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by Nilam Permatasari Munir Dkk

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Development of Mathematics Student Worksheets Through the Approach Model Eliciting Activities (MEAs) on the Triangle Material

N P Munir^{1*}, A Anas², Sunarti³, N R Mursalin⁴, I Natsir⁵

¹Department of Mathematics Education, Faculty of Education and Teacher, IAIN Palopo, Palopo, Indonesia,

²Department of Informatics, Faculty of Computer Technik, Universitas Cokroaminoto Palopo, Palopo, Indonesia,

³Department of Mathematics Education, Faculty of Education and Teacher, IAIN Palopo, Palopo, Indonesia,

⁴Department of Madrasah Ibtidaiyah Teacher Education, Faculty of Education and Teacher, IAI DDI Polman, Polman, Indonesia

⁵Department of Mathematics Education, Faculty of Education and Teacher, Universitas Musamus Merauke, Merauke, Indonesia

*nilam_permatasari@iainpalopo.ac.id,

Abstract. Student Worksheet is one of the teaching materials needed by teachers on the mathematics learning process to achieve basic competencies needed. The objective of this study is prototype final, quality, and effectiveness of the development of worksheets based on the MEAs approach of triangle material. This type of R & D (Research and Development) research adopts the ADDIE development model. The trial subjects in this study are Grade VII students of SMP Negeri 1 Suli, Luwu Regency. Technique collection data that used were validity data obtained from validation sheets by experts, practicality data obtained from student response questionnaires and effectiveness data obtained from student learning outcomes tests. The data obtained were analyzed using descriptive statistics. The results of this study indicate that: The final prototype of the worksheet product developed had suitable with the principles of the MEAs approach, they are: identifying problems, simplifying problems, building mathematical models, transforming and solving models, and interpreting the results; the quality of worksheet for validation is 85% in the very valid category, the average practicality is 73% in the practical category; and the effectiveness of the student worksheet score average 87% is in the very effective category increasing student learning outcomes in the material triangle.

1. Introduction

One of the fields of study that has an essential role in education and daily life problems is mathematics. Mathematics is a piece of basic knowledge in the development of science and technology because mathematics is a means of thinking to develop reasoning, logical, systematic, and critical thinking. Therefore, mathematics tested at every level of education from elementary school to high school and even college. To create appropriate mathematics learning in everyday life, a teacher needs to use



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teaching materials; In this case, the writer chooses teaching materials in the form of student worksheets, which can facilitate mathematics learning. It following the Ministry of National Education, which said that teaching materials (Student Worksheets) that are suitable for the real context in everyday life would make it easier for students to understand mathematics learning and gives the motivation to learn mathematics ^[1].

So far, in the real state, the student worksheets used are made through the publisher's services in the mathematics learning process. The worksheets used by publishers are sometimes not suitable for student characteristics, even not according to Core Competencies, Basic Competencies, and Indicators ^[2]. another factor that causes the lack of mathematical reasoning of students is that students' worksheet (LKPD) used is not adequate yet. Based on the observation that has done, LKPD used in the school contains the summary of content and exercises. The presented content is the short summary containing formulas of related concepts. The presented problems consist of routine problem that just asked the students to calculate. Only a few of the problems are related to the daily life and are problem solving and reasoning problems. Based on the results of observations and interviews with mathematics teachers at SMPN 1 Suli, information obtained that the mathematics learning carried out was still sourced from textbooks and worksheets from publishers determined by the school. It causes students to have difficulty understanding the teacher's material; in order that student worksheets are more attractive and suitable for student characteristics, then the LKS should be made by the teacher so that it can make it easier for students to understand the material provided by the teacher at the learning process; Prastowo stated that the worksheets that were made by the teacher could be more interesting, more real following the situation and conditions of the students' socio-cultural environment and could make it easier for students to understand the material provided by the teacher ^[3].

