Development of authentic assessment to improve students' mathematical problem solving ability

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Abstract. This study aims to find out how the implementation of authentic assessment development in producing a valid product by the principles and characteristics of authentic assessment to improve students' mathematical problem-solving abilities. This research uses research and development methods with the stages of carrying out needs analysis, literature review, pre-test, designing an authentic assessment form, and conducting a post-test to determine students' mathematical problem solving abilities before and after using authentic assessment. The results of the study concluded that the stages of authentic assessment development had been carried out through a limited validation process and broader validation involving experts to produce a product taking into account the principles and characteristics of authentic assessment. There is a difference in the average results of students' mathematical problem-solving skills between the results of the post-test compared with the results of the students' pre-test, so it is said that the development of authentic assessment can improve students' mathematical problem-solving abilities.

1. Introduction

Authentic assessments can engage and motivate students to understand the real-world relevance of assignments and meaningful to their learning [1] through performance appraisals and portfolio assignments. Assessment is considered important to find out how to develop this assessment and how it affects students' mathematical problem solving abilities. Authentic assessment does not merely look at the final results that sometimes lead to the ability of students is not intact, so the assessment activities should emphasize what should be assessed [2] related to the process and learning outcomes of students with various instruments adjusted for competency demands [3]. Authentic assessment becomes very important in its use in schools because it emphasizes the process and is not only oriented to papers and pencil tests to measure knowledge competence [4, 5] but also able to improve the quality of learning and provide feedback to students [6] through elements of authentic assessment, for example, through the Rubric of Performance, it is considered appropriate in testing the ability of students in raising and solving mathematical problems [7].

The relationship of authentic assessment with the ability to solve mathematical problems seen in the context of school mathematics refers to situations where students are involved in problem-solving tasks as part of instructional sequences and as applications for mathematical concepts, principles, and algorithms taught [8]. These mathematical problems are real questions or situations in life that require appropriate mathematical methods and knowledge to be solved [9]. Mathematical problem solving highlights the capability of the process of finding a solution to the difficulties and obstacles faced or problems that are unknown to students [10]. Students' problem-solving skills, participants'
mathematical reasoning needs to be developed through mathematical thinking done by the teacher [11].

Improving the quality of assessments made by teachers of students through activities to increase student involvement, improving the quality of the process and conducting follow-up assessment results [12]. Assessment has an impact on improving students' mathematical problem solving abilities through students' responses to the tasks given by teachers in the form of portfolios over a certain period of time [13] which assesses the development of students' mathematical problem solving abilities based on four hierarchical stages created by Polya which includes: understanding the problem, planning the problem, 3) implementing the plan, and 4) confirmation of the answers obtained [14].

Lack of skills in using cognitive abilities in learning effectively will affect students' mathematical problem-solving skills [15]. In addition, the low ability of students to understand mathematics problems caused by the following factors, namely: 1) students cannot understand the whole or some parts of the problem due to lack of imagination and experience needed to consider the problem, 2) students have difficulty in reading and understand, cannot understand what important information is in a mathematical problem, and 3) students are not able to manage mathematical problems as desired [16].

Authentic assessment can assess students' mathematical problem-solving abilities through given tasks by looking at the extent to which students are able to understand the problem when students know what the problem is, know what is in the problem, know what problems are asked, and know the completeness of any information contained in solving problems.

Problem-solving plans through the same tasks can also be assessed through authentic assessment by looking at the ability of students when choosing the strategy to be used. In implementing the problem-solving plan can be seen from the ability of students to use whatever steps have been taken relating to the strategy that has been selected, whether there are elements of try and choose other strategies that are more appropriate so that they can get the solution of problem-solving.

2. Method
Research is categorized into research and development using evaluative methods; evaluative methods are used to evaluate the trial process of developing a product [17]. Research and development procedures are carried out in stages: 1) needs analysis, 2) literature review 3) conducting initial tests of mathematical problem-solving abilities, 4) making authentic assessment design forms and seeing their validity, 5) conducting post-tests and 6) comparing solving abilities mathematical problems before and after using an authentic assessment product.

Data collection techniques use: 1) checklist and list of interview instructions to see the final product of the authentic assessment in the form of performance appraisal; portfolio assessment; product assessment; and self-assessment that can be obtained from students; teacher, evaluation expert; and mathematics education experts, 2) checklist is also used to view validation: worksheet, formative test.

The data collected looks at 1) the suitability of essential mathematics competencies taught with indicators of students' mathematical problem-solving abilities that they want to be measured in the form of test assessments; portfolio assessment; performance assessment; product assessment; and attitude assessment, 2) the authentic assessment developed has followed the characteristics and characteristics of the authentic assessment, 4) the authentic assessment that was developed was in accordance with the function and purpose of the authentic assessment, 5) the authentic assessment that was developed was easy and practical to use. Data in the qualitative form will be analyzed using descriptive analysis, while quantitative data is used to see the improvement of mathematical problem solving skills before and after using the results of the development of authentic assessment using descriptive statistics and using inferential statistics with the t-test for interrelated samples.

