The Development of Learning Device Based on the Discovery Learning Model Which is Oriented with Natural Disaster Mitigation Towards Mathematical Analyzing Ability of Pupils in Grade VIII of Middle School

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Abstract. This study aims to produce mathematics learning media based on the discovery learning model, which is oriented to natural disaster mitigation towards the mathematical analyzing abilities of grade VIII in Junior High School students. This media was developed based on the results of a mathematical analyzing skills test and the results of a questionnaire on disaster mitigation at MTsN 1 Padang. Based on the results, it can be concluded that the mathematical analyzing abilities of students were still very low by the achievements of 20.7%. However, in natural disaster mitigation, the survey results showed that 88.9% of MTsN 1 Padang students showed that there was no socialization and learning treatment about natural disaster mitigation. This research is development research. The development model used in this research was the Plomp model, which consists of three phases: preliminary research, prototyping phase, and assessment phase. The results of the analysis of the data based on the lesson plan (RPP) and (LKPD) validation sheets showed that the mathematics Learning media based on the discovery learning model which oriented to natural disaster mitigation on the mathematical analyzing abilities of students have been valid in terms of construct and content and have also been practical in terms of implementation and easiness of use, which an average of 80.3% and it was also effective for improving students' mathematical analyzing abilities by achievement of 73.84%.

1. Introduction

Students' mathematical analyzing abilities have not matched in expectations reanalyzing ability is one of mathematics subject objectives \([1]\). The low ability of students' mathematical analyzing could be seen from the results of studies that have been conducted at MTsN1 Padang. The concrete evidence of low analyzing abilities was obtained based on the results of the initial tests of analyzing abilities given. For the analyzing ability test, the achievements obtained by students were still very low, for indicators of the ability to compile evidence, provide reasons, or evidence of the correctness of the solution by the achievement of about 30.7%. On the other hand, for the indicator of drawing conclusions from statements, the achievement was about 10.7%. Related to the achievements obtained by students, it showed that students' mathematical analyzing abilities still need to be improved. The main obstacle of students’ slackness in mathematical analyzing ability was because they were not accustomed to various questions at the analyzing levels and the explanation of learning models, which weren’t able to...
improve students' mathematical analyzing abilities. It can also be referred to as the results of the 2018 PISA study. Indonesia only has got a ranking of 63 out of 70 participants.

Apart from the mathematical analyzing abilities of students, researchers are also interested in observing how students' knowledge of natural disasters was. It was because Indonesia was in 36th position by a risk index of 10.36 below India and Iceland [2]. This was in line with Government’s programs due to a lack of knowledge about natural disasters. Therefore, learning about disaster mitigation is needed. Moreover, the President of the Republic of Indonesia asked ministries and agencies to increase the awareness of students in facing disasters. It was stated by the President in a plenary cabinet session at the State Palace, Jakarta, Monday (7/1/2019). "As a country in a prone place with natural disasters, a ring of fire, we must be ready to respond and take responsibility for dealing with all-natural disasters. I asked for better, consistent, and earlier education to enter the content of our education system," said President Jokowi, as quoted by Antara. from [3].

In accordance with the government program which desired to integrate knowledge of natural disasters into subjects in school. It has been seen that there was no single subject that integrates knowledge of natural disasters learning in schools. Therefore, based on that fact, the researcher is interested in applying it in one of the subjects at school, learning mathematics. And to find out how the knowledge of students regarding natural disaster response was and to know whether schools have been provided socialization about disaster response or not. The researcher distributed a questionnaire, and it got about 65% of students' knowledge about disasters. However, the attitudes of students’ disaster response were only about 51.7%. About 31% of the students were indifferent. Students stated that they did not get socialization or learning about natural disaster response for about 88.9%. Based on the above explanation, it could be concluded that the knowledge of students about disaster response was still low due to the absence of socialization about the importance of natural disaster background knowledge. Despite it, some of the students also ignored it because there was no relation knowledge with learning program at school. It was so upset because MTsN 1 Padang school is one of the schools that is prone to flooding during heavy rain. Therefore, it is a chance for MTsN 1 Padang students to become aware of disaster response. Based on the fact above, the researchers were interested in conducting research at MTsN 1 Padang. It hoped that students of MTsN 1 Padang could be more aware and looking for the importance of knowledge of disaster response.

Referring to the problem of students' mathematical analyzing abilities, the researchers composed a study of the application of the discovery learning model. Discovery learning-based model was the suitable choice for the development of this Learning media [4] - [8]. The advantages of this learning model showed that students were actively thinking and analyzing to find out the result. In addition, students got better understanding of the material which they were studying. It was because the students had their own experience with the process of constructing the material that they were learning. This way would be more meaningful and activate their long-term memories. [9].

Based on the explanation above, the researcher conducted the developed research entitled "The Development of Learning media Based on the Discovery Learning Model which Oriented to Natural Disaster Mitigation of the Mathematical Analyzing Ability of grade VIII Junior High School Students".

2. Materials and Methods
This research was part of developed research. Borg and Gall [9] stated that developed research is a research method that is used to develop or validate products used in education and learning. The developed model used was the Plomp developed model. Plomp divides the developed stage into three stages: preliminary research, the development or prototyping phase, and the assessment phase [10].

This article discussed the practicality of learning designs in one to one evaluation and small group evaluation stages. The subjects were students of grade VIII MTsN 1 Padang. The students who were involved in one-to-one evaluation stage were three students, and the students who were involved in the small group evaluation stage were six students, which differed inabilities. The data collection
The descriptive techniques were used to describe the data of the interview result. Practicality questionnaires were arranged in the form of a Scale-Likert. This scale was arranged in a positive category so that the positive statement got a score in accordance with what Arikunto had stated [11]. 4 points for very agree (VA), 3 points for agree (A), 2 points for disagreeing (DA), 1 point for very disagree (VDA). Questionnaires of practicality or practicality of learning designs were described using frequency analysis techniques with the formula by Riduwan [12]. Learning design is practical if the average practicality value is more than or equal to 75 [13].

3. Results and Discussion
Lesson plan (RPP) and LKPD validation activities which 2-dimensional plane topic was carried out to prove the validity of the product in terms of content and constructs that would be used for the one to one evaluation and small group evaluation trials in this study. Validation was carried out by 3 mathematics lecturers, bahasa lecturer and an educational technology lecturer. Mathematics lecturers validated starting from the aspect of dictation or presentation, material, and content aspects, a bahasa lecturer validated starting from the linguistic aspect and an educational technology lecturer validated starting from the aspect of graphics or appearance. In general, the aspects which became the assessment of the lesson plan (RPP) can be showed in Table 1.

| No. | Aspects                                      | Validity Score | Category       |
|-----|----------------------------------------------|----------------|----------------|
| 1   | Component of Lesson Plan (RPP)               | 3.6            | Perfectly Valid|
| 2   | Identity of Lesson Plan (RPP)                | 3.6            | Perfectly Valid|
| 3   | Indicator of Competency Achievement          | 3.5            | Perfectly Valid|
| 4   | Learning Objectives                          | 3.6            | Perfectly Valid|
| 5   | Teaching Materials                           | 3.3            | Perfectly Valid|
| 6   | Learning Strategy                            | 3.6            | Perfectly Valid|
| 7   | Learning Activity                            | 3.4            | Perfectly Valid|
| 8   | Learning Sources                             | 3.6            | Perfectly Valid|
| 9   | Assessment                                   | 3.6            | Perfectly Valid|
| 10  | Language structures and writing              | 3.4            | Perfectly Valid|
| 11  | Lesson Plan (RPP) benefits                   | 3.3            | Perfectly Valid|
|     | **Average of validity**                     | **3.5**        | **Perfectly Valid** |

Overall analysis of LKPD validation can be seen in Table 2.

| No. | Validity Aspects    | Validity Score | Category |
|-----|---------------------|----------------|----------|
| 1   | Contents and Presentations | 3.4            | Valid    |
| 2   | Language            | 3              | Valid    |
| 3   | Graphic and Display | 3              | Valid    |
|     | **Average of validity** | **3.1**        | **Valid** |

Based on Tables 2 and 3, it can be concluded that generally, the lesson plan (RPP) and LKPD which based on the discovery learning model had been valid. To determine the validity of Learning media, the researcher used the Walpole formula [15].

The one to one evaluation activity aimed to identify possible mistakes such as poor grammar, incorrect spelling, unclear clues, suitable examples, the systematics of the material, easiness of use, students’ satisfaction, and interest. During one to one evaluation activity, students were called one by
one to conduct interviews. During this activity, the researcher was sitting down together with students who were using / reviewing the LKPD which had been compiled by the researcher. In this activity the researcher paid attention to which parts were difficult for students in understanding the content of the LKPD. It would be a consideration for developed LKPD. After doing some improvements in the one to one evaluation activity, then a small group evaluation activity was carried out consisting of 6 students who were divided into 3 groups. At the end of the one to one evaluation and small group evaluation meeting, the aim was to determine the practicality of the product. The practical results of the students’ response questionnaire in the one to one evaluation stage can be seen in Table 3 below.

| Table 3. Overall Average Results of Student Practicality Questionnaire for Stage One to One |
|-----------------------------------------------|---------------------------------|--------------------|----------------|
| No.   | Aspects of Assessment | Students’ Practicality | Average of Practice | Category |
|       |                   | R   | S   | T   |                   |         |
| 1     | The easiness of use | 20  | 22  | 21  | 75%               | Practical |
| 2     | Time efficiency    | 3   | 2   | 4   | 75%               | Practical |
| 3     | LKPD benefits      | 18  | 17  | 19  | 75%               | Practical |
|       | Overall Average of Practicality | 75% | Practical |

Based on Table 4, the average practicality level of LKPD which based on discovery learning models that oriented to natural disaster mitigation, the 2-dimensional plane topic according to the feasibility questionnaire was 75%. So it can be concluded that LKPD based on discovery learning that oriented towards practical natural disaster mitigation was practical based on its feasibility.

| Table 4. Overall Average of Practicality Questionnaire Results in Small group evaluation stage |
|-----------------------------------------------|---------------------------------|--------------------|----------------|
| No.   | Aspect               | Average of Practicality | Category |
| 1     | Easiness of usage    | 75%               | Practical |
| 2     | Time efficiency      | 50%               | Practical |
| 3     | LKPD benefits        | 75%               | Practical |
|       | Average of Practicality | 80.3% | 66.6% |

Based on the description of Table 5, the analysis of the results in easiness of usage was with an average of 80.9%, time efficiency with an average of 79.1% and for LKPD benefits with an average of 81%. The total average of the students’ response questionnaire analysis was 80.3% with the practical category, so it can be gathered that the use of LKPD based on discovery learning models that oriented to mitigating natural disasters, 2-dimensional plane topic were practical according to the students' responses.

Practicality questionnaires were given to grade VIII mathematics teachers at MTsN 1 Padang. The results of the practicality questionnaire of teacher responses could be seen in table 5.

| Table 5. The Overall Average of the Teacher Response Practical Questionnaire Analysis Result. |
|-----------------------------------------------|---------------------------------|--------------------|----------------|
| No.   | Aspect               | Average of Practicality | Category |
| 1     | Easiness of usage    | 80.9%               | Practical |
| 2     | Time efficiency      | 79.1%               | Practical |
| 3     | LKPD benefits        | 81%                 | Practical |
|       | Overall Average of Practicality | 80.3% | Practical |

Based on the analysis of the teachers’ response questionnaire for time efficiency was only about 50%, the teacher gave suggestions on the prism and pyramid volume material that the time was divided into two meetings because these materials were quite a lot. So, the time needed for 1 meeting was insufficient. The next activity was to investigate the effectiveness of the device. The effectiveness
of learning devices is related to the impact or effect of the designed device on students [16]. The effectiveness of the research was conducted to observe how effective the extent of usefulness and benefits of learning media based on discovery learning models that oriented to natural disaster mitigation on the mathematical analyzing abilities of students. This effectiveness assessment was done by giving analyzing ability test questions to students. Test results could be used to evaluate various aspects of the teaching process. Based on the data analysis, there were 3 out of 6 students above the specified minimum of standard score (KKM) which is ≥ 78. The results of the analyzing ability test could be seen in table 6.

| No. | Students' Name | Points | Scores | Category  |
|-----|----------------|--------|--------|-----------|
| 1   | A              | 41     | 80.4   | Very good |
| 2   | B              | 40     | 78.4   | Good      |
| 3   | C              | 41     | 80.4   | Very good |
| 4   | D              | 37     | 70.6   | Good      |
| 5   | E              | 36     | 70.6   | Good      |
| 6   | F              | 36     | 70.6   | Good      |

The researcher had also analyzed the percentage of students' answers for each indicator of mathematical analyzing ability. The results of the analysis can be seen in Table 7.

| Indicators                                                                 | Percentage | Category          |
|---------------------------------------------------------------------------|------------|-------------------|
| The ability of proposing the hypothesis                                    | 83.3 %     | Very Successful   |
| The ability of mathematical manipulating                                  | 79.1%      | Very Successful   |
| The ability of conducting the evidences                                   | 91.6%      | Very Successful   |
| Finding patterns or properties of mathematical phenomena to generalize    | 66.6%      | Successful        |
| The ability of making conclusion from the statements.                     | 48.6%      | Almost Successful |
| **Average percentages**                                                   | **73.84%** | **Successful**    |

Seeing the effectiveness of the analyzing ability test carried out on the analyzing ability test consisting of 4 questions, each problem contains analyzing indicators and from the test an average of about 75.4 was obtained with good criteria and for the value of mathematical analyzing skills of students obtained an average of 73.84% with Both categories of the above explanation can be said to be effective Learning media to improve students' mathematical analyzing abilities. It was emphasized by Trianto in the Ministry of Education and Culture that every student is said to have completed his learning (individual completeness) if the proportion of students' answers is correct ≥ 65%. [17]. Good Learning media should be valid, practically effective. Validation in a development research includes content validation and construct validation. Content validity aims to measure certain specific objectives that are parallel to the material or content of the given lesson, while construct validity is the suitability of the arrangement of the device with discovery learning model-based learning oriented to natural disaster mitigation to the mathematical analyzing abilities of students. At this stage of the LKPD validation these criteria were developed into several aspects, namely aspects of content and presentation, language, graphics, and appearance. with an average validity index of 3.1 with a valid category. Furthermore, RPP analysis of data validity results by the validator shows that each aspect, namely the lesson plan component aspects, RPP identity, competency achievement indicators, learning objectives, teaching materials, learning strategies and methods, steps of learning activities, learning resources, assessment, writing language, and the overall benefits of the lesson plans as a whole the developed lesson plans category is very valid with an average of 3.5
The criteria used to assess the practicality in developing this device are the feasibility of learning using a mathematics learning device based on a discovery learning model oriented to natural disaster mitigation, the easiness with which the teacher is able to use the tool and understood by students and the time that refers to the sufficient time provided for it implement these devices. The instrument needed to see practicality is a questionnaire, from the results of the questionnaire, about 66.6% were obtained for teacher response questionnaires and about 80.3% for student response questionnaires with practical categories so it can be concluded that Learning media can help and make it easier for students to understand the material and solve the problem. Meanwhile, to see the effectiveness, a analyzing ability test was carried out on the analyzing ability test consisting of 4 questions, each of which contained analyzing indicators and from the test an average of about 75.4 was obtained with good criteria and for the mathematical analyzing ability score of students obtained an average of 73.84 % with a good category from the above explanation, it can be said that Learning media are effective for improving students’ mathematical analyzing abilities.

4. Conclusion
After collecting and analyzing data based on interviews with teachers and students, giving questionnaires and conducting tests of students' mathematical analyzing abilities, it was shown that mathematics Learning media based on discovery learning models oriented to natural disaster mitigation succeeded in helping students understand the material of flat-sided shapes so that this learning device considered valid, practical and effective to use in learning mathematics to improve students' mathematical analyzing abilities.

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