Quality learning depends on student motivation and teacher creativity in processing the learning process. Therefore, to form the character of students to be active in the learning process and have the ability to solve problems in mathematics, a learning approach is needed that can support these goals, one of which is the Model Eliciting Activities (MEAs) approach ^[4]. Model-Eliciting Activities (MEAs) are an approach based on realistic problems, working in small groups, and presenting a model to help students develop problem-solving ^[5]. Learning based on issues that exist in everyday life and tries to solve problems independently, students expected to gain more meaningful knowledge. In line with research conducted by A Yunda et al. stated that the Model Eliciting Activities (MEAs) can be one of approach used to increase students' creative mathematical thinking ability ^[3]. MEAs support the goals of teaching and learning mathematics by integrating concepts found inside and outside of mathematics, by encouraging learning through discovery ^[6]. MEAs with problem-based learning and draw from MEA design features to modify existing curricular tasks allowed participants to think more broadly about mathematics content ^[7]. specified six design principles for MEAs: a) The model construction principle: Students must provide an explicit description, explanation, or prediction for a mathematically significant situation; b) The reality principle: Problem solvers must behave like scientists or engineers who are working for a particular client or organization; c) The self-assessment principle: A group of students use criteria embedded in the activity to self-evaluate their work. In turn, they go beyond their initial ways of thinking to create a model that is more robust and more closely aligned with the needs of the client; d) The model documentation principle: Students must produce documentation of their thinking that reveals their mathematical and nonmathematical interpretation of the problem situation; e) The generalizability principle: Students must produce models that are generally useful and could be easily modified and applied to situations that are similar to the one being studied.; f) The effective prototype principle: Students use the concepts that underlie the activity to create simple but powerful models for complex situations ^[8]. Based on these principles, the researchers, together with the team, formulated a strategy to develop integrated worksheets with the

MEAs approach following the 2013 curriculum's demands that apply at the Class VII Junior High School level.

2. Model Of The Research

This type of research is R&D (Research and Development), specifically in the field of education, by adopting the ADDIE development method (Analyze, Design, Development, Implementation, and Evaluation). This research has conducted at SMP Negeri 1 Suli, Luwu Regency. The research subjects were grade VII students of the 2019/2020 academic year.

The research procedure is shown in Figure 1 below.

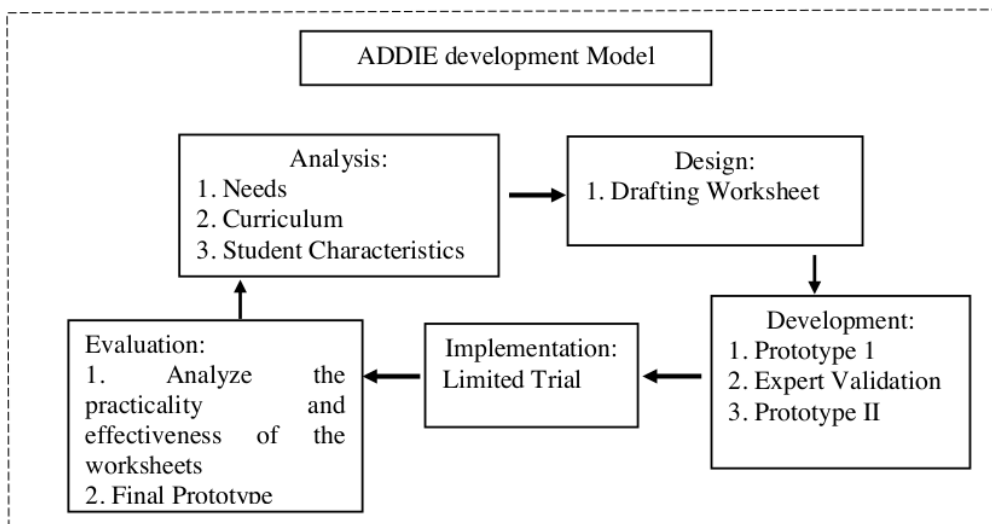


Figure 1: Research procedure

Technique collection data that used were validity data obtained from the validation sheet by experts, the practicality data obtained from the practicality test in the form of a questionnaire, and the effectiveness data obtained from the test. The instrument in the form of an expert validation questionnaire includes a Format of worksheets, content, language, and graphics. The practicality questionnaire instrument, the indicators include readability, attractiveness, and efficiency. The effectiveness mechanism is in the form of a deepening test of triangle material with question indicators that solves contextual problems related to the triangle's perimeter and area.

In this research, the technical analysis data used descriptive statistics, namely the average percentage of acquisition from the questionnaires' validity and practicality. The criteria for the validity and practicality of the student worksheet product shown in the table 1:

Table. 1 Validity Criteria and Practicality of Student Worksheet Products

No	Kriteria	Validity/Practicality
1	0–20	Invalid/Impractical
2	20–40	Poor Valid/Poor Practical
3	40–60	Fair Valid/Fair Practical
4	60–80	Valid/Praktical
5	80–100	Very Valid/Very Practical

Conclusion :

- A = Worth using without revision
- B = Not yet suitable for use; it needs a small revision
- C = Not yet suitable for use; it needs a major revision

The effectiveness data obtained of the average score the deepening test of the triangle material with the categories on the table. 2 below:

Table 2. Triangle Material Deepening Test Categories

% completeness (p)	Category
$0 \leq p < 41$	Very Low
$41 \leq p < 56$	Low
$56 \leq p < 66$	Fair
$66 \leq p < 80$	High
$80 \leq p < 100$	Very High

3. Result and Discussion

The first stage in this research is the analysis stage. It consists of: (1) needs analysis is carried out to determine the fundamental problems in developing student worksheets. In this step, the researcher observes the issues in learning mathematics at SMP Negeri 1 Suli, especially VII grade. From the initial study results, the researcher randomly asked ten respondents from VII grade students to fill out an assessment questionnaire for teachers who taught mathematics. It found that 100% of teachers used textbooks provided by the school in the learning process. 35% of teachers sometimes use the student worksheets purchased. Still, these worksheets are not optimal because they have not facilitated students to construct their knowledge and do not encourage problem-solving abilities; 68% of the learning approach is oriented. (2) Analysis of the curriculum, it is obtained information that the curriculum used in SMP Negeri 1 Suli, especially class VII, is the 2013 curriculum. Part of the 2013 curriculum that analyzes is the Core Competencies (KI) and Basic Competencies (KD) of Triangle material, KD includes: a) Analyze various shapes of triangles based on sides, angles, and the relationship between sides and between angles; b) Derive the formula for determining the area and perimeter of the triangle; c) solve problems related to the shape of the triangle; d) solve contextual issues related to the area and perimeter of the triangle.

The second stage is the student worksheet draft design, developed based on analysis needed and the 2013 curriculum, which is described in detail as follows. The design of the theme/ topic worksheets determined by a map needs of triangle worksheets which are composed of sub-themes / topics as follows:

Sub Chapter 1: explains the meaning of a triangle.

Sub Chapter 2: explains the types of triangles based on side length, angle measure, and side length and angle measure.

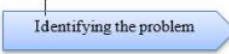





Section 3: find the area and perimeter of the triangle

The design of the LKS draft consists of 1) a cover consisting of the title, the MEAs approach, the name of the author, the target users, the identity of the owner, 2) Introduction; 3) Table of Contents; 4) student worksheet components, namely sub-chapter titles, essential competencies, learning objectives, concept maps, opening pictures, information about the material to be studied, student worksheets

instructions, remember (important notes that students must remember), conclusions, practice questions worked by students; and 5) Bibliography.

