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Development of Digital Learning Devices Oriented On Realistic Mathematics Education to Increase Visual Thinking Ability of Senior High School Students Yapim Taruna Marelan

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ABSTRACT
This study aims to: (1) find out how the validity, practicality, and effectiveness of learning tools developed using the Realistic Mathematics Education learning model in grade 9 Yapim Taruna Marelan High School, (2) analyze the improvement of students' mathematical problem solving abilities using model learning tools. Realistic Mathematical Education learning in grade 9 Yapim Taruna Marelan High School. This type of research is development research using the learning device development model of Thiagarajan, et al, namely the 4-D model (define, design, develop, desseminate). This research was conducted at SMA Yapim Taruna Marelan class XI even semester of the academic year 2020/2021 on geometry transformation material. The results of the study show that: (1) Digital learning tools oriented towards realistic mathematics education have met the criteria of being valid, practical, and effective. (2) Students' visual thinking ability increased from trial I to trial II by using digital learning tools oriented to realistic mathematics education.
KEYWORDS: *Digital Learning Devices, Visual Thinking Ability, Realistic Mathematics Education*

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I. INTRODUCTION

In the world of education, technology can be used not only for administrative purposes but it is possible to use it as an alternative in the selection of learning media. This is stated in Permendiknas No. 22 of 2006.

Learning mathematics is one of the most important basic lessons learned by students because mathematics will make them think creatively and thoroughly and can be useful for solving problems in everyday life (Sister, D.2020: 3842). For this reason, teacher creativity is needed in the mathematics learning process so that it can be interesting and not boring. (Permendikbud, 2013).

Based on the results of an interview with one of the mathematics teachers of SMA Yapim Taruna Marelan, the researchers found facts in the field that in learning mathematics, the teacher explains in front of the class and writes on the blackboard and gives math problems and then asks students to solve the problem. This causes students to participate less actively in learning, students who are active are only students who have more abilities.

Ambarita and Siburian (2013: 85) also explain that one of the factors that make a teacher successful is determined by his ability to plan lessons, implement quality learning processes, assess and evaluate quality learning outcomes.

How to design learning in question is to design learning tools that will later be run to achieve a learning goal. Learning tools are devices that support students to achieve the desired competency standards. The learning tools used must be in accordance with the target characteristics (Depdiknas, 2008:12). Inappropriate learning devices will result in the achievement of learning objectives that are less than optimal, especially in mathematics. Students often complain about learning mathematics as a difficult and boring field of study because mathematics is usually taught in an unattractive method, namely the teacher explains while the students only take notes.

To support the achievement of learning objectives, in addition to the use of appropriate learning models, the use of IT media is one of the appropriate learning strategies because children are very liked and awaited by children. It is undeniable that children's interest in mastering technology is very large, we can see so

many children, both at an early age and school age who lose learning time because they are too busy with the world of technology such as playing games, playing mobile phones, and playing computers.

So, in addition to developing learning tools using the RME model, researchers also need to look for learning media that can improve problem solving abilities and student learning independence. From the observations of researchers, the Yapim Taruna Marelan High School teacher has not used computer technology-based media in the software-assisted mathematics learning process, due to the lack of understanding of teachers in using technology, especially teachers in the field of Mathematics studies.

Visual thinking is an abstract thought into a scientific form of thinking and is a cognitive bridge between verbal thinking and practical activities between words and activities (Zhukovzky, 2018: 150). Visualization (Visual Thinking Skill) according to Yin (in Surya, 2011: 5) identifies the important role of visualization (visual thinking), among others: to understand problems, simplify problems, see problems into related connections, meet individual learning styles, as a substitute for calculations , as a tool for checking answers, and for converting problems into mathematical forms.

According to Surya (2010: 5), visualization is the core of mathematical problem solving, and can be a powerful cognitive tool in solving mathematical problems. This is characterized as an important skill in learning and applying mathematics. Visualization has an important role in developing mathematical thinking and understanding and in the transition from concrete to abstract thinking related to problem solving (Lavy, 2016: 25-32). For this reason, students are expected to have visual thinking skills and independent learning.

NCTM (2000) stipulates that there are 5 standard processes that must be mastered by students through learning mathematics, namely: (1) problem solving; (2) Reasoning and proof; (3) Communication; (4) Connection; and (5) Representation. The five process standards are known as Mathematical Power, namely the ability to solve problems, both in mathematics and problems in real life.

Today, teachers and educators are required to master computers and the internet, because in the 2013 curriculum all subjects must be based on Information and Communication Technology (ICT). Syamsyah (2019:81) states that the learning process in the 2013 curriculum requires students to actively participate and provide sufficient space for students' creativity, interests, and talents. Technology has also become the main focus in the 2013 curriculum, this is contained in Permendikbud No. 65 About Process Standards. Learning using ICT can increase the attractiveness and attention of students, because learning will be more interesting and meaningful. Students can directly interact and more easily see the evidence of what the teacher said. In addition, learning using ICT will be more efficient in the use of time. With the principle of optimal, effective and efficient use of ICT, it will attract and stimulate students' creativity. Learning mathematics using computer technology-based media is very good if we support it with mathematical software that will greatly assist students in working on or analyzing existing problems.

As technology develops, there are many ICTs that can be used in learning mathematics, for example digital book software (Flip PDF Professional) is an application used to make e-modules attractive, containing text, images, animation, practice questions, audio and video.

Learning with Flip PDF Professional can accommodate students who are slow to receive lessons, because it can provide an effective climate in a more individual way, never forget, never get bored, can stimulate students to do exercises. In addition, the use of Flip PDF Professional as a learning medium can make it easier for teachers to deliver material, make it easier for students to absorb what the teacher says, and simulations occur because of the availability of animation and manipulation movements (dragging) that can provide a clearer visual experience for students. .

Based on the description above, the researchers tried to combine the Realistic Mathematics Education (RME) model with computer technology media (Flip PDF Professional), to improve visual thinking skills.

II. METHODS

Research Pattern

This type of research is development research using the learning device development model of Thiagarajan, et al, namely the 4-D model (define, design, develop, desseminate).

Subjek

The subjects in this study were several students of grade 11 MIA-1 Yapim Taruna Marelan High School which amounted to 20 people in trial 1 and students of grade 11 MIA-2 Yapim Taruna Marelan High School which also amounted to 20 people in trial II.

Research Procedure

This research is divided into two stages. The first stage is the development of digital learning tools using realistic mathematics education assisted by digital books. Development of learning tools includes the design of learning devices.

