

# Developing Geometry Students Worksheet Based on Realistic Mathematics for Learning in Elementary School

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**Abstract:** This study aims to develop Geometry Students Worksheet based on Realistic Mathematics for Learning in Elementary Schools. This study conducted for one year in elementary schools in DKI Jakarta. This study is a research and development (Research & Development/R & D) using mixed methods research with adapted from the models of Borg and Gall and models of Dick, Carey and Carey. Based on this model, there were four major stages, namely stages: (1) Research and information gathering that includes preliminary studies and needs analysis; (2) development of a draft that includes planning and developing the initial form of the product; (3) product testing and revision which includes expert testing/validation (expert judgment), one-on-one testing, small group evaluation, field testing, for each trial possible the revision of the product being developed; and (4) finalization and dissemination. The results showed that the use of Geometry Students Worksheet Based on Realistic Mathematics was able to improve the mastery of conceptual knowledge and procedural geometry of elementary school students. For that reason, Geometry Students Worksheet Based on Realistic Mathematics can be used as one of the Students Worksheet models used in mathematics learning in elementary schools. The results of this study recommend that Geometry Students Worksheet Based on problem-based learning Geometry Students Worksheet Based on inquiry, Geometry Students Worksheet Based on scientific approaches, Geometry Students Worksheet Based on 4C skills (Critical Thinking, Creative, Collaborative, and Communication), and others.

**Keywords:** *students worksheet, geometry, realistic mathematics, elementary school*

## INTRODUCTION

Mathematics is a universal science that underlies the development of modern technology, has an important role in various disciplines and advances human thinking. Mathematics is a tool to develop thinking skills, therefore mathematics is very necessary both in daily life and in the advancement of science and technology (science and technology), so mathematics needs to be given at every level of education from elementary to tertiary, even at the education of participants early age students.

Mathematical abilities achieved by students are still categorized as less satisfying. This is in line with what was stated by Minister of Education and Culture Muhadjir Effendy, not dismissing the spotlight of a number of domestic and foreign researches, related to Indonesia experiencing a Mathematical emergency. Various studies have shown, students ranging from elementary to high school levels, are considered less able to solve simple math problems. It was stated that "Mathematical emergency, yes we (Kemendikbud) have always known, if mathematics is severe. So this is not a new issue, Dikbud has understood it," said Muhadjir Effendy at the PMK Ministry of Kemenko Office, Jalan Medan Merdeka Barat, Jakarta Pusat, Monday November 12, 2018 (Yaspen Martinus). The Ministry of Education and Culture through the Indonesia National Assessment Program (INAP) in 2016 shows about 77,13% Elementary students throughout Indonesia have very low mathematical competence, which is 20.58% enough and only 2.29% which is good category. The latest research in 2018, the Research on Improvement of System Education (RISE) Program in Indonesia released the results of its study which showed that the ability of students to solve simple math problems did

not differ significantly between new students entering elementary school and those who had graduated from high school (Zubaidah, 2018).

These problems can be caused because the teacher in learning in class does not provide an opportunity to rediscover and construct mathematical ideas themselves. In fact, linking students' real life experiences with mathematical ideas in classroom learning is important so that learning is meaningful (Soedjadi, 2007). If students learn mathematics a part from their daily experiences, students will quickly forget and be unable to apply mathematics (Van de Henvel-Panhuizen, 2000).

This requires learning mathematics in class emphasizing the relationship between mathematical concepts with the daily experience of students. In addition, it is necessary to re-apply the mathematical concepts students have in their daily lives or in other fields it is very important to do. One of mathematics learning which is oriented to mathematically everyday experience and applying mathematics in everyday life is learning Realistic Mathematics.

To carry out learning that emphasizes the relationship between mathematical concepts with the daily experience of students is the use of students worksheets. Students worksheet is one important component in helping students construct objects contained in mathematics. One of the students worksheets needed in mathematics learning is the geometry students worksheet. This is designed by the teacher to help students learn the objects contained in geometry. Based on the results of a preliminary study and analysis of the needs of mathematics learning tools in elementary schools designed by elementary school teachers, it was found that there are still many weaknesses in the students worksheet. The students worksheet designed by the teacher is more about providing opportunities for students to complete assignments in the form of question exercises. Very rarely found students worksheet which is designed to provide opportunities for students to construct material through activities carried out by linking it to the daily lives of students.