The third stage is the development stage. The outline of the worksheets' contents developed into a teaching material in the form of worksheets MEAs approach. Student worksheet use the Indonesian language. The worksheets developed by researchers have components that aim to facilitate students' learning process and understand the material. These components will discuss more detail:

Table 3. Development of Workshet MEAs Approach

The stages of MEAs Approach	Student Worksheet Components
<p>Stage I: Identifying the Problem</p> <p>(The problems presented in the worksheets are related to the real-life of students who often meet objects that resemble triangle shapes)</p>	<div style="text-align: center;">  </div> <div style="border: 1px dashed green; padding: 5px; margin: 10px 0;"> <p>Triangular shapes are widely used in everyday life. Here are some examples in everyday life that use triangular shapes.</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p style="text-align: center; font-size: small;">Figure 1. rulers and cake traditional</p> </div> <div style="display: flex; justify-content: space-between; align-items: center; margin-top: 10px;">  <div style="border: 1px solid red; border-radius: 10px; padding: 5px; width: 200px;"> <p>A triangular hijab is usually used for Muslims.</p> </div> </div>
<p>Stage II Simplifying Problem</p> <p>(Generating students' critical thinking skills towards real problems presented in the student worksheet)</p>	<div style="text-align: center;">  </div> <div style="border: 1px solid orange; border-radius: 15px; padding: 10px; margin: 10px 0;"> <div style="display: flex; justify-content: space-between; align-items: center;">  <div> <p>Did you know?</p> <p>Is there an equilateral triangle that is a obtuse triangle?</p> </div> </div> <div style="padding: 10px;"> <p>Did you know that there is no equilateral triangle that is a obtuse triangle? Why? Also there is no equilateral triangle which is a right triangle, why yes? In this subsection you will learn the types of triangles based on the length of the sides and the size of the angle. By following the steps you will find the reason for those questions. follow the steps to find the type of triangle based on the length of the sides and the size of the angle!</p> </div> </div>

Stage III
Building a mathematical model

(Helping students construct their knowledge to build a mathematical model of a problem)



Building a mathematical model

Types of triangles based on the length of the sides and the size of the corners are divided into:

.....

.....

.....

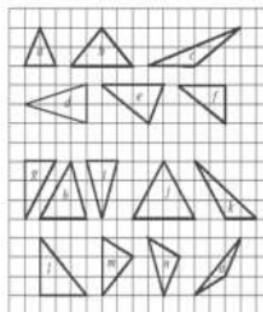
Fill in the following table according to the information you obtained !

	Acute Triangle	Right Triangle	Obtuse triangle
Isosceles Triangle			
Equilateral Triangle			
Scalene Triangle			

Stage IV
Transforming and solving model

Transforming and solving model

Classification that triangular below :



- types of triangles based on the length of the sides
- types of triangles based on the size of the angle
- types of triangles based on the length of the sides and the size of the angle



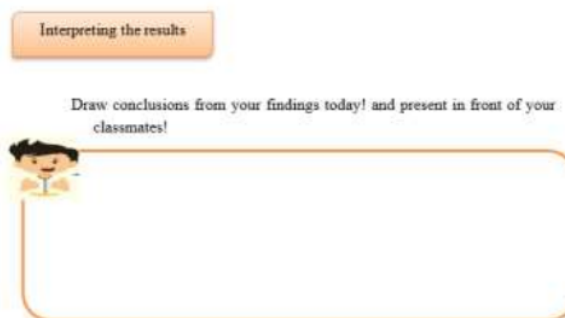
types of triangles based on the length of the sides

types of triangles based on the size of the angle

types of triangles based on the length of the sides and the size of the angle

1	Isosceles triangle (a, b, d, i, j, n dan o)	Acute triangle (a, b, d, e, h, i, j, m, n dan o)	Isosceles-acute triangle (a, b, d, i, j, n, dan o)
2			
3			
4			
5			
6			
7			

Stage V
Interpreting the results



The prototype student worksheet with triangle material with the MEAs Approach for grade VII students had completed; the next stage is editing/reviewing teaching materials. Two mathematics education lecturers carried out LKS validation and one mathematic subject teacher from Class VII as validators to obtain assessments, input, and suggestions for improving the product. Data recapitulation by expert validation can be seen as follows in table 4.