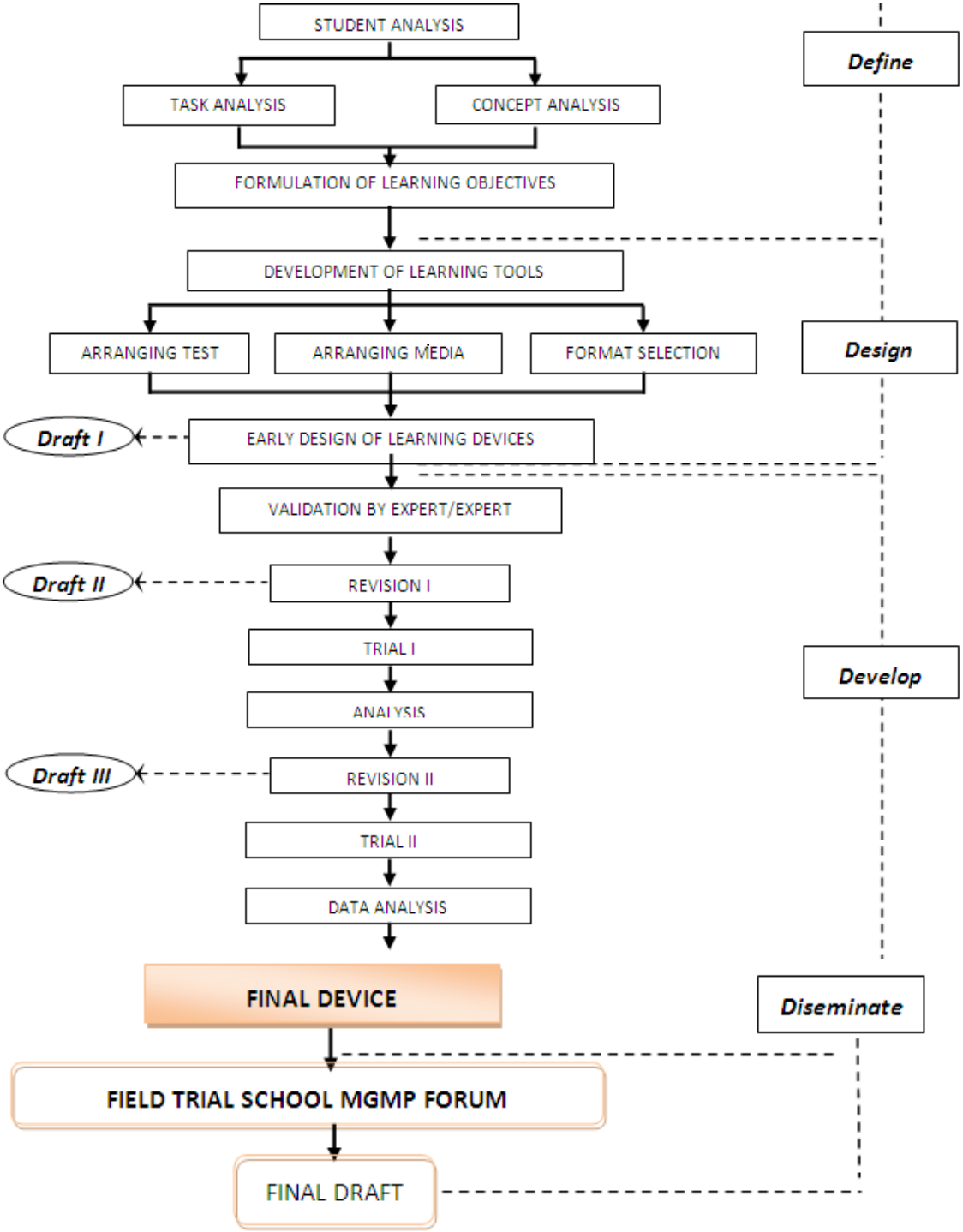

Figure 1. Chart of 4-D model learning device development (modified from Trianto, 2010)

Data Analysis

The data analysis technique used in this research is descriptive analysis. The purpose of data analysis in this study was used to answer the validity, practicality and effectiveness of the learning tools oriented towards realistic mathematics education that were developed referring to the formulation of research problems and questions. To see the validity of the learning tools based on the average score of each validated learning device. The practicality of learning devices is based on the observation sheet on the implementation of learning starting from the teacher opening the lesson to closing the lesson. The effectiveness of learning is seen by classical student mastery, analysis of student activities, and student responses during learning by using developed learning devices.

III. RESULT

Validity of Realistic Mathematics Education Oriented Digital Learning Devices Developed

The learning tools that have been prepared through the define and design stages in the form of draft I are in the form of all components of the developed learning tools such as teacher digital books, student digital books, and digital student activity sheets which will be validated by a team of experts. The following will present a summary summary of the results of the validation assessment from the expert team..

Table 1. Summary of Validation Results

No	Learning Device Components	Average Validation Value	Category
1	Learning Implementation Plan	4,51	Valid
2	Teacher's Book	4,43	Valid
3	Student Book	4,43	Valid
4	Student Activity Sheet	4,41	Valid

From table 1. above, it can be seen that the validation results for each component of the learning device developed using a realistic mathematical approach are in the "valid" category with the average value of each component, namely 4.51, 4.43, 4 ,43, and 4.41. However, although the components of the learning tools developed have met the criteria for validity, there are several things that must be corrected according to the notes provided by the expert team including the use of language, the problems must be contextual, the display of images must be in accordance with the conditions and clarified. So based on the results of the notes from the expert team that this learning device has met the criteria for validity in the "valid" category with a slight revision note.

Practicality of Realistic Mathematics Education Oriented Digital Learning Devices Developed

The results of the first practical assessment of learning devices were obtained from the assessment of experts/practitioners who stated that the developed learning tools could be used with little or no revision. Based on the results of expert assessments, the components of the learning tools developed in the form of lesson plans (RPP), teacher digital books, student digital books, and digital student activity sheets are practical/can be used with a little revision.

