

DEVELOPMENT OF MATHEMATICS LEARNING DEVICE WITH GUIDED DISCOVERY MODELS ON CIRCLE MATERIAL**Winny Tri Kurniasari**

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e-mail : ikakurniasari@unesa.ac.id**Abstract**

The research conducted is a development research that adapts to the model by Plomp development model (2010) which consists of 3 phases, they are the preliminary research phase, the prototyping phase, and the assessment phase. The purpose of this study is to find out how the process of developing learning devices and how the results of the development of mathematics learning tools in junior high school level that apply guided discovery models for circle that meets valid, practical, and effective criteria. In this study, researcher uses several instruments such as Learning Implementation Plans, Student Worksheets, and Assessment Sheets; observation instrument sheet of the implementation of learning; students' questionnaire response instruments and the instrument of validation sheet. The results of this study is junior high school mathematics's learning tools on the circle material using the guided discovery model. This learning tool has been validated by experts and received positive responses from both teachers and students when applied in class. So, the mathematics learning device with guided discovery models on this circle material has fulfilled valid, practical, and effective criteria.

Keywords : development research, learning tools, guided discovery.**PRELIMINARY**

Mathematics is one of the subjects that have been taught from kindergarten to university and has an important role for the advancement of science and technology. The rapid development of information technology requires the world of education to always adjust the development of innovation and demanded the creativity of teachers in learning by developing learning tools that are oriented to students and facilitate student needs (Soetianta, 2014). Thus, learning mathematics plays an important role in the success of an educational program.

According to Rohman & Karimah (2018) educators realize that learning methods that are often used in class use the lecture method or by assignment, this is one of the factors that causes the learning outcomes of students to tend to be low, so learning activities in the classroom are less attractive to students. This happens because during learning, the material is delivered in an unpleasant way.

As educators or teachers in the modern era, to be careful in preparing a variety of learning strategies that will be applied in the classroom designed to be fun is a must. This is very closely related to the preparation of mathematics learning tools. The importance of the preparation of learning tools before learning becomes a very risky thing if

there is no preparation. Even using an existing learning tool may not necessarily make the learning atmosphere fun.

Therefore, the existing learning tools need to be developed in such a way that the knowledge to be conveyed can be distributed well to students. According to Karim (2011) teachers who apply conventional learning with teachers who apply the guided discovery model in the classroom, there are significant differences in students namely the ability to think critically and also understand the concepts for them.

According to Rahmiati, Musdi, & Fauzi (2017) mathematics is still considered as a difficult subject for students. Because of the difficulties when working on a mathematical problem in which there is a stabilization of concepts or contextual problems that vary hard to be understood toward high social activity of students. When the students are confronted with a mathematical problem, they are required to think creatively and critically. For the students who find mathematics as difficult subject, they must try harder to learn it. The conditions when students are unable to solve a problem, basically they only hold fast to one way of solving and lack of understanding of the concept, it causes the learning outcomes are not optimal.

One of the efforts for teachers to help students achieve their mathematics learning goals and also optimal in their learning outcomes is by preparing something different from

usual. For example, by preparing learning media or by developing learning tools that will be used in class. Before starting the study, one of the preparations that must be done by a teacher is developing existing learning tools. Adjusting to curriculum development, science and technology, and also adjusting the characteristics of local students. The preparation of learning tools depends on the creativity of the teacher itself, to support learning in the classroom.

Implementation of learning must be guided by a learning device. Learning devices must be designed properly and correctly before learning in class. To achieve learning objectives, it is better for a teacher to utilize an effective teaching material including RPP (Learning Implementation Plan, Student Worksheet), and Assessment Sheet.

Study Plan is a plan of face-to-face learning activities for one or more meetings developed from the syllabus to direct learners' learning activities in an effort to achieve basic competencies (KD) (Permendikbud, 2016). LKPD (Students' worksheet) is a guide that is used by students to conduct investigations or problem solving in the form of a collection of sheets containing the activities of students (Yulius, Irwan, & Yerizon, 2017). The results of a study conducted by Winarsi (2014) state that the learning outcomes of students who use students' worksheet have a higher value than those who do not use students' worksheet. So the use of Students' worksheet in learning should be considered.

A good learning device according to Khabibah (2006) is a learning device that is expected to support learning activities so that learning objectives are expected to be achieved. A device learning is said to be good if it meets the criteria for the quality of learning tools adapted from Nieveen (1999), namely validity, practicality, and effectiveness.

According to Nieveen (1999) a product is said to be valid if the components of the product developed are based on a solid theory, and also relate to each other consistently. A product is said to be practical according to Nieveen (1999) if the validator considers the product to be easily used by teachers and students, which can be seen in the connection with the implementation of learning and student activities. A product is said to be effective according to Nieveen (1999) seen based on good responses from students as well as the level of achievement seen from increased learning outcomes.

According to Purnomo (2014), the discovery learning model is a learning model which student oriented or student-centered, to find new knowledge using trial and error techniques, guess, use intuition, investigate, draw conclusions, and allow teachers to do guidance and giving direction in helping students to fight for ideas, concepts, and skills they have.

According to Rohisah, et al (2014) for material related to strengthen the concepts and principles, the guided discovery learning model is very suitable for application in the classroom. Guided discovery learning model (guided discovery) is a learning model that the conditions made the students to think for themselves so they can find concepts desirable, but still accompanied by guidance and instructions from the teacher in the form of several questions that lead to the desired learning objectives.

According to research Mulyono et al (2018), the application of the guided discovery method for junior high school level for mathematics subject still has several obstacles, one of them is when some of the students have not been able to and are not accustomed to carrying out a discovery activity. However, the obstacles in this study can be overcome by forming several study groups with heterogeneous compositions so they can help each other if there is difficulty in making a discovery. In addition, by applying the guided discovery learning method there are other difficulties during learning that there are some students who do not actively contribute when exchanging ideas about the material being discussed.

Markaban (2008) states that one of the learning methods that can be used by a teacher is guided discovery. The teacher as a facilitator, who accompanies students to find information. So, a teacher must make minimal preparations in understanding concepts and other things that might occur while learning takes place. Guidance that occurs does not have to be one-way only from the teacher, students will get guidance from several instructions on the LKPD (students' worksheet) that have been developed.

According to Kasmawati (2015), when compared to other branches of mathematics, the branch of mathematical geometry has a greater opportunity to be understood by students because geometry was known early before they entered elementary school. However in reality, to understand the concept of geometry students still experience difficulties, especially in the circle material. Related to the opinion of Wicaksono (2019) which states that in the concept of geometry there are still many students understanding are still low, one of them is the concept of a flat circle shape.

According to Norsanty (2016) there are still many students facing difficulties in mastering Circle material, it is because when learning they are only asked to memorize the material summary about the circle, even though the material is one of the materials that must be mastered because it will relate to further material. The material given by recording formulas and demanding students to memorize and work on exercises will not be able to make students construct their interpretations to build concepts.

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In this learning model students are not only required to master the subject matter, but also how they can use their potential. A learning device that is developed by the teacher is needed in accordance with the conditions of the students, the teacher has the role to determine the problem and the stages to guide the students in order to solve the problem, so that the learner learns more oriented to the guidance and instructions of the teacher.

The subject matter of this study is limited to Mathematics VIII at second period (semester 2) chapter with basic competence;

3.7 Explain the central angle, circumferential angle, arc length, and wide area of the circle ring, and their relation.

4.7 Solving problems relating to the central angle, circumferential angle, arc length, and wide area of the circle ring, and their relation.

Based on the description above, it is necessary to develop mathematical learning tools for junior high school levels using guided discovery models on circle material. Then the research questions were formulated as follows, how is the process and results of the development of Mathematics learning tools for VIII grade junior high schools with guided discovery learning models.

METHOD

This research is a form of research development (development research) because in this study will be developed a mathematical learning tool consisting of Learning Implementation Plan (RPP), Students' Worksheet (LKPD), and Assessment Sheet (LP).

The development model applied refers to the development model proposed by Plomp (2010) which consists of 3 phases, namely the preliminary research phase, the prototype phase (prototyping phase), and the assessment phase (assessment phase). This Plomp (2010) model is seen as more natural and flexible because at each step it contains a development activity that can be adjusted to the characteristics of the researcher. (Arianatasari & Hakim, 2018)

The procedure of this study refers to the Plomp (2010) model which begins with an initial research phase to determine the basic problems needed in developing devices. An interview was conducted with one of the mathematics teachers in the school, the results obtained were the curriculum used in the school, namely the 2013 curriculum, when mathematics learning took place it was still dominant using conventional learning methods that were centered on the teacher, the character of students who tended to be passive seen from the lack of question and answer activities, the use of LKPD (students' worksheet) relies on practice questions on LKS (Commercial students' worksheet) that are purchased from public publishers. Then proceed with the prototype making phase, in this phase the preparation of

learning tools in the form of RPP (Learning Implementation Plan), LKPD (Students' Worksheet), and LP (Assessment Sheet), as well as preparing of supporting instruments, which are then referred to as prototype I. After that, continued the assessment phase, in this phase the learning device validation and instruments is carried out, validation of learning tools and research instruments carried out by validators who are experts and competent in their fields. Validation results indicate criticism and suggestions from expert validators that will be used as revised materials to produce prototype II, then used for trials. If the device does not meet the practical and effective categories, then a revision is made until the final prototype is obtained.

The following is the presentation of the trial design.

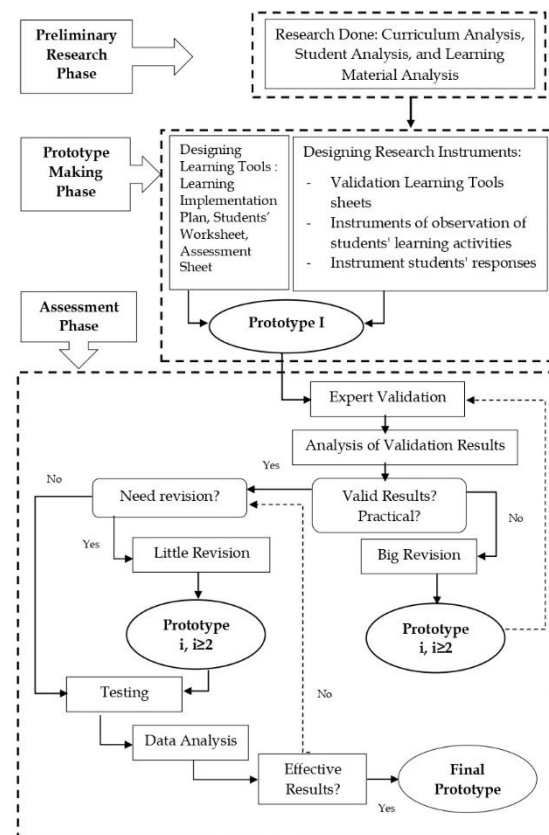


Figure 1. Development Phase Flow Chart by Tjeered Plomp (2010)

The subjects in this study were the teacher and one class of junior high school students. The teacher applies the lesson plan and tries out the LKPD (Students' worksheet) that has been developed. Then to observe the activities of students during learning by using a learning implementation observation sheet that has been developed. And for effectiveness seen from the level of appreciation of students in participating in learning in accordance with

what is expected, based on positive resonance and learning outcomes.

The type of research data obtained in this study are qualitative and quantitative data. Qualitative data is used to describe the results of developments that have been made, in the form of conclusions or evaluations of the implementation of learning on the observation sheet of the implementation of learning. While the quantitative data obtained are calculated data from the validator assessment results and student questionnaire response data. The instruments that will be used in this research are the learning instrument validation sheet, the learning observation implementation sheet, the students' questionnaire response instrument.

The analysis technique in each data uses recapitulation of average calculation. Validity analysis for learning tools and research instruments; Practicality analysis adheres to the validator's statement that the learning device can be used with minor or no revisions, and also seen from the implementation of learning and student activities. Then for effectiveness analysis, seen from the questionnaire responses of students, said to be effective if most of the learning outcomes of students complete and get a positive response from students.

To determine the validity category of learning tools including RPP, LKPD, and LP, that is by matching the average total validity (V_r) with a predetermined category, is.

3,25	$\leq V_r \leq$	4	very valid
2,5	$\leq V_r <$	3,25	valid
1,75	$\leq V_r <$	2,5	less valid
1	$\leq V_r <$	1,75	invalid

Learning devices are said as a valid source if they are included in the valid category or very valid.

To determine the practicality category in the implementation of learning, namely by matching the general average practicality (K_p) with a predetermined category, is.

3,25	$\leq K_p \leq$	4	very good
2,5	$\leq K_p <$	3,25	good
1,75	$\leq K_p <$	2,5	not good enough
1	$\leq K_p <$	1,75	not good

Learning devices are said to fulfill practicality if they are included in either good or very good categories.

To determine the response criteria of students viewed from all items in the questionnaire. If a minimum of 50% of all statement items in the criteria are very strong or strong, then the student's response is said to be positive. However, if less than 50% of all statement items in the criteria are very strong or strong, then the students' response is said to be negative.