For this reason, students worksheet based on realistic mathematics is needed which is able to provide opportunities for students to construct objects contained in geometry by linking to everyday life so that learning of geometry is not abstract. Through the use of students worksheet based on realistic mathematics, students are guided to be able to concretize the objects contained in geometry with everyday life. Thus, students will realize that geometry is very closely related and important in everyday life. This is consistent with the results of the study which concluded that the mathematics students worksheet for students is one of the important mathematics learning tools which is expected to be able to help students to find and develop mathematical concepts so that effective interactions between students and teachers will be formed, as well as can increase student activity in improving learning achievement (Lika Relia, 1997).

Researchers are encouraged to conduct research and development of geometry students worksheet based on realistic mathematics. The use of realistic mathematics approach, considering the realistic mathematical approach is one of the efforts to improve students' understanding of mathematics. Basically a realistic approach to mathematics guides students to "rediscover" mathematical concepts that have been discovered by mathematicians or if possible students can find things that have never been found. Learning using a realistic approach, at least can make: (1) Math is more interesting, relevant, and meaningful, not too formal and not too abstract; (2) consider the ability of students; (3) emphasizing learning mathematics in "learning by doing"; (4) facilitating the resolution of mathematical problems without using standard solutions (algorithms); (5) using context as a starting point for learning mathematics (Kuiper & Knuver, 1993).

The application of students worksheet in learning geometry with a realistic approach will instill more geometrical objects in students, so students can not only work on geometry problems by memorizing facts, concepts, principles, and skills contained in geometry. But more than that, students will understand meaningfully the facts, concepts, principles, and skills contained in the geometry. Understanding of facts, concepts, principles, and skills will make it easier for students to work on problems related to geometry, so that it can be ascertained that students' mathematics learning outcomes will improve.

## METHOD

The type of study used is Research and Development (R & D). The planning mechanism and preparation of the Students worksheet model in this study were adapted from the Borg and Gall model and the Dick, Carey and Carey models. There are four major stages in this study, that is (1) the study and information gathering phase which includes a preliminary study and needs analysis, (2) the stage of developing a draft that includes planning and developing the initial form of the product, (3) the trial and product revision phase which includes expert judgement, one to one evaluation, small group evaluation, field test, where in each trial it is possible to make a revision of the product being developed, as well as the last, and (4) finalization and dissemination stages. The study was conducted in grade IV elementary school in Jakarta. This study uses several instruments that is questionnaires, interview guides, and tests. The instrument is used for needs analysis and trials conducted four times, that is expert test/validation, one-on-one test, small group test and field test. Analysis of the results used expert test/validation, one-on-one test, small group test and field test. Data processing results of validation using a Likert scale consisting of a score range of 1-5 (Riduwan, 2015). Validation results are used to determine the feasibility of Students worksheet which is developed and interpreted in the form of percentages as follows:

**Table 1.** Interpretation Criteria Score

Value	Criteria
0 - 20	Not Feasible
21 - 40	Less Feasible
41 - 60	Quite Feasible
61 - 80	Feasible
81-100	Very Feasible

Based on the feasibility criteria, the developed Students worksheet was declared feasible if it obtained a percentage of  $\geq 61\%$  (Riduwan, 2015). The student response questionnaire consists of answers "Yes" (score 1) and "No" (Score 0) (Riduwan, 2015). Data from the responses of students used to determine the empirical Students worksheet feasibility developed was measured using the following equation:

$$Response (\%) = \frac{Total\ Score}{Total\ Maximum\ Score} \times 100\%$$

## RESULTS AND DISCUSSION

The planning and preparation mechanism of the student geometry worksheet in this study was adapted from the Borg and Gall model and the Dick, Carey and Carey model. Based on this model, there are four major stages, namely stages: (1) Research and information gathering

which includes preliminary studies and needs analysis; (2) developing a draft that includes planning and developing the initial form of the product; (3) trials and product revisions that include expert judgement /testing, one to one evaluation, small group evaluation, field tests, at each trial it is possible revision of the product developed; and (4) finalization and dissemination.

### ***Research and Information Collection***

In the needs analysis phase, researchers conducted observations on mathematics learning geometry material in grade IV SDN Guntur 09 Pagi and interviews with grade IV elementary school teachers about the use of the Students worksheet in learning. The results of direct observation, it was found that teachers rarely use the Students worksheet. Existing the Students worksheet only contains a collection of questions so it is less attractive to students. Students worksheet used is not based on RME. Interview results show that the Students worksheet is rarely used in learning. The results of these observations and interviews are used as researchers as a basis for developing the Students worksheet based on realistic mathematics.