For the next practical assessment, in terms of observing the implementation of learning tools in the classroom, it is included in the high category ($3 < 4$) or very high ($4 < 5$). Aspects of this practicality assessment are described as follows.

The practical criteria in terms of the implementation of the learning tools in this study have also met the practical criteria. In the first trial and second trial, the implementation of the learning devices has met the specified criteria, namely it has reached the high category ($3\ P < 4$). In the first trial, some students were still not familiar with the use of realistic mathematics education-oriented learning tools that demanded student activity, but in the next trial the students became more accustomed and happy.

Based on the description above, it can be concluded that the learning tools oriented towards realistic mathematics education assisted by digital books (professional flip pdf) have met the practicality as expected. Thus, learning tools oriented towards realistic mathematics education assisted by digital books (professional flip pdf) that were developed were easy and could be implemented by teachers and students.

Effectiveness of Developed Realistic Mathematics Education Oriented Digital Learning Tool

Based on the results in the first trial and second trial, the learning tools based on realistic mathematics education developed have met the effective category in terms of: (1) classical student learning completeness; (2) student activities within the established ideal time tolerance limits; and (3) students gave a positive response to the components of the learning tools developed.

Description of Improving Students' Visual Thinking Ability Using Realistic Mathematics Education Oriented Learning Tools Assisted by Digital Books (Flip Pdf Professional) Developed

The data obtained from the posttest results of students' visual thinking abilities in the I and II trials were analyzed to determine the improvement of students' visual thinking abilities by comparing the average student scores obtained from the posttest results of students' visual thinking abilities in the I and II trials. . The description of improving students' visual thinking skills using realistic mathematics education-oriented learning tools aided by digital books developed in trials I and II is shown in table 2.

Table 2. Description of Visual Thinking Ability Results

	Posttest of Visual Thinking Ability in Trial I	Posttest of Visual Thinking Ability in Trial II
Highest score	88	90
Lowest score	46	63
Average	72,1	78,6

Based on table 2., the results of the analysis of increasing students' visual thinking abilities in the first trial and second trial show that the average visual thinking of students in the posttest results of the first trial is 72.1%, increasing to 78.6% in the second trial. . This is in accordance with the data analysis of increasing students' visual thinking abilities in chapter III, namely increasing visual thinking abilities seen from the average posttest results of trials I and II, thus it is known that there is an increase in the average value of students' visual thinking abilities of 6.5 %.

Furthermore, a description of improving students' visual thinking skills using realistic mathematics education-oriented learning tools developed in the first trial and second trial for each student's visual thinking indicator can be seen in table 3. below.

Table 3. Average Visual Thinking Ability of Students for Each Indicator

Indicator *Visual Thinking*	Average		
	Trial I	Trial II	Enhancement
Looking & Seeing	2,86%	3%	0.14%
Imagining	3,26%	3,33%	0.07%
Showing & Telling	3,23%	3,36%	0,13%
Refresentation	2,28%	2,88%	0,6%

Based on table 3. it can be seen that the students' visual thinking ability increased from trial I to trial II for each indicator. On the Looking & seeing indicator of 0.14; for the Imagining indicator of 0.07; for the Showing & telling indicator of 0.13; and for the Reflection indicator it is 0.6.

IV. CONCLUSION

1. The validity of the learning tools developed is included in the valid category.
2. Realistic mathematics education-oriented digital learning tools have met the practical criteria in terms of: (1) expert/practitioner assessment states that the components of realistic mathematics education oriented learning tools developed can be used with minor revisions; and (2) the implementation of the learning tools has reached a high category in the first trial, and the observation sheet on the implementation of the realistic mathematics education-oriented learning device components achieves good reliability, namely in the first trial.
3. The developed digital learning tools oriented towards realistic mathematics education have met the effective criteria. The effective criteria are viewed from: (1) classical student learning completeness in the first trial has reached a good category and in the second trial has reached a very good category (2) student activities during learning activities meet the criteria of ideal time tolerance set; and (3) positive student responses to the components of digital learning tools and learning activities developed.
4. Students' visual thinking skills increased from trial I to trial II by using digital learning tools oriented to realistic mathematics education.
5. Students' learning independence increased from trial I to trial II by using digital learning tools oriented to realistic mathematics education.

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