given to students when the small group test is complete. The tests given amounted to 4 questions in accordance with indicators of problem solving ability and subject matter taught. The test was given to 6 grade VII students of Solok City Middle School. The final results of the problem solving ability test can be seen in Table 1.

Table 2. Problem solving ability test results

Number of students	Number of students who have completed	The number of students who did not complete
6	5	1

From Table 1, it appears that 5 people are complete (students' score 75 or more) and 1 person is incomplete (students' score < 75). This means that more than 75% of students get grades above 75. In addition, tests from the learning tools based on the NHT model have a positive effect on students. This is because many solutions are raised by students on the test answers. Based on these results the mathematical learning tools based on the NHT model are effective.

IV. CONCLUSION AND SUGGESTION

Based on result of the research and development, it can be concluded that learning devices (RPP and LKPD) based on the NHT models are valid, practical, and effective.

Based on the results of the study, it is hoped that learning tools based on the NHT model can be used as a guide for teachers in implementing learning.

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