Development of Learning Devices for the Method in The Bamboo Dancing Stage of Defining A 4-D Model on Triangle Material in Class VII

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Abstract. This study aims to determine the process and results of defining the development of learning devices with the method bamboo dancing in the triangular material of class VII SMP. This research is a type of development research. The research procedure uses a 4-D model in the stage define. The research results obtained are: the need for the availability of learning tools in the classroom, the needs of students based on the background knowledge and level of cognitive development, the order of the material and the allocation of learning time, the combination of methods bamboo dancing and techniques scaffolding, and indicators of learning objectives. Based on the results of the study, it was concluded that: a) The use of methods bamboo dancing and techniques scaffolding can meet the needs of students in understanding triangle material with conceptual understanding, b) Presentation of triangle material based on basic competencies in the syllabus, indicators of competency achievement and specification of learning objectives, implementation of learning with sub material: understanding triangular flat shapes, types and properties of triangular flat shapes, perimeter and area of triangular flat shapes, special lines and points on triangles, and area of irregular flat shapes.

Keywords: learning device, bamboo dancing, 4-d model stage define

1. Introduction

Learning devices are a collection of media or facilities used by teachers and students in the learning process in the classroom, as a support for the learning process so that it can run smoothly, effectively, and efficiently [1].

Effective learning is learning that succeeds in achieving the learning objectives of students as expected by the teacher. While efficient learning is learning that minimizes effort but gets maximum results. The learning process will run effectively and efficiently if the teacher can design learning well, starting from planning and developing learning tools, implementing classroom learning, to evaluating it.

The importance of developing learning tools is so that the learning process can run well and learning materials can be accepted by students. In other words, the development of learning tools is developed according to the needs of students who are expected to realize an effective teaching and learning process. According to Rohman and Amri, development of learning tools is a series of processes or activities carried out to produce a learning device based on existing development theories [2].
Government regulation of the Republic of Indonesia number 19 of 2005 concerning national education standards article 17 paragraph 2 states that learning activities must be carried out by teachers by developing learning tools that will be used so that the learning carried out by teachers will run more optimally. Therefore, the learning tools used must of course continue to be developed so that they can continue to produce innovations in learning. There are several reasons why learning tools are so important for a teacher, including: (1) learning tools as a guide, (2) as a benchmark, (3) increasing professionalism, and (4) making it easier for teachers to help the learning facility process. Seeing the importance of learning tools in teaching and learning activities so that their development is highly demanded of every teacher.

According to Sudjana [3] to carry out the development of learning tools a development model is needed that is in accordance with the education system. In developing a learning device there are several development models used, one of which is the 4-D model by Thiagarajan, Semell, and Semel (1974). This model consists of four stages of development, namely define, design, develop, and disseminate, or adapted into a 4-P model, namely defining, designing, developing, and distributing. Arvyaty & Jazuli [4] suggest that the 4-D model has the advantage that it is more systematic and suitable for developing learning tools.

In learning the teacher must be precise in determining an appropriate method or strategy and can create conducive classroom situations and conditions so that the teaching and learning process can take place by the expected goals. The selection of learning methods must pay attention to the circumstances of students and be adjusted to the needs in realizing educational goals. However, not all learning methods can be applied to all subjects. This is influenced by the characteristics of subjects and learning methods that are mutually sustainable.

In the Method Bamboo Dancing in its application, students are trained to have a responsible attitude towards the assigned tasks and share information. Bamboo dancing is a cooperative strategy developed by Anita Lie from the inside outside circle (IOC) [5]. According to Suprijono in Kartika Eta [6] that the method of Bamboo Dancing makes students motivated to study the material well and the knowledge gained through discussion in each large group can be objectified and become the same knowledge throughout the class.

Based on these descriptions, then the problem in this research is how the process and results of the learning device defining methods dancing bamboo-phase define the 4-D model of the material in class VII triangle?

2. Materials and methods
Type of research is included in the type of development research (R&D), namely the development of learning devices using the learning method Bamboo Dancing in the triangle material for class VII SMP. This research is located at SMP Negeri 10 Kendari and the subject of this research is class VII for the 2019/2020 academic year. The development model that will be used to develop learning tools in this research is the 4-(D model Four D model) from Thiagarajan, Semmel, and Semmel [7]. The Four-D model was chosen because it is systematic and more detailed, making it easier for the process of developing learning tools. However, in this study, the researchers modified the 4-D model. The modifications made are as follows:

a. Simplification of the model from four stages into one stage, namely defining. Based on the problem limitation in this study, the researcher focused on the definition stage.
b. Concept analysis is changed to material analysis. This is done because what will be developed is a learning device, while in learning, the material has a wider scope than the concept.
c. Material analysis and task analysis, which were initially parallel, were changed sequentially from material analysis and then continued with task analysis. This is done because in mathematics the material is structured, so the sequence of tasks depends on the order of the material.