Table 4. Recapitulation Data Validity Expert

No	Aspect	Validator			$\sum v$	%	Description
		V1	V2	V3			
A	LKS Format	82	90	85	257	86	Very Valid
B	LKS Content	80	80	80	240	80	Valid
C	Language	86	86	84	256	85	Very Valid
D	Graphic	92	88	90	270	90	Very Valid
Average ($\frac{A+B+C}{4}$)					85%		Very Valid

Based on the results of expert validity, the researcher made improvements according to the validator's suggestions. Among them are: (1) clarity of material images on worksheets; (2) Student worksheet has not fulfilled the principles of the MeAs approach; (3) errors in writing text; (4) the use of fonts and font sizes should be consistent; (5) the use of image icons should represent the components of the worksheets, for example, the doctor icon in "did you know?" should be replaced with a teacher icon. All suggestions and criticisms from the validator revised by the researcher and then shown back to the validator to obtain a final prototype of the student worksheet with the MEAs approach.

The fourth stage is the implementation stage, namely product testing in small groups totaling 32 from VII grade students, which was conducted four times. At the beginning of the class meeting, the researcher distributed worksheets to students before the learning process started with the aim of allowing students to read and study the contents of the worksheets. At this meeting, the researcher also explained the instructions and steps in using worksheets with the aim that students would be easier to work on the worksheets and had no difficulty understanding the commands in the worksheets during learning. The teacher organizes students into groups of 3-4 people per group. Each group was directed to solve the problems stated in the LKS and find solutions to these problems together. At the end of the lesson, researchers and students reflect to review the material studied briefly and ask students to read the following sub material. Furthermore, after trying out the student worksheets, the researchers distributed questionnaires to students to get practical responses from the student worksheet products

developed. At the last meeting, the deepening test of triangle material was given to see the effectiveness of using the worksheets that have been developed.

The fifth stage is the evaluation stage; at this stage, the researcher evaluates practicality results, as shown in table 5.

Table 5. Recapitulation Data Practical of Student' Worksheet with MEAs Approach

Aspect	Average Practical Score	Category
Legibility	77%	Practical
Attractiveness	72%	Practical
Efficiency	70%	Practical
Conclusion	73%	Practical

In table 5. the average practicality score is in the efficient category. Next, evaluate the test results, as shown in table 6.

Table 6. Recapitulation Data of Material Deepening Test

Indicator	Average Score	Category
Explain the meaning of the triangle	92%	Very High
Describe the types of triangles based on side lengths and angles	87%	Very High
Find the area and perimeter of the triangle	83%	High
Conclusion	87%	Very High

From table 6 above, the average score of the deepening test of triangle material is 87%; this indicates a very high category, the acquisition value is increasing more than the minimum completeness criteria (KKM) that is 75 so that the researchers concluded that the students worksheet with the MEAs approach is useful to use.

Based on the validity, practicality, and effectiveness data obtained, it concluded that the student worksheet with the basic mathematical concept approach developed is suitable to use for VII grade students of Triangle Material.

The essence of MEAs is the creativity of learners in learning. Chamberlin stated that creativity is the main thing that is put on MEAs and plays an important role in the success of learners in mathematics. With the presence of MEAs, the ability of learners to generate creative mathematical ideas in creating their own models to solve mathematical problems in response to well structured problems. So hopefully this makes the creative thinking ability of learners will develop.[9] and then Through modelling, the students are accustomed with the modelling steps, namely: simplifying the problem; making mathematical model; transforming and solving the problem with the model; then interpreting the result. This is potential to improve students' problem solving skill.

4. Conclusion

The product developed was a worksheet with the MEAs approach in triangle material using the ADDIE method; it concluded that: final prototype of the LKS product developed had suitable with the principles of the MEAs approach, namely identifying problems, simplifying problems, building mathematical models, transforming and solving models, and interpreting the results; The quality of the

student worksheet product declared very valid with 85 % acquisition score and very practical with 73% acquisition score. The effectiveness of the worksheets product developed shows 87% is useful in learning triangle material.

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