### ***Draft Development***

The purpose of this Students worksheet product development research is to improve students' abilities about geometry material. Researchers take two basic competencies with the following indicators:

**Table 2.** Basic Competencies and Mathematical Indicators for Class IV Geometry Materials

<b>Basic Competencies</b>	<b>Indicators</b>
3.12 Explain and determine the angular size of a flat shape in standard units using a protractor	- Determine the size of the angle on a flat figure in standard units using a protractor.
4.12 Measure angles on a flat figure in standard units using a protractor	- Measuring angles on a flat shape in standard units using a protractor - Compares the angular size of a flat shape in standard units using a protractor.

### ***Product Trials and Revision***

Product trials and revisions include expert judgement, one to one evaluation, small group evaluation, and field test.

### ***Expert Review***

At the stage of *expert review*, the assessment was carried out by three experts, one material expert, a media expert, and a linguist expert. Assessment is done using a questionnaire. The recapitulation of the Students worksheet assessment by experts shows:

### ***Material Expert Evaluation***

The results of the assessment carried out by material experts on all aspects of the development of the Geometry Students worksheet based on realistic mathematics were captured using the following questionnaire:

**Table 3.** Results of Expertise Eligibility on Geometry Students Worksheet Based on Realistic Mathematics

No.	Aspect	Eligibility Score	Criterion
1.	Content or Material	87%	Very Feasible
2.	Purpose	85%	Very Feasible
3.	RME Approach	88%	Very Feasible
<b>Average Score</b>		86.7%	Very Feasible

### *Media Expert Evaluation*

The results of the assessment carried out by media experts on all aspects of the development of the geometry students worksheet based on realistic mathematics were captured using the following questionnaire:

**Table 4.** Result of Media Expertise Eligibility on Geometry Students Worksheet Based on Realistic Mathematics

No.	Aspect	Eligibility Score	Criterion
1.	Content Design	82%	Very Feasible
2.	Use of Language	83%	Very Feasible
3.	Presentation Techniques	88%	Very Feasible
<b>Average Score</b>		84.3%	Very Feasible

### *Linguist Evaluation*

The results of the assessment carried out by linguists on all aspects of the development of the geometry students worksheet based on realistic mathematics were screened using the following questionnaire:

**Table 5.** Result of Linguists Eligibility on Geometry Students Worksheet Based on Realistic Mathematics

No.	Aspect	Eligibility Score	Criterion
1.	Appropriate language with the level of development of students	89%	Very Feasible
2.	Communicative	90%	Very Feasible
3.	Romping and Unity	86%	Very Feasible
<b>Average Score</b>		88.3%	Very Feasible

**Table 6.** Recapitulation of Expert Test Data Analysis Results

No.	Expert Review	Average Feasibility Score	Criterion
1.	Material	86.7%	Very Feasible
2.	Media	84.3%	Very Feasible
3.	language	88.3%	Very Feasible
<b>Average Overall</b>		86.4%	Very Feasible

Based on the recapitulation results, the average overall students worksheet assessment based on expert review reached a percentage of 86.4%. Using the criterion reference criteria with a score range of 86.4% means it is very feasible.

### ***One to one Evaluation***

In the one to one evaluation stage involved three respondents in grade IV, SDN Guntur 09 Pagi. The selection of the three students was based on the recommendation of grade IV teachers. This evaluation activity is carried out by filling out a questionnaire consisting of 10 statements that are answered "yes" or "no" by students. The questionnaire contains students' opinions about three aspects, namely: aspects of students' understanding of the material, aspects of students' interest in the students worksheet, and aspects of using the Students worksheet. Based on the results of the questionnaire filled out by three students, the following results were obtained:

**Table 7.** Recapitulation Results of *One to one Evaluation*

<b>No.</b>	<b>Aspect</b>	<b>Average Score</b>
1.	Students' Understanding of the Material	100%
2.	Student Interest in the Students worksheet	100%
3.	Use of the Students worksheet	83.3%
<b>Average Overall</b>		94.4%

Based on the recapitulation results, the overall average is 94.4%, which means very good. This evaluation is also done by interviewing students and class teachers. The results of the interviews with three students were students who stated that they liked the Students worksheet mathematics of this geometry material because the material was easy to understand and in accordance with the material they were learning. According to them also the colors on the contents of the students worksheet are bright so that students are interested in learning to learn mathematics and also the use of balanced types and letters, clearly visible and easy to read.