The results of the modification of the 4-D model at the stage Define can be seen in the following figure:
Stages of development procedures in the stage of defining the learning device (define) in this study can be described as follows.

1) Early-late analysis
   Analysis was conducted to determine the basic problems in the development of learning materials. This stage has been carried out on how to present learning and a learning atmosphere that allows students to enjoy learning, relevant learning theories, and future demands, to obtain a description of suitable learning patterns.

2) Student analysis
   Student analysis is a study of the characteristics of students as an illustration for the design and development of learning devices. These characteristics include background knowledge and the level of cognitive development of learners.

3) Material analysis
   At this stage, the analysis carried out is topic analysis because what is learned in mathematics is not only concepts but includes facts, concepts, and principles. The material analysis aims to identify, detail, and systematically compile the relevant material to be taught based on the initial-late analysis. The material chosen is the triangle material in class VII.

4) Task analysis
   From the analysis of the triangle material, it can be described the tasks that can be done by students, namely learning to find the concept of a triangle.

5) Specification of learning objectives
   Determining the specification of learning objectives in learning must show the curriculum and syllabus used as a reference.

In this research, the instrument (data collector) is the researcher himself. This study also uses other instruments as a complement, namely observation sheets, and interview guidelines. This observation sheet is an observation sheet for the Teacher Ability Assessment Tool (APKG). This
observation sheet contains observations to the teacher on the ability to carry out learning. Interviews are the next step to get information about the availability of learning tools.

The technique of collecting data in this research is to use observation sheets and interview guidelines. This observation sheet is an instrument used to collect observation data in the field. The instrument sheet was assessed by a mathematics education lecturer. The type of interview in this study is an unstructured interview using an interview guide that includes several general questions that the researcher can develop during the interview process. Through interview techniques, researchers have the opportunity to be able to understand basic problems to develop learning tools that support the learning process in the classroom.

3. Results
The results are presented in sequence according to the stages of software development phase 1 definition (define) modification of the 4-D models. This stage aims to determine and define the learning conditions. The five steps that have been carried out are described as follows.

3.1 Early-late analysis
At this stage, an analysis is carried out to identify the fundamental problems needed in the development of learning tools. Researchers conducted interviews with mathematics teachers in grade VII SMP 10 Kendari based on the results of the APKG observation sheet assessment which were assessed by two mathematics education lecturers. Several points are of concern to researchers, namely the use of learning strategies/methods, the learning process in the classroom, and the use of learning tools.

From the results of interviews with mathematics teachers, it is known that the basic problems that occur in the classroom include, students are less active in the learning process, the learning methods taught are less varied, and the availability of learning tools that teachers use when the learning process is incomplete. The results of the analysis related to the problems above, among others, by linking mathematics learning with problems in everyday life, can increase student interest in learning and activeness during the learning process. In addition, learning must be precise in determining an appropriate method or strategy and can create conducive classroom situations and conditions so that the teaching and learning process can take place by the expected goals. The selection of learning methods must pay attention to the circumstances of students and be adjusted to the needs in realizing educational goals. However, not all learning methods can be applied to all subjects. This is influenced by the characteristics of subjects and learning methods that are mutually sustainable.

Mathematics learning that emphasizes the learning process will be appropriate for junior high school students because learning that focuses on the learning process, can bridge the process of constructing students' knowledge from concrete to abstract thinking. Through the philosophical foundation of constructivism, students create something meaningful from experience after experience and what is learned. Experience after experience can be obtained by using cooperative learning methods.

The learning method *Bamboo Dancing* is a teaching and learning technique as a modification of *Inside-Outside Circle* that can benefit students' learning because in its implementation students line up and face each other with a model similar to the two pieces of bamboo used in the Filipino bamboo dance which is also popular in several regions in Indonesia. The Method is *Bamboo Dancing* certainly very useful for classroom learning to be more varied so that it does not bore students.

With the cooperative learning method *bamboo dancing* in its application, students are trained to have a responsible attitude towards the given task and share information. The method of *bamboo dancing* makes students motivated to study the material well and the knowledge gained through discussion in each large group can be objectified and become the same knowledge throughout the class. The use of this method in addition to improving students' communication skills is also expected to be able to provide solutions to students in understanding a subject concept so that it can improve
student learning outcomes. The advantage of this method is that it has a clear structure, so it can be used at all ages and requires a short time to change partners.

From the description above, the method bamboo dancing is considered suitable to meet the needs of students in learning which can increase activity during the learning process. A learning atmosphere that allows students to feel happy, learning that focuses on the learning process can bridge the process of constructing students’ knowledge from concrete to abstract ways of thinking by linking mathematics learning with problems in everyday life. Based on the above analysis, it is necessary to have a media that accommodates the learning patterns that can help achieve learning objectives. So that learning tools are needed so that the learning process can run well.

3.2 Analysis of students
At this stage, a study of the characteristics of students is carried out as an initial description which can later be used as a reference at the stage of designing and developing learning tools. The characteristics analyzed include the background of students' abilities and the level of cognitive development of students. Analysis of the background of the ability of students obtained that students have diverse abilities.

When viewed from the level of cognitive development, students are in the age range of 13 years. According to Piaget's theory of development in Suprijono [8], ages 11 years and over are in the formal operational stage. However, the level of cognitive development is not yet fully at the formal operational stage but is still developing from the concrete operational stage to the formal operational stage. This is taken into consideration in the preparation of learning materials. To bridge cognitive development from the concrete operational stage to the formal operational stage, students need a variety of real experiences in solving various problems to develop their thinking abilities.

3.3 Material analysis
Aims to identify, detail, and systematically compile relevant material that will be studied by students. Overview of the 2013 curriculum the scope of SMP/MTs mathematics includes: Numbers, algebra, geometry and measurement, statistics, and probability. The material of quadrilaterals and triangles is included in the scope of geometry and measurement. The quadrilateral and triangle material has an allocation of 25 hours of lessons and consists of four main materials, namely the understanding of quadrilaterals and triangles; types and properties of flat shapes; perimeter and area of rectangles and triangles; special lines and points on the triangle; and estimating the area of irregular flat shapes. This study focused on the material triangle which is a sub-material of quadrilaterals and triangles.

Based on the principles of studying mathematics as follows:

1. Mathematical materials are arranged according to a certain order or mathematical topics are based on certain sub-topics.
2. A student can understand a mathematical topic if he has understood the supporting sub-topics or prerequisites.
3. Differences in ability between students in learning or understanding a problem are determined by differences in the mastery of the prerequisite sub-topics.
4. A student's mastery of a new topic depends on the previous topic.

The principles above are very in line with Gagne's learning theory which suggests a hierarchy of intellectual skills, which is the ability to master a concept. In this study, triangular material was chosen. Based on the hierarchy of mathematical intellectual skills to learn the triangle material, the requirements for understanding the concept of the previous material must be met first. The definition of a triangle is a flat shape formed from three points that are not located in a straight line and interconnected will intersect and form three angles. Then the basic concepts that must be mastered by students are the concept of line and angle material then the concept of quadrilateral material.

The triangle material in the 2013 curriculum which will be studied in the even semester of class VII SMP in the 2019/2020 school year consists of two basic competencies (KD), namely analyzing
various triangular shapes based on sides, angles, and relationships between sides and between angles, and deriving a formula for finding the perimeter and area of a triangle. With an allocation of 12 hours of lessons.

The main focus of learning mathematics on triangle material is, 1) understanding triangular flat shapes, 2) types and properties of triangular flat shapes, 3) perimeter and area of triangular flat shapes, 4) special lines and points on triangles, 5) area of shapes irregularly flat.

3.4 Task analysis
At this stage an analysis of the tasks that can be done by students is carried out, namely learning to find the concept of triangles. To analyze the task we need to know the students' initial abilities. The facts in the field are known that the learning outcomes of class VII students of SMP Negeri 10 Kendari are low. This can be seen in the value of the Mathematics Mid-Semester Examination (UTS) for the odd semester of the 2019/2020 academic year for class VII SMP Negeri 10 Kendari, it is known that only 78 students out of 211 students have completed or fulfilled the KKM.

One of the factors causing low student learning outcomes is student interest in learning which is very influential on student activity in class. In learning the teacher must be precise in determining an appropriate method or strategy and can create conducive classroom situations and conditions so that the teaching and learning process can take place following the expected goals. In the method Bamboo Dancing in its application, students are trained to have a responsible attitude towards the assigned tasks and share information. One of the reasons for the low learning outcomes is students who have difficulty in learning material. In this case, the teacher must have the ability to assist in the form of questions, directions, instructions, warnings, encouragement, giving examples, giving instructions, and steps on how to work on questions that allow students to increase their understanding of the material. This kind of activity is known as providing scaffolding.

