

# Development Of Student Worksheets Based On Discovery Learning To Improve Student Mathematical Problem Solving Ability In Class X Senior High School

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**Abstract:** The results of preliminary studies show that students problem solving ability is still low. This is due to a lack of learning resources, students are less active in the learning process, and are not used to working on problems in the form of problem solving. Therefore, learning tools based on discovery learning are expected to improve student mathematical problem solving ability. This research is a development research by adapting the development model of Plomp. Plomp consists of three phases, which are preliminary research, prototype phase, and assessment phase. The preliminary research stage consist of needs analysis, curriculum analysis, student characteristics analysis, and concept analysis. In the prototype phase, worksheet developed based on discovery learning, then doing formative evaluation includes self evaluation, expert rivew, one to one evaluation, and small group evaluation to determine the validity and practicality of the product. In the assessment phase doing an assessment with limited practicality and effectiveness for students class X SMAN 1 Panyabungan. Practical data is obtained from the teacher's practicality questionnaire, and the students practicality questionnaire. Effectiveness data obtained from student learning outcomes in the form of a final test to see students mathematical problem solving ability. The results of the studies show that worksheet based on discovery learning are valid in terms of content and constructs. Practical because it is easy to use and understand, the allocation determined is very efficient, interesting, and contributes to learning. Based on the results of the test of students mathematical problem solving ability with an average completeness is 84.34%, it indicates that learning device is effective in improving students mathematical problem solving ability.

**Index Terms:** Problem Solving Ability, Discovery Learning

## 1 INTRODUCTION

Mathematical science has an important role in human life because it is one of the sciences that can improve the ability to think and argue, contribute to solving everyday problems. Mathematics is a way to find answers to problems faced by humans, a way of using information, using knowledge of shapes and sizes, using knowledge about counting, and the most important thing is to think in humans themselves in seeing and using relationships [4 ]. Based on the learning objectives in Permendikbud RI Number 59 of 2014, one of the mathematical ability that needs to be developed is problem solving ability [12]. The importance of problem solving ability given to students so that students are able to solve mathematical problems and other sciences, being able to provide logical, systematic, critical and open reasoning ability needed in everyday life [10]. This is because mathematics cannot be separated from challenges and mathematical problems. Although the problem solving ability is very important in mathematics learning activities, but actually the students mathematical problem solving ability in Indonesia are low [19]. This can be seen from the results (TIMSS) and (PISA). From the results of 2015 TIMSS, Indonesia is in 45th position from 50 countries [8]. Based on the 2015 PISA results, Indonesia is ranked 63 out of 71 participating countries [11]. The low students problem solving ability can also be seen from the results of the initial test of problem solving abilities given to students class X SMAN 1 Panyabungan and SMAN 3 Panyabungan.

obtained only reaches 2.25 and 3.41 of 10 maximum scores that must be achieved by students. This shows that students mathematical problem solving ability represented by four problem solving indicators are still low. Based on the observations and interviews results conducted at SMAN 1 Panyabungan information obtained that the students mathematical problem solving ability is low due lack of learning resources obtained by students, practice questions that only come from textbooks, many students are still unfamiliar with the form questions related to problem solving, the student difficulties in understanding the information contained in the question, and in learning activities the teacher still using conventional learning models in which learning is still centered on the teacher. Based on the problems encountered above, to improve students mathematical problem solving ability, the teacher must arrange and plan a good preparation, one of the forms of preparation that must be prepared by the teacher is learning tools [2]. The preparation of learning tools is adjusted to the current curriculum development, the 2013 curriculum. The 2013 curriculum emphasizes the current learning process referring to the scientific approach which consists of observing, inquire, trying, reasoning, associating, concluding, and communicating on all subjects as well as mathematics [9]. One of the learning models applied to implement the scientific approach based on the Ministry of Education and Culture (2014) is a learning model based on Discovery Learning [8]. Discovery learning is a model for developing active learning methods by finding itself, investigate itself, then the results obtained will be faithful and durable in memory [6]. Through discovery learning students can also learn analytical thinking and try to solve problems themselves [5]. Whereas according to Bruner, "discovery is a process, way/ method of approaching a problem rather than a product or item of certain knowledge". Thus in Bruner's view, learning with discovery (discovery learning) is learning to find, where a student is faced with a