### ***Small Group Evaluation***

At this evaluation stage, the researchers involved eight respondents from grade IV SDN Guntur 09 Pagi students. This evaluation activity is carried out by filling out a questionnaire consisting of 10 statements that are answered "yes" or "no" by students. The questionnaire contains students' opinions about three aspects, namely: aspects of students' understanding of the material, aspects of students' interest in the Students worksheet, and aspects of using the Students worksheet. The results of the small group evaluation are as follows:

**Table 8.** Recapitulation Results of *Small Group Evaluation*

<b>No.</b>	<b>Aspect</b>	<b>Average Score</b>
1.	Students' Understanding of the Material	100%
2.	Student Interest in the Students worksheet	100%
3.	Use of the Students worksheet	87.5%
<b>Average Overall</b>		95.8%

Based on the recapitulation results, an overall average of 95.8% can be obtained, which means very good. The results of interviews conducted with ten students. Shows that students really like this geometry students worksheet because the material contained in the Students worksheet is easy to understand and has bright colors so students are more interested and eager to learn mathematics.

### **Field Test**

In this evaluation phase, 32 students were involved in grade IV SDN Guntur 09 Pagi. This evaluation activity is carried out by filling out a questionnaire consisting of 10 statements that are answered "yes" or "no" by students. The questionnaire contains students' opinions about three aspects, namely: aspects of students' understanding of the material, aspects of students' interest in the students worksheet, and aspects of using the Students worksheet. Field test evaluation results are as follows:

**Table 9.** Recapitulation Results of *Field Test Evaluation*

<b>No.</b>	<b>Aspect</b>	<b>Average Score</b>
1.	Students' Understanding of the Material	95.8%
2.	Student Interest in the Students worksheet	96.9%
3.	Use of the Students worksheet	85.9%
<b>Average Overall</b>		92.9%

Based on the data obtained, the value obtained from 32 respondents is a mean score of 92.9% which means the quality of the geometry students worksheet based on realistic mathematics is very good.

The trial results and product revisions show that the geometry students worksheet based on realistic mathematics makes it easier for students to understand, increases their interest in learning mathematics, and the students worksheet is easy to use in learning mathematics. The results of this development remember the geometry students worksheet is a development of teaching materials in the form of worksheets for mathematics students that contain activities to solve problems that must be done by students so that learning objectives are achieved. The geometry students worksheets are collection sheets containing brief material, student activities and assignments that must be completed by students according to basic competencies (Pratita, Barlian, and Rivai, 2017). The geometry students worksheet is a stimulus or teacher guidance in learning that will be presented in writing so in writing it needs to pay attention to the criteria of graphic media as visual media to attract the attention of students (Fannie, R. D., & Rohati, 2014). The geometry students worksheet can make it easier for students to understand the material provided, rich in the task of practicing and practicing student learning independence. Through the geometry students worksheet feel given the responsibility to complete the task and feel they have to do it, especially if the teacher gives full attention to the results of their work, so students are actively involved in learning (Ernawati, A., Ibrahim, MM, and Afif, 2017) In the geometry students worksheet, students will get material, summaries, assignments related to the material and there are directions for understanding the material provided so that it will make students learn independently. The teacher does not give answers but students are expected to be able to solve and solve the problems contained in the worksheet with guidance or instructions from the teacher, so as to increase student learning activities (Wati, R., Suyatna, A., & Wahyudi, 2015). This is because the Students worksheet has several functions, namely: (1) As teaching material that can minimize the role of educators, but more activates students; (2) as teaching material that makes it easy for students to understand the material provided; (3) as a concise and rich teaching material for training; and (4) facilitating the implementation of teaching to students (Prastowo A, 2015: 205).

The importance of the geometry students worksheet based on realistic mathematics is that realistic mathematics encourages students to actively participate in learning mathematics. The realistic mathematics education approach can be used as an appropriate method to improve the

quality of teaching and learning. (Zakaria and Syamaun, 2017). A key principle of realistic mathematics is that students must actively participate in the learning process. Students must be given the opportunity to build their own knowledge and understanding (Syahri, 2017). Realistic Mathematics Education (RME) is a learning approach to improve mathematics learning (Lestari and Surya, 2017). The purpose of the application of RME is that mathematics learning becomes more fun and meaningful for students because students are introduced to problems in real contexts (Laurens, et al., 2018). RME provides an opportunity for students to actively participate in resolving problems encountered and seeks to examine, search for, and summarize themselves logically, critically, analytically, and systematically. This activity will encourage students to improve reasoning and thinking in a structured, open and happy manner, to deepen their knowledge independently (Fauzi, Akhmad, St. Budi Waluya, and Masrukan, 2018).

## CONCLUSIONS

Based on the results and discussion of the study, it can be concluded that the geometry students worksheet based on realistic mathematics that has been developed is declared suitable for use as teaching material for geometry because it has reached and fulfilled all the eligibility criteria, in terms of material, media, and language aspects.

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