According to McMahon in Damayanti [9], the concept of scaffolding is in line with Vygotsky's opinion regarding the Zone of Proximal Development (ZPD), which states that every child, with assistance, can do more than he can do only if learning is carried out within his developmental limits. Vygotsky emphasized the importance of utilizing the environment in learning. The environment around students includes people, culture, including experiences in that environment. Students will be able to learn concepts well if they are in the ZPD. ZPD is a student's thinking zone when students have not been able to solve their problems, but after getting help from other people who are more expert or friends (peers) students can solve the problem. By combining the bamboo dancing method with scaffolding techniques in the learning process where students are trained to have a responsible attitude towards the given task and share information and are supported with assistance from the teacher in the form of directions, instructions, warnings, encouragement, giving examples, giving instructions, and steps. The steps on how to do the problem can do more than what they can do only if learning is carried out within the limits of their development can be a suitable learning pattern to make it students easy to learn to find the concept of triangles.

The assignment method is divided into two parts, namely individual assignments and group assignments. The use of the group assignment method is stated to be more effective in activating students to find out because students can convey what they have learned during the discussion and can create an interesting learning atmosphere. Giving individual assignments must still be done to train students' independence after group learning is over.

The description of the task is arranged in four parts, where each part is taught in one learning meeting so that there will be four meetings in learning the triangle material.

3.5 Specifications of learning objectives
In this step, the formulation of indicators for achievement of learning outcomes is obtained which will be developed in learning tools. The formulation of indicators for the achievement of learning outcomes is obtained from the results of material analysis and task analysis. Based on the triangular material syllabus, there are two basic competencies, namely analyzing various triangular shapes based
on sides, angles, and the relationship between sides and between angles and derive formulas to determine the perimeter and area of a triangle.

From the two basic competencies, they are revealed to be indicators of achievement of learning outcomes, namely explaining the types of triangles based on their sides and angles, determining the types of triangles based on their properties, identifying special lines and points on triangles, calculating the perimeter and area of triangles, solving problems of perimeter and area of triangles daily life, and estimating the area of irregular flat shapes.

From the six indicators of achievement of learning outcomes, specific learning objectives are derived as follows:

a. Through the method of bamboo dancing, students can explain the types of triangles based on their sides and angles correctly.
b. Through the method of bamboo dancing, students can find types of triangles based on their properties.
c. Through the Method bamboo dancing, students can identify special lines and points on triangles correctly.
d. Through the Method bamboo dancing, students can calculate the perimeter and area of a triangle correctly.
e. Through the Method bamboo dancing, students can solve problems of perimeter and area of triangles in daily life
f. Through the Method bamboo dancing, students can estimate the area of irregular flat shapes.

4. Discussion

Definition stage (define) consists of several stages, namely early-late analysis, student analysis, material analysis, task analysis, and specification of learning objectives.

a. In the early-late analysis stage, an analysis is carried out to identify the fundamental problems needed in the development of learning tools. The researcher used the APKG observation sheet to assess the teacher's ability when carrying out the learning process. The APKG observation sheet is filled out by the assessor, namely the mathematics education lecturer. Then the results of the APKG observation sheet assessment become a reference for researchers to identify the initial problems that are used as the basis for questions to conduct interviews with mathematics teachers. The results of the APKG observation sheet assessment have 3 important points that are the main focus of the problem, namely the use of learning strategies/methods, the learning process in the classroom, and the use of learning tools.

From the 3 points of the problem, the solution was obtained, namely:

- The use of bamboo dancing learning methods,
- The learning process by presenting the material based on constructivism learning theory,
- Development of learning tools using the Method bamboo dancing.

b. At the stage of student analysis, a study of the characteristics of students is carried out as an initial picture which can later be used as a reference at the stage of designing and developing learning tools. Learners are at the stage of formal operational cognitive abilities. But in fact, students have different abilities in the development of their thinking. So that there will be cases of students based on age who have entered the formal operational stage but their thinking patterns are still at the concrete operational stage. The preparation of learning materials must be considered by bridging the cognitive development of students by providing learning that contains concepts that lead students from real experience in solving various problems to develop their thinking power abilities.

c. Material analysis is carried out to identify, detail, and systematically compile relevant material that will be studied by students. Even semester there are 5 lesson chapters with an effective week allocation of 16 weeks so that the effective lesson hours for odd semesters are 80 lesson hours. The division of lesson hours is based on the level of difficulty in mastering the material and the many sub-subjects in each chapter. The divisions obtained are as follows:
• Chapter 5: Comparison (10 hours of lessons)
• Chapter 6: Social arithmetic (10 hours of lessons)
• Chapter 7: Lines and angles (20 hours of lessons)
• Chapter 8: Flat shapes (squares and Triangle) (25 hours of lessons)
• Chapter 9: Presentation of data (15 hours of lessons)

From the distribution of the material above and based on several considerations, the researcher chose the triangle material as the focus of defining learning tools in this study. The triangle material in the 2013 curriculum consists of two basic competencies (KD), namely analyzing various triangular shapes based on sides, angles, and relationships between sides and between angles, and derive formulas to determine the perimeter and area of triangles. With a time allocation of 12 hours of lessons and the main focus of the material, namely 1) understanding of flat triangles, 2) Types and properties of flat triangles, 3) Perimeter and area of triangular flat shapes, 4) Special lines and points on triangles, 5 ) Area of irregular flat shape.

Based on the results of the definition of the material above, it is necessary to consider in terms of aspects of the student's initial abilities and the number of basic competencies to be achieved. With the five main focuses of the material considered, it is sufficient to be able to achieve the two basic competencies of the triangular material. The division of time allocation of 12 hours of lessons is broken down into five meetings with the division of lesson hours consisting of the first meeting of 3 x 40 minutes, the second meeting of 2 x 40 minutes, the third meeting of 3 x 40 minutes, the fourth meeting of 2 x 40 minutes and the fifth meeting of 2 x 40 minutes.

d. Task analysis at this stage is carried out by analyzing the tasks that can be done by students, namely to learn to find the concept of triangles. In presenting learning materials, appropriate learning strategies/methods are needed. The use of methods bamboo dancing and techniques scaffolding is very appropriate for students at the formal operational age stage.

At the first meeting, the main material was the understanding of triangular flat shapes and the types and properties of triangles, students were directed to achieve the learning objectives of recognizing and understanding the types and properties of triangles. Therefore, students are given group assignments to work on LKPD and read the material on the teaching materials. As well as given individual tasks to do at home.

At the second meeting, the main material was the circumference and area of a flat triangle, students were directed to achieve the learning goal of understanding the perimeter and area of a triangle. Therefore, students are given group assignments to work on LKPD and read the material on the teaching materials. As well as given individual tasks to do at home.

At the third meeting, the main material was special lines in triangles, students were directed to achieve the learning objectives of understanding special lines and points on triangles. Therefore, students are given group assignments to work on LKPD and read the material on the teaching materials. As well as given individual tasks to do at home.

At the fourth meeting, the main material is the area of irregular flat shapes, students are directed to achieve the learning objectives of estimating the area of irregular flat shapes. Therefore, students are given group assignments to work on LKPD and read the material on the teaching materials. As well as given individual tasks to do at home.

e. At this stage, the specification of learning objectives is determined based on the 2013 curriculum and syllabus. Indicators are derived from basic competencies. The triangle material consists of two basic competencies and then six indicators of competency achievement are formulated. After obtaining the competency indicators, specific learning objectives are formulated. Guidelines for the preparation of specific learning objectives by the ABCD guidelines (Audience, behavior, condition, and degree).
5. Conclusions

Based on the results of the study through the procedure for developing modified learning devices Four-D that were modified into One-D, namely the stage definition (define), then the following conclusions can be drawn.

1. The process of defining learning tools consists of several stages, namely initial-late analysis, student analysis, material analysis, task analysis, and specification of learning objectives.
2. In the development of learning tools must be adapted to the needs of students. Relevant learning theory, use of learning strategies/methods/techniques, and presentation of learning materials must be adapted to the circumstances of the learners. At the junior high school level, students are at the age of the formal operational stage so that their mindset develops from concrete to abstract ways of thinking. The results of the definition of learning tools obtained several important points, namely:
   a. In the learning process using methods bamboo dancing and techniques scaffolding can meet the needs of students in understanding triangle material by thinking about understanding concepts.
   b. Presentation of triangular material based on basic competencies in the syllabus obtained: 1) Six indicators of competency achievement and six specifications of learning objectives; 2) Taught in five meetings; 3) With five sub-materials (definition of triangular flat shapes, types, and properties of triangular flat shapes, perimeter and area of triangular flat shapes, special lines and points on triangles, area of irregular flat shapes).

Based on the results of the research that has been carried out, the researcher can suggest that other researchers can design and develop learning tools well and interestingly based on the results obtained from this study.

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