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problem or situation that seems odd so that students can find how to solve the problem [7]. In implementing discovery learning in the classroom, there are several procedures that must be implemented in general teaching and learning activities as follows: 1) Stimulation, students are faced with something that causes confusion, then proceed to not give generalizations, in order to arise desire to investigate itself. Teacher can start learning activities by asking questions, suggestions for reading books, and other learning activities that lead to problem solving, 2) Problem statements, students identify as many as possible issues that are relevant to the subject matter. Then one of them is chosen and formulated in the form of a hypothesis (temporary answers to the question of problem), 3) Data collection, students are given the opportunity to collect relevant information, reading literature, observing objects, interviewing respondent, etc. Data processing, students process the data obtained from reading activity, interviews, observation, etc., all data are processed, randomized, classified, tabulated, even if necessary to be calculated in a certain way and interpreted at a certain level of confidence, 4) Verification, student perform examination, and 5) Generalization is the process of drawing conclusion that can be used as a general principle and applies to all occurrences or similar problems, taking into account the verification results [17]. Based on research conducted by Rosdianwinata at junior high school class VIII and Sahrudin at senior high school class X, the result show that discovery learning with students mathematical problem solving ability can increase [15], [16]. Based on the description above, researcher is interested to develop mathematical learning tool based on discovery learning to help provide learning tool that support enhancement of students mathematical problem solving ability. This development is realized in the form of research with the title Development of Students Worksheet Based on Discovery Learning to Improve Student Mathematical Problem Solving Ability in Class X Senior High School.

## 2 RESEARCH METHOD

Based on the formulation of the problem and the stated research objectives, this research includes Developmental Research. The development model used in this study is the plomp model [14], [17]. Plomp consists of three phases, which are preliminary research, prototype phase, and assessment phase to obtain learning tool based on discovery learning that are valid, practical, and effective [1]. At the preliminary research, doing a needs analysis to obtain information about the problems found in mathematics learning. Curriculum analysis to find out the goals and objectives of mathematics learning. Concept analysis to determine the content and subject matter needed. Analysis of students to find out the characteristics of students, the desired learning and worksheet that students like. At the prototype phase, doing designing worksheet based on discovery learning. Next, the designed worksheet is validated. There are two phase that are doing in validating worksheet, namely self evaluation and validation by five validators. After being revised based on the validator's suggestion and the worksheet said to be valid then doing one to one evaluation phase. One to one evaluation doing on three students of class X IPA SMAN 1 Panyabungan. The results of the revised one to one evaluation continued with small group evaluation by six students. At this phase it is seen the practicality of worksheet on a small scale. The results of the

analysis and revisions obtained in the small group evaluation were tested on a large group (field test) in one class at class X IPA SMAN 1 Panyabungan. In this field test are seen the practicality and effectiveness of worksheet. The instruments of data collection are, at the preliminary research is the form of questionnaires, interview sheets and observations. Validation instruments in the form of self evaluation and validation instruments. The instrument of practicality is implementation observation of learning, student and teacher questionnaires. The instrument of effectiveness is from the results of final test students mathematical problem solving ability. Each instrument is first validated by the validator.

## 3 RESULTS AND DISCUSSION

The development of mathematics worksheet based on discovery learning begins with the preliminary research. This phase is doing with several activities including need analysis, curriculum analysis, concept analysis and student characteristic analysis. Based on the results of the need analysis, information obtained that student during learning activities were embarrassed or do not want to ask if they do not understand the material provided, students lazy to do the exercises, and only will do exercises if teacher give the task to be gathered, teacher dominated the process learning in the classroom, and teacher do not use worksheet in the learning process. Students expect worksheet that is easy to understand, with the appearance that dominates blue, various interesting types of letters and A4 paper size. In the curriculum analysis obtained the subject matter mandatory field of mathematics study which used at class X SMAN 1 Panyabungan in the second semester is trigonometry comparison. Based on the results of concept analysis, the learning material on the topic of trigonometry comparison are about angle size in degrees and radians, trigonometry comparisons on right triangles, trigonometry comparisons on special angles, comparison of angular trigonometry in various quadrants, angular trigonometry comparisons related, simple trigonometry identity, sine rules, cosine rules, triangle area, trigonometry functions, and finally the graph of trigonometry functions. Based on the results of student characteristics analysis, obtained information that students have high curiosity, students lack focus and have difficulty concentrating in learning, students easily forget about the concepts learned, students are less motivated to learn, and students ability are diverse. Based on the results of preliminary research, doing the prototype phase that begins with designing worksheet based on discovery learning. Worksheet based on discovery learning that have been designed and then doing self evaluation by researchers and colleagues. The results of analysis and revisions in self evaluation then validated by 5 validators. The results of validation obtained average score worksheet validity for the overall score is 94.2% (very valid). Based on the results of validation obtained worksheet is valid. After the validation process is complete, doing improvements to the prototype 1 according to the validator's suggestion. The revised result on prototype 1 is called prototype 2. In prototype 2, doing practicality tests. The first one to one evaluation involved three of students at class X IPA SMAN 1 Panyabungan who have different learning ability (high, medium and low). One to one evaluation is conducted face to face between researchers and students in turn. The results of one to one obtained a worksheet revised in the form of terms and questions that were not understood by students. The term

" $0^0 < \alpha < 9^0$ " is replaced by " $\alpha$  in quadrant I ( $0^0 < \alpha < 9^0$ )". Next, worksheet based on discovery learning which has been tested in one to one evaluation and has been revised, then tested on a small group consisting six of students at class X IPA SMAN 1 Panyabungan who have high, medium and low ability. In small group evaluation researchers teach using worksheet based on discovery learning. Students are asked to work on the worksheet given. During the small group evaluation researchers assisted by one observer. The Observer is tasked with observing the implementation of learning using worksheet based on discovery learning. The small group evaluation aims to see the practicality of using the device which includes student acceptance, implementation, suitability of time allocation, ease of use of learning devices. After revising the results obtained in the one to one evaluation and small group evaluation, a prototype 4. Prototype 4 will be tested in class X IPA SMAN 1 Panyabungan. Field test of worksheet based on discovery learning is done in 6 meetings. This trial was conducted to see the practicality and effectiveness of worksheet had been designed. Doing assessment to find out whether the product is in line with expectations, practical and effective to improve students' mathematical problem solving ability. In the test field the selected students are students who have not participated in one to one and small group evaluation. The teacher who teaches in the field test is the class teacher in the trials school. After trials doing, the teacher and students are given a questionnaire with the aim of knowing how the opinions of teachers and students about the worksheet used during the learning process. Practical data is obtained from observations the implementation of learning and the results of practical questionnaires by teachers and students. Based on the results of the practicality questionnaire by the teacher, the average results of practical test by teacher on worksheet based on discovery learning is 91.4% with very practical criteria. Thus it can be concluded that based on the criteria that have been made, the teacher considers worksheet based on discovery learning to be practical for use in learning mathematics in class X senior high school. Based on the practicality questionnaire given to students after following learning using mathematical worksheet based on discovery learning, the average results of the practical test by class X students worksheet based on discovery learning is 84.50% with very practical criteria. Thus it can be concluded that students view worksheet based on discovery learning as practical for use in learning mathematics in class X senior high school. In practicality there is an increase through one to one evaluation, small group evaluation, and field tests. The effectiveness of mathematics worksheet is seen from the results of the final test the student mathematical problem solving ability after learning by using mathematical worksheet based on discovery learning in the form of 5 problem solving description questions. The number of students who took the test was 32 people. The average score of the final test for students was 83.06. Based on the learning outcomes criteria used, the mathematics worksheet based on discovery learning is effective and can improve students mathematical problem solving ability.

#### 4 CONCLUSION

The conclusion of this study are

- Students have been able to use mathematical learning tools in the form of worksheet based on discovery learning well.
- The mathematics learning tool in the form of worksheet based on discovery learning has been valid and practical.

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