3. Results and Discussion
3.1. Results
With assessment criteria, very good; well; pretty good; not good; and not very well for performance appraisal, self-assessment, and peer evaluation include the following statements: 1) mathematical
assessment has fulfilled the principles and characteristics of authentic assessment, 2) authentic assessment in the form of performance appraisal, self-assessment, and peer assessment has seen and measured aspects students’ mathematical problem-solving abilities. With regard to this statement, most experts have given good ratings, but they have not yet given very good evaluations, and there are still those who have given sufficient assessments, so it is necessary to make up with suggestions and comments from experts.

Statements assessed by experts for the type of portfolio assessment include: 1) mathematical assessment has fulfilled the principles and characteristics of authentic assessment, 2) authentic assessment forms of portfolio assessment see and measure aspects of students’ mathematical problem-solving abilities, 3) authentic assessment format on Portfolio valuations can be understood by anyone who assesses. About this statement, most experts on limited validity and broader validation activities have rated it well, and there are even some experts who have rated it very well so that instruments on portfolio assessment are considered to be used by teachers in assessing students, and can be a means of analyzing reflection between teachers and students when working with learning portfolios in the room [18], and can contribute to better student understanding and have implications for teaching [19] After conducting a trial process on authentic assessment products, a post-test is then performed, and the results are then compared with the pre-test before the implementation of the trial product process to see the effect of authentic assessment products on students' mathematical problem-solving abilities. The results of students’ mathematical problem-solving abilities before and after the assessment of the results of the authentic assessment development can be seen in Table below:

| Table 1. Descriptive Statistics of Pre-Test and Post-Test Results in Mathematical Problem Solving Ability. |
|-----------------|-----------------|-----------------|
| **N**           | **Maximun**     | **Minimum**     |
| Pre Test        | Post Test       |
| 34              | 34              |
| 63              | 86              |
| 10              | 35              |
| 32.79           | 61.24           |
| 12.192          | 13.649          |
| 148.653         | 186.307         |

| Table 2. Paired Samples Test Paired Differences. |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| **Pair 1**      | **Means**       | **Std. Deviation** | **Value t** | **df** | **Siq (2-tailed)** |
| Mathematical Problem Solving AbilityPretest and Post Test | 34.824 | 14.341 | 14.159 | 33 | 0.000 |

Based on Table 1 and Table 2, there is a significant difference between pre-test and post-test students’ mathematical problem solving abilities. The influence of the use of authentic assessment development products on the ability to solve mathematical problems known from the pre-test and post-test average values. Based on the results of the calculation of the t-test sample that is interconnected using the SPSS program in Table 2, it is found that the significance value is equal to 0.000, which is smaller than the value of 0.05. So the null hypothesis is rejected, meaning that there is a significant difference between pre-test and post-test students' mathematical problem-solving abilities. Thus, the development of authentic assessment can improve students' mathematical problem-solving abilities. This is reinforced by the results of research which state that authentic assessment has an effect on students’ mathematical problem solving abilities [20] and problem based learning with authentic assessment has an effect on mathematical problem solving abilities [21], and it is known that there are differences in mathematical problem solving abilities between students facilitated by the authentic assessment model and the conventional assessment model [22].
3.2. Discussion

Some factors that cause the influence of using authentic assessment products on students' mathematical problem-solving abilities are the production of authentic assessment products that are appropriate to be used based on the results of expert assessments because they meet the principles and characteristics of authentic assessment. The principles and characteristics of authentic assessment have an effect on improving students' mathematical problem-solving abilities including 1) their assessment goals have led to the competencies to be achieved as learning objectives, 2) able to challenge students to apply new academic information or skills to real situations and for clear purposes, 3) have measured all aspects of learning, 4) implemented during and after the learning process takes place, 5) using a variety of ways and resources [23,24].

The teacher during the implementation of learning using a product that has been developed can direct students through habituation and strengthening activities on questions related to increasing students' mathematical problem solving abilities [25,26]. Students are not only focused on routine mathematical problems but are directed to challenging mathematical problems, where students are required to think for a long time to contemplate and try to find the right way to solve it, and this is done by the teacher through discussion 1 and discussion 2 by giving questions issues that have been designed in order to strengthen students' mathematical problem-solving abilities.

Besides, it is also known that the teacher is a significant factor in having an effect on improving mathematical problem solving skills when using authentic assessment products by familiarizing students with solving mathematical problems through discussion activities and portfolio assignments, which can be seen in the increase in student scores in terms of 1) understanding the problem solving; 2) planning problem solving; 3) solving math problems until students find answers to the math problems being asked; 4) re-check the results of solving the mathematical answers being asked [27].

In collecting data during the study, performance appraisal in discussion groups was carried out using validated instruments by assessing the following aspects: 1) conveying ideas and ideas in the discussion, 2) the ability to listen to the ideas and ideas of others when the discussion takes place, 3) using the sourcebook and other references during the discussion, 4) maintain the condition and atmosphere of the course of the discussion so that it runs well, 5) critical and logical abilities when rejecting the ideas and ideas of others when the discussion takes place. The teacher evaluates the course of the 1st discussion activity and the 2nd discussion with predetermined criteria when the discussion takes place. The teacher evaluates the course of the 1st discussion activity and the 2nd discussion with predetermined criteria.

4. Conclusion

The stages of authentic assessment development can be done through a limited validation process and broader validation involