Developing lesson plan and student worksheet on realistic mathematics approach oriented to achievement and interest in mathematics

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Abstract. This study aimed to produce lessons plan and student worksheet based on realistic mathematics approach oriented to the Achievement and Interest of mathematics learning which is good quality and fulfill valid, practical and effective criteria. This study was development research. The method used in this study was the development method of ADDIE. The ADDIE development method consists of analysis, design, development, implementation, and evaluation. The result of this study shows that the lessons plan and worksheet developed have been valid, the lesson plan is in very good quality with the average score 150.33, and the student worksheet is in good quality with the average score 117.67. The lessons plan and worksheet that have been developed is practical, with very good quality based on the teacher's assessment and good quality by student assessment. The implementation of learning activity is 98%. The results also show that lessons plan and worksheet are effective. It is shown by the improvement of achievement and interest mathematics learning of students after using lesson plan and worksheet. Achievement has high quality with average score 82 and students learning completeness percentage reaches 82%. Similarly, the questionnaire results of interest are of high quality with the average score 88.71. Therefore, the lessons plan and worksheet fulfill the criteria of validity, practicality, and effectiveness.

1. Introduction
Education has the purpose of developing intellectual intelligence. The intellectual ability can be seen from the achievement of student achievement. Of course, this intellectual ability can not be separated from many courses that are taught. Mathematics is a universal study program. This means the science of mathematics is very required in any study program. Mathematics also become the foundation of the development of modern technology like now. But, as known that the mathematical are still not fully human resources that is. It can be seen from the results of the National Examination (UN), Indonesian students have low achievement in the study program of mathematics if the mathematics result compared with other study programs. The average mathematics score of junior high school year 2015/2016 in Indonesia is 50.24 and the average of Bahasa is 70.75, English is 57.17 and Science is 56.7. Then, based on the results of
preliminary observations in Junior High School 15 Yogyakarta showed that the achievement of circle material is low. Many students feel afraid of and face difficulties in studying mathematics. Commonly, mathematics problems are made so complicated that it is difficult for the students to solve them. This condition then impacts in poor students’ cognitive achievement [2]. In student college mathematics learning achievement is also not satisfactory. The student's mathematical abilities must be improved to improve learning achievement [3]. A math teacher should be able to help foster even develop students' interest in mathematics to produce good learning outcomes [4].

And then besides of cognitive aspect, affective aspect is also needed for the students. Assessment Standards that the assessment of achievement is not only in the domain of knowledge, but the assessment is also done on the attitude and skills of students. Aspects of attitude, among others, can be in the form of interest, motivation, confidence, self-regulated learning. One of the factors that determine the success of learning mathematics is an interest [5]. Competence in learning mathematics, attitudes, and interests of students to mathematics has a very important role in the learning process and the acquisition achievement [6]. But in reality, student interest in learning mathematics has not been given much attention. It can be seen from the using of teacher-centered methods by many teachers and the result is a student in low achievement. Based on interviews with one of the teachers at one of Junior High School in Yogyakarta, the students in the school are still lacking in the interest aspect in the mathematics learning that can be seen from the learning process where the students are more likely to be silent and prefer to do other activities while studying mathematics. All are expected from teachers or teacher-centered and consequently this has an impact on student achievement in school. Beside interviewed the teachers, the researcher also interviewed the students. From interviewing the students, the researcher obtained information that the students prefer if there are no math classes or no teacher in math classes. Also, the students prefer to keep silent while teaching and learning process than to be active in the classroom. Based on the information obtained that the mathematics learning of students is still low so and it needs to be improved.

The problems that have been discussed previously shows that teachers must to find an approach in the learning that can support students to increase the potential within. One of the approaches recommended in the Curriculum 2013 is a realistic mathematical approach. The Implementation of a realistic mathematical approach provides hope for mathematics education in Indonesia to improve mathematical ability and mathematics learning achievement [7]. Learning will be more meaningful if the learning process applies the concept of realistic. But not all teachers make innovations in learning [8]. In the learning of mathematics, students are still accustomed to wait for teacher explanation, then the teacher will explain the concept of giving examples and then followed by giving the exercise while the students just sit still listening and taking notes. As mentioned before, an approach is needed to make the learning of mathematics in the classroom more meaningful [9].

Efforts are made to support the learning process good. The plan of learning needs learning kits which consist of preparing lesson plan, preparing media and sources of learning, learning assessment kits, and learning scenario. One of the components that should be in the lesson plan is learning resources. Learning resources can be printed media, books, student worksheets, or other relevant learning resources. Thus, to obtain relevant learning resources, teachers are expected to develop learning kits to support the student learning process. Especially in the hope that using learning kits can improve the student's ability of achievements and interests in mathematics learning.

Achievement is knowledge, skills, and abilities that students have developed as a result of instruction [10]. Achievement is understood in terms of standards, and these are defined as academic outcomes, which are judged against absolute or comparative criteria across a narrow range curriculum subject [11]. Interest are preferences for specific types of activities when a person is not under external pressure” [12]. Interest is assumed to be individuals’ general attitude or liking of the task that is somewhat stable over time and a function of personal characteristics [13]. Interest is now established as a motivational construct in education [14]. From the opinion of experts who have stated earlier can be concluded that interest is the feeling of someone likes to a particular object while interest in the lesson is a sense of attraction someone to learn something. Interest in this study is limited in four indicators of readability, curiosity, attention, and choice.
RME is based on the concept of mathematics as a human activity [15]. The word realistic not only shows something related to the real world but more towards a focus on emphasizing the use of a situation imaginable by students [8]. Learning using a realistic mathematical approach has three main principles, guided reinvention, and progressive mathematizing, Didactical phenomenology dan self-developed models [15].

2. Method
This research was a research development that aimed to develop lessons plan and worksheet. That was lesson plan and student worksheet. The method used in this research was the development method of ADDIE. To design the learning system. The ADDIE development method consists of analysis, design, development, implementation, and evaluation. The study was conducted in Junior High School 15 Yogyakarta in Jl. Tegal Lempuyangan DN III No. 61, Bausasran, Danurejan, Kota Yogyakarta, Daerah Istimewa Yogyakarta, 55211 on February 1, 2017, to March 9, 2017. The subject of this study was 34 students of class VIIIC in Junior High School 15 Yogyakarta,

2.1. Development Procedures

2.1.1. Analysis
The Analysis phase was the pre-planning phase of product development in the form of mathematical Lesson plan and worksheet based on a realistic mathematical approach. The analysis phase consists of needs analysis, student analysis, and material analysis.

2.1.2. Design
In this phase were arranged (1) lesson plan (2) student worksheet based on realistic mathematical approach, and (3) achievement test instrument and interest Questionnaire. Instruments will be used to measure the effectiveness of developing. Here's the phase of preparing each product development

2.1.3. Development
In the development phase, it was conducted the development of mathematics Lesson plan and worksheet in the form of lesson plan and student worksheet based on realistic mathematics approach oriented to the achievement and interest mathematics learning of students of junior high school, as well as assessment kits such as teacher assessment sheet, student achievement test. Interest Questionnaire in mathematics learning. The development lesson plan was conducted based on the rules of the curriculum 2013. Development was also adapted to the learning phase with a realistic mathematical approach. The development of worksheet was adjusted to the order of the circle material. In the learning circle material, there were 6 meetings. It have been developed and consulted with supervisors. Furthermore, after learning and assessment kits are consulted with the supervisor, validation and revision of the product is conducted.

2.1.4. Implementation
After the lesson plan and worksheet were revised, the researcher proceeds at the implementation phase. At this phase, the researcher would test the product of draft 2. The experiments implemented are trying out of instrument test and questionnaire, small group trial (Trial limited), field trial

2.1.5. Evaluation
This phase will be conducted by referring to the results of experimental learning mathematics kits. At the evaluation phase, the analysis of practicality and effectiveness of Lesson plan and worksheet based on a realistic mathematical approach.

2.2. Data, instrument and techniques data collection
The results of this study consist of quantitative data and qualitative data. Instruments in this research are: (1) validation sheet to validate student worksheet, lesson plan, achievement test and questionnaire of interest (2) practicality assessment sheets by teachers and students; (3) observation sheet of learning
implementation; (4) test of achievement; And (5) a questionnaire of interest in learning mathematics. Data collection techniques in this study using test and non-test techniques. Instruments in this study were first validated by three validators. Then Instruments are tested to see effectiveness and to see their reliability value estimates. The instrument is said to be reliable if the minimum score of the estimated reliability is 0.65 [16]. The instrument has been reliable because the cronbach's alpha of achievement test is 0.798 and the cronbach's alpha of interest questionnaire is 0.781. Besides estimating the reliability of the instrument it is also analyzed different power, the level of difficulty and effectiveness of distractor achievement test, the results of achievement test learning has very good quality. Then the researcher also conducted a factor analysis on the questionnaire of interest mathematics learning questionnaire were items good statement and it can be used

2.3. Data Analysis
The data obtained from the results at the development phase were then analyzed to get the criteria of validity, practicality, and effectiveness. Data in the form of expert validation score, teacher's practicality score, learning achievement score, interest questionnaire score. Score got in the form of five scale scores then converted into qualitative criteria with criteria as follows.

**Table 1. Conversion Score into score value 5.**

| Score Interval                                      | Quality         |
|----------------------------------------------------|-----------------|
| $X > X_i + 1.8 SBi$                                | Very Good (VG)  |
| $X_i + 0.6 SBi < X \leq X_i + 1.8 SBi$             | Good (G)        |
| $X_i - 0.6 SBi < X \leq X_i + 0.6 SBi$             | Good Enough (GE)|
| $X_i - 1.8 SBi < X \leq X_i - 0.6 SBi$             | Not Good (NG)   |
| $X \leq X_i - 1.8 SBi$                             | Very Bad (VB)   |

Expert validation results for lesson plan, and student worksheet then summed, calculated the average ideal score and standard deviation ideally, then determined the category by referring to Table 2 Here the results of the category

**Table 2. Validity Criteria of student worksheet and lesson plan.**

| Interval student worksheet | Interval lesson plan | Criteria               |
|----------------------------|----------------------|------------------------|
| $X > 147$                  | $X > 147$            | Very Good (VG)         |
| 119 < $X \leq 147$        | 119 < $X \leq 147$   | Good (G)               |
| 91 < $X \leq 119$        | 91 < $X \leq 119$    | Good Enough (GE)       |
| 18 < $X \leq 91$        | 18 < $X \leq 91$     | Not Good (NG)          |
| $X < 18$                  | $X < 18$             | Very Bad (VB)          |

To obtain the practicality data of Lesson plan and worksheet, the researcher uses the practicality assessment result of the teacher, the result of the practicality assessment from the student, and the observation data of the implementation of the learning in the classroom. The following descriptions of each data analysis are practical. Assessment is done by calculating the number and average score given by the teacher on the assessment sheet. It is said to be practical if the minimum is in good quality.

**Table 3. Practically criteria.**

| Teacher | Student | Criteria               |
|---------|---------|------------------------|
| $X > 147$ | $X > 88.2$ | Very Good (VG)         |
| 119 < $X \leq 147$ | 71.4 < $X \leq 88.2$ | Good (G)               |
| 91 < $X \leq 119$ | 54.6 < $X \leq 71.4$ | Good Enough (GE)       |
2.4. Effectiveness Analysis Reviewed From Achievement Test

- Providing score answers on each item answers obtained by students based on the assessment rubric that has been made.
- Calculating value obtained each student. A score converted by using scale 5 according to widoyoko (2014: 238) [17].
- Comparing the scores of students with minimum completeness criteria (KKM) in Junior High School 15 Yogyakarta is 75.
- Calculating the percentage of students who have achieved the KKM score with the following formula. \( K = \frac{T}{S} \times 100\% \). Where \( K \) is percentage of completed students, \( T \) is Many students are completed, \( S \) is Number of students.
- Next perform a qualitative assessment of results, effectiveness criteria of achievement \( X > 80 \) is very high, \( 60 < X \leq 80 \) is Height, \( 40 < X \leq 60 \) is Medium, \( 30 < X \leq 40 \) is Low \( X < 30 \) is very low.

Based on the table and based on the classical completeness standard lesson plan and worksheet is effective if at least 75% of students have achieved completeness.

2.5. Effectiveness Analysis Reviewed from Interest Questionnaire

- Analysis of Effectiveness Viewed From Questionnaire Interest Learning Mathematics of Students
- Calculating interest score obtained by students from questionnaire of student by using scoring guidance.
- Calculating the number of scores obtained from the student.
- Calculating the average score obtained by students from the questionnaire of interest and learning mathematics students in the following way. \( \text{Average Score} = \frac{\text{Total Score}}{\text{items}} \).
- Converting the average score earned into qualitative score according to the criteria of scale 5 according to Widoyoko (2014: 238).

Lesson plan and worksheet based on realistic mathematical approach is to be effective if. Total classical score of interest questionnaires and math learning achievement of students after using learning tools developed more than the total score questionnaire interest in learning mathematics before using lesson plan and worksheet, the minimum average score is in high quality.

3. Result and Discussion

3.1. Analysis of Practical Data

As has been stated before that the data of practicality will be obtained through the data of teacher assessment results, student assessments, and observation of the learning implementation. Lesson plan and worksheet based on the teacher's assessment result data has a total score of 155 and an average of 4.43 using the interval of practicality criteria of the score indicates that the learning tool has been practical with very good quality. Furthermore, based on the student's assessments, in this case, the subjects taken are the students of class VIII C which are 34 students, the total score of 34 students is 2644 and the average is 77.76. The score indicates that the lesson plan and worksheet that have been developed have been practical in good quality. Then based on the observation of the learning implementation has shown that lesson plan and worksheet developed have been practical with very good quality which the average of the results of the observation analysis of the implementation is at 98% percentage.
3.2. Analysis of Effectiveness Data
In this study the effectiveness of lesson plan and worksheet that have been developed shown by the result of achievement tests and the results of the interest learning mathematics questionnaire of students. Previously, researchers conducted pre-research data by providing achievement test and interest learning mathematics questionnaire, the results of pre-research showed that student achievement is no one student complete or the percentage of students who Complete is 0%. Then the interest questionnaire of students showed an average of 81.15 so that the interest of the students before the action was in the medium quality. Then to get effectiveness data is conducted after the learning is done. The result of achievement test results are 24 students or 71% of students complete in the test. From both tests, it can be seen that there is a significant increase between before and after learning using learning mathematics kits, it shows that lesson plan and worksheet have been effective. Furthermore, as has been stated before to measure the effectiveness of the kits also seen from the interest of learning mathematics questionnaire. For the interest in learning mathematics, the questionnaire shows 9% or 3 students are at very high quality, 47% or 16 students are at high quality and 44% or 15 students are in the medium quality. Overall the average score of student interest is 88.71 it is indicated student's interest is of high quality. From the data, after the learning seen there is an increase between before and after learning using the kits. And this also shows that learning mathematics kits have been effective.

3.3. Implementation Result
3.3.1. Expert Validation
The Validation phase is the phase before a product implemented. At this phase, the researcher gives the products and instruments to the validator to checked and assessed the validity of the products and instruments. Validators assessing this instrument is three validators. From the assessment of the three validators, the results obtained that the products and instruments that have been developed is feasible and ready for use for field trials.

3.3.2. Field Test Result
This field trial phase is the phase to obtain the practicality and effectiveness data of the developed product. The result of the analysis of the practicality of lesson plan and worksheet is shown in Table 4.

| NO | Instruments                  | Skor | Average | Quality |
|----|------------------------------|------|---------|---------|
| 1  | lesson plan                 | 47   | 4.273   | VG      |
| 2  | student worksheet           | 43   | 4.778   | VG      |
| 3  | Test                        | 33   | 4.125   | G       |
| 4  | Implementation of learning  | 32   | 4.571   | VG      |
|    | Total                        | 155  |         | VG      |
|    | Average                     | 4.43 |         |         |

The data assessment collection of students is conducted student worksheet that students use during the learning process. Student's assessment is for all aspects of usefulness, clarity of guidance and language on student worksheet as well as instruments, writing procedures of student worksheet and instruments.

| NO | Aspects assessed | Amount | Average | Quality |
|----|------------------|--------|---------|---------|
| 1  | student worksheet| 1886   | 55,47   | G       |
| 2  | Test instruments | 794    | 23,35   | G       |
|    | Total Score      | 2644   |         |         |

An Overall Average 77.76 G
Learning activity data is obtained by doing the learning process about circle material as much as 6 meetings. Observation data result of learning activity is used to see the learning steps using the realistic mathematical approach which has been done. The observation sheet is based on the steps already in the lesson plan. Observation of the implementation of learning activity is done by mathematics teacher in Junior High School 15 Yogyakarta. Data observation results of the implementation of learning activity can be seen in Table 6.

**Table 6. Analysis result of learning implementation.**

| Class of VIII C | Meeting | Average |
|----------------|---------|---------|
| Score          | 1       | 23      |
|                | 2       | 24      |
|                | 3       | 25      |
|                | 4       | 25      |
|                | 5       | 25      |
|                | 6       | 25      |
| Percentage (%) | 92%     | 96%     |
|                | 100%    | 100%    |
|                | 100%    | 100%    |
|                | 98      | 98%     |

From Table 6 it is seen that the implementation of learning activity at each meeting percentage of more than 85% and the average score of learning implementation is 98.67 with a percentage 99%. Show that the implementation has more than 85%. This suggests that learning tools that have been developed reach practical criteria.

Data on the effectiveness of mathematics lesson plan and worksheet based on realistic mathematics education is obtained from the test of achievement test and interest of learning mathematics questionnaire. All tests and questionnaires are given before and after the learning process using the lesson plan and worksheet are done. Here are the results of the analysis effectiveness of kits

**Table 7. Analysis result of achievement test.**

| NO  | Description             | Interest Score |
|-----|-------------------------|----------------|
| 1   | Total Students          | 34             |
| 2   | Many Completed Students | 27             |
| 3   | Many Uncompleted Students | 7             |
| 4   | The Lowest Score        | 50             |
| 5   | The Highest Score       | 90             |
| 6   | Percentage of uncompleted students | 21% |
| 7   | Percentage of completed students | 79% |
| 8   | Average Score           | 77             |
| 9   | Quality                 | High           |

**Table 8. Analysis result of learning mathematics interest.**

| Quality    | Before Learning | After Learning | |
|------------|-----------------|----------------|
|            | Amount of Students | Percentage | Amount of Students | Percentage |
| Very High  | 2               | 6%            | 5               | 15%       |
| High       | 7               | 21%           | 23              | 68%       |
| Medium     | 24              | 71%           | 6               | 18%       |
| Low        | 1               | 3%            | 0               | 0         |
| Very Low   | 0               | 0             | 0               | 0         |

Based on the results of the analysis effectiveness, lesson plan and worksheet developed have been effective when viewed from achievement and interest and mathematics learning of students.

4. Conclusion

Based on the development and research, it can be concluded that lesson plan and worksheet based on realistic mathematical approach oriented to achievement and interest mathematics learning of students obtained the following results: Quality lesson plan and worksheet developed based on realistic
mathematical approach oriented to achievement and Interest, mathematics learning of students is determined based on three criteria that is valid, practical and effective. Based on the validator's assessment, the products developed in lesson plan and student worksheet have got valid criteria with very good quality. The lesson plan and worksheet that have been developed are practical, with very good quality based on the teacher's assessment and good quality by student assessment. The implementation of learning activity reaches 98%. The results also show that lesson plan and worksheet are effective. It is shown by the improvement of achievement and interest mathematics learning of students after using lesson plan and worksheet. Achievement has high quality with average score 82 and students learning completeness percentage reaches 82%. Similarly, the questionnaire results of interest are of high quality with the average score 88.71. Therefore, the lesson plan and worksheet fulfill the criteria of validity, practicality, and effectiveness.

5. Acknowledgement
I would like to express our appreciation to Junior High School 15 Yogyakarta for the support in this research.

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