RESULTS AND DISCUSSION

The purpose of this study is to determine the process of developing learning tools and the results of the development of learning tools for junior high school mathematics subjects by applying guided discovery learning models in order to make it valid, practical, and effective criteria. Therefore to make these objectives, development research is carried out with reference to the Plomp model (2010) which consists of an initial research phase (preliminary research phase), a prototyping phase, and an assessment phase. The results of the development of this tool are in the form of Learning Implementation Plan (RPP), Student Worksheet (LKPD), and Assessment Sheet (LP).

The research procedure that will be carried out consists of the preparation stage before conducting research and the implementation phase when conducting research. In the preparation stage, the researcher first prepares a research proposal, arranges learning tools and other supporting research instruments. Followed by coordinating with the school which is the place of research. Then in the implementation phase, researchers adapt the Plomp development model (2010) which consists of 3 phases. (1) Initial research phase, an analysis of the applicable curriculum in the school concerned, an analysis of the characteristics and background of students' mathematical knowledge, as well as an analysis of the material and learning models to be applied. (2) Prototype making phase, design and preparation of learning tools, along with other research instruments such as student activity sheets, and student questionnaires as prototype I. (3) Assessment phase, validated learning devices and instruments by experts.

It is obtained that the results of the assessment by the validator about the development of learning tools which include Learning Implementation Plan (RPP), Student Worksheet (LKPD), and Assessment Sheet (LP). The Learning Implementation Plan (RPP) has a validation score with an average of 3.61 so that it gets the "very valid" category; Student Worksheets have a validation score with an average of 3.13 so that they get a "valid" category; and the Assessment Sheet has a validation score with an average of 3.33 so that it gets a "valid" category. The conclusion of the validation results by the experts as a whole is in the valid category and is very valid with the condition of a slight revision, then the learning device has fulfilled the validity criteria.

Then a trial was held for 2x meetings, for the results of practical analysis on the implementation of learning management has an average value of 3.44 with the category of "very good". In addition, based on observations of learning activities in class, students in the class showed that more than 80% of students had an active role in the work of

LKPD (students' worksheet) at each meeting during the learning activities, so that it was included in the "active" category. Thus, according to the results of the analysis of the data the learning tool has been shown to meet practical criteria.

For the results of the effectiveness analysis can be seen from the conclusions of questionnaire responses of students and also the opinions of teachers who carry out the learning process. There are more than 50% of students in the class who fill positive statements in the Agree (S) and Strongly Agree (SS) categories.

The opinions of teachers who apply the learning process also give positive responses. Then it can be concluded that using the guided discovery model has responses from students who tend to agree and strongly agree with mathematics learning.

Then the results of the final assessment sheet of circle material grade average value is at 83.10. With the value obtained by students that is a maximum of 100 and a minimum value of 40. With details, of the 29 students in the class who took part in learning activities and working on the final assessment sheet there were 6.7% in the low category, 16.3% in the moderate category, 42.2% were in the high category, and 34.8% were in the very high category. So this shows that there are varying understandings and abilities of each student, but still this guided discovery model has been successfully applied to most students.

Based on the results of the analysis research data, it can be concluded that after learning with the guided discovery model, most of the students' scores can be said to be complete, because the most of the final assessment results of students have grades above KKM (minimum score) 75.

CLOSING

Conclusion

In connection with the results of the research described previously, the conclusions that can be drawn are the research that has been carried out is a research development and using the Plomp development model (2010) which consists of 3 phases namely, the initial research phase, the prototype manufacturing phase, and assessment phase.

This development research gave birth to the learning tools, among others, Learning Implementation Plan (RPP), Student Worksheet (LKPD), and Assessment Sheet (LP). With the results of the validation and analysis of the trial data, the results show that the mathematics learning tool for junior high schools using the guided discovery model has reached the criteria of validity, practicality, and effectiveness.

Suggestion

Based on the results of research conducted, there are some suggestions such as mathematics subject teachers can apply the guided discovery model as a variation of learning rather than use bored learning process with conventional learning models and also as an alternative learning model in class to improve concept understanding for students; In addition, the teacher also needs to prepare a careful study plan and consider the appropriate allocation of time because to apply this guided discovery model relatively requires a longer time than conventional learning; development of learning tools for other mathematical material should be carried out with apply a more varied learning model, but still adjust the suitability of the material to be taught in order to practice the mathematical abilities of students in terms of finding concepts and stabilizing concepts.

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