Validation of discovery learning-based to increase the ability of elementary students problem solving skills

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Abstract. This study aims to develop learning to produce mathematical learning device products based on discovery learning that are able to improve elementary students’ problem solving abilities that are valid, practical, and effective. The specific target to be achieved is to produce a product in the form of Teaching Materials for mathematics discovery learning to improve problem solving skills of elementary school students and RPP as a companion to the use of teaching materials. This is a development research with 4D models consisting of Define, Design, Develop, and Disseminate. Development is done up to the develop stage to produce valid learning materials. The revision process according to the validation’s assessment and suggestion, a valid mathinstructional material based on discovery learning in terms of content and construct is obtained. The validity of teaching materials is obtained through expert assessment and revision based on expert advice until the validity level of RPP and Teaching Materials designed is 3.45 and 3.42 with valid categories.

1. Introduction
Mathematics is a subject that plays an important role in welcoming the future and the world of work later to think and take initiative and train in solving problems. Given the importance of mathematics, mathematics is taught to students from elementary school to college. Many efforts have been made by the government to increase and develop the quality of Indonesian education, including improving the quality of teachers. Improvement in teacher skills can be seen from the learning that teachers use in the classroom.

Discovery learning is a method that encourages students to arrive at a conclusion based upon their own activities and observations. Inclusion of activities based on discovery learning in science teaching in Turkey is important for meaningful and lifelong learning. The activities in science teaching raise the curiosity of students and drive them to inquire their priorities and perceive the natural phenomena from different aspects. Such activities help to correct the conceptual errors of students [1].

Discovery learning is an activity of presenting subject matter to gain knowledge that is done by investigating it yourself. The use of device-based discovery learning is expected to be able to guide students to be actively involved in making discoveries about the concept. The teacher acts as the person who directs and guides students in making discoveries, so that the activities and understanding of students' concepts can increase. Learning method is a method of learning that focuses on the students’ activity in learning. In this method, the teacher is not only the manager in the class, but moreover the teacher acts as a mentor and facilitator who direct the students in building their own knowledge by giving the problems to be solved through scientific steps [2].
This is similar to the one mentioned by In'am and Hajar in his research which is "Discovery learning is proven to improve the quality of learning compared to conventional methods, and can improve their knowledge during the learning process". From the results of research conducted, it was found that the teachers could carry out previously planned learning activities and their learn activities might be able to improve student learning activities. The average value of student learning outcomes in groups is found to be 96; while their individual learning outcomes were found to be 95. This condition indicates that student learning outcomes are under a very good category [3].

Correspondingly, the research conducted by Jurniawati obtained learning results showed that the ability of observation, discussion and acquisition of students' knowledge was enhanced by guided discovery learning. Data on learning outcomes are obtained by carrying out tests and analyzed with simple statistics. Therefore, guided discovery learning improves student mathematics learning outcomes [4].

In his article Tompo also stated that the results of the study after two trials showed that the discovery inquiry learning model (DI) was valid, practical, and effective. Student activities in learning are fulfilled the achievement of ideal time, and the results of student questionnaires provide a positive response to learning discovery inquiry (DI). It can be concluded that the discovery inquiry learning model (DI) to reduce the misconception of science students meets valid, practical, and effective criteria [5].

Based on the results of research conducted Agust Kristian obtained that The discovery technique is a translation of discovery. There is influence of discovery learning method toward the mathematics learning result of class V SDN 18 students of Banda Aceh. This is seen from the results of the students’ learning taught by discovery learning method is better than the results of students’ learning taught by expository [6].

In addition, Hendri and Kenedi in his research stated that mathematical learning devices based on discovery learning can improve problem-solving skills of junior high school eighth grade students [7]. Kiki Yuliani, it was suggested that teachers can use guided discovery learning model by presenting problems related to daily life as an alternative student learning [8]. Based on this, researchers are interested in developing learning tools in the form of discovery learning-based teaching materials in mathematics learning tailored to the conditions and needs of students with the title 'Development of mathematics teaching materials based on discovery learning to improve elementary school students' problem-solving skills. The purpose of this study is to produce mathematical teaching materials that are valid, practical and effective in improving students' problem solving abilities.

2. Types of research

This type of research is research and the development. Setyosari explain that "Developmental research, as opposed to simple instructional development, has been defined as the systematic study of designing, developing, and evaluating instructional programs, processes and products that must meet the criteria of internal consistency and effectiveness" [9].

The development model used in this study is the 4-D development model (four D models). According to Haryati the stages of the 4-D model include: define, design, develop, and disseminate [10]. However, because of the limitations of manpower, costs, and time of the writer, the dissemination stage is only carried out on a limited scale, ie another class or other school that is suitable for the needs of the researcher.

2.1. Instrument and technique of data validity analysis

Descriptive techniques are used to describe data from preliminary analysis. The data collected is in the form of data from curriculum and concept analysis as well as data from interview results. There are three stages in analyzing qualitative data, namely reducing data, presenting data and drawing conclusions. Reducing data is the process of selecting, focusing and transforming raw data obtained through interviews.
The steps used to determine the level of validity are as follows: 1) Validation sheet that has been assessed, presented in the form of a table by scoring each answer, 2) Determining the number of scores and the average given by the validator for each item.

\[ \bar{X}_i = \frac{\sum_{i=1}^{n} X_i}{n} \]

Information:
- \( \bar{X}_i \) = Average of each item
- \( X_i \) = Score given by validator – i
- \( n \) = Number of validator

Products that have been designed at the design stage are validated by four validators. The names of validators can be seen in the table 1.

| No | Validator’s Name                  | Areas of expertise          |
|----|----------------------------------|-----------------------------|
| 1  | Yullys Helsa, M.Pd               | Mathematics                 |
| 2  | Bunga Febrimora Hendri, M.Pd     | Indonesian                  |
| 3  | Syamsyuarlis, M.Pd               | Design and teacher          |
| 4  | Elsi Harisa, M.Pd                | Elementary Mathematics      |

From table 1 it can be seen the validity of mathematical content in teaching materials and lesson plans is validated by Yullys Helsa who is a mathematics lecturer in Padang State Elementary School Teacher Education (PGSD) (UNP). Language content validated by Bunga Febrimora Hendri is a lecturer in Indonesian Language Education at STKIP Lubuk Alung. Content design and learning validated by Syamsyuarlis was an Education lecturer at the PGSD UNP study program, and teacher content was validated by Elsi Harisa who was a teacher at SD 09 Padang.

3. Results and discussion

In the initial investigation phase, needs analysis, curriculum analysis, analysis, students, and concept analysis are carried out. Needs analysis is obtained through interviews with teachers and students and observation of the learning process. The results of the needs analysis show that the learning of class V SD 01 Padang Air Base has not been maximally implemented. This is due to the fact that the learning device developed has not facilitated students to be active in learning. Curriculum analysis is done by reading, understanding and analyzing KI, KD found in the Fraction material.

The results of curriculum analysis show that additional materials and subtraction fractions are added to equate the denominator of fractions. The material is modified or sorted based on the relevance of the previous material. In addition, the indicators of affective assessment are based on conformity with the addition and subtraction of fractions.

Analysis of students is done through interviews and observations. The results of the analysis of students show the characteristics of class V students according to learning to find concepts from the material because they are at the formal operational stage. Students also revealed that they like teaching materials in mathematics learning that relate to everyday life and they themselves find concepts from the material being studied. Students also revealed that they like colors that are neutral and unobtrusive.
Concept analysis is done by analyzing various books contained in the material linear equations and inequalities and then concept mapping is carried out. The concepts needed in this material consist of fraction addition, equating denominators, reducing fractions, and applying everyday problems related to addition and subtraction of fractions.

The phase of making a prototype or development phase begins with designing mathematical learning devices based on discovery learning which includes lesson plans and teaching materials. After generating mathematical learning devices based on discovery learning, then validated and produced mathematical learning devices based on valid discovery learning are shown in Table 1.

To obtain a valid learning device, then the learning device is validated. A good learning tool should meet the validity criteria. van den Akker, et al explains the characteristics of products that are said to be valid if they reflect the state of the art [11]. This is what we call content validity. Meanwhile, the product components must be consistent with each other (construct validity). This means that the requirement for a product to be valid is if it meets the validity criteria for the content and validity of the construct. Validity of test results based on mathematics learning tool based discovery presented in Table 2.

Table 2. Mathematics learning tool based validation test results based on discovery.

| Product             | Average value of Validity | Criteria |
|---------------------|---------------------------|----------|
| RPP                 | 3.45                      | Valid    |
| Teaching materials  | 3.42                      | Valid    |

The results of the lesson plan validation show that the value of each indicator in the aspect ranges from 3.25 to 3.75 with a valid and very valid category. In general it is written in Table 2, the validity of RPP from component aspects, learning activities, and language is 3.45 with a valid category.

The results of the LKS validation show that the value of each indicator in the aspect ranges from 3.00 to 4.00 with a valid and very valid category. In general it is written in Table 2, LKS validity from didactic aspects, content, language, and appearance is 3.42 with a valid category.

In the validity process there are several revisions in the suggested lesson plan and revised discovery discovery syntax is more highlighted and clearly detailed. In teaching materials, there are several problems that are replaced in accordance with the characteristics of students and colors that are too striking. In addition, in the initial design of many pages that still contained a series of writings that were not yet interesting and were still thought to make students bored to read them. Based on the validator's suggestion, some of these pages are corrected again by designing neatly arranged sentences or questions, so that the instructional materials are expected to be more attractive to students in reading, doing activities and answering the questions in them. The following is one example of a revision made.
Figure 1. Before revision.

In figure 1, researchers have designed teaching materials using standard grammar, with comic sans ms font type with size font 12. Layouts have also been designed with attractive colors consisting of purple and pink. Content discovery learning has also been well designed, a series of questions has been sought that can guide students to find concepts and have also been designed that greatly guide students in practicing solving problems.
After refilling according to the validator's suggestion, teaching materials are obtained as shown in figure 2. At this stage revision are made by giving a picture of a child who is thinking of a question, where the question must be considered by the student's answer; the purple design is also changed to orange.

In the RPP validation, the most ideal value of validity is 4.00 but achieving 3.45 is close to the ideal. This shows that most RPPs can be said to be good. The lowest part of the value of validity is learning indicators in accordance with KI and KD with a score of 3.00. The formulation of learning indicators does not include the objectives of affective and psychomotor competencies, only the goals of cognitive competence.
In the validation of Teaching Materials, the value of 3.42 was obtained with very valid criteria. This shows that most teaching materials can be said to be good. The part with the lowest validity value is the language component. In the graphics component, a validator is still recommended to improve the use of language according to EYD and correct some sentences that can give rise to multiple meanings.

Based on the results of validation on didactic aspects, it was found that discovery learning based learning tools designed had met the principles in teaching science. In other words this device can be used to help realize learning in accordance with the basic principles of teaching, logical learning flow and discovery learning models. Whereas from the results of validation on the content aspect, it is found that the learning materials based on discovery learning have contained continuous content between material, training and reflection components. Illustrations presented in teaching materials can also help students to relate the material learned with events in the daily life and environment of students. Therefore, it can be concluded that the learning device produced is valid in terms of content.

The language used in discovery learning-based teaching materials is also in accordance with the rules of Indonesian language that are good and correct and easy to understand. These results are obtained after repairs on some parts of the material that are too dense or even use words that are difficult for elementary school students to understand. This shows that the sentence and writing in the teaching material are in accordance with the correct, clear rules and do not cause confusion for students.

In terms of appearance, obtained teaching materials that can be read clearly, neatly packaged, and have an attractive appearance for students in grade V elementary school. Initially according to some validators, instructional materials use too many lines in the layout and the coloring of the background image is too strong. Based on input from the validator, several revisions were made to correct this. In the end, the presentation of discovery learning based teaching material is valid in terms of appearance.

4. Conclusion
Based on the results of data analysis that has been done, it can be concluded that the learning device based on Discovery Learning in the fraction material designed has been valid. Therefore, this learning device can be used as a teacher as one of the images in improving the quality of mathematics learning. This mathematical learning tool based on discovery learning can make learning more practical and effective. Therefore only valid materials can be used to see the practicality and effectiveness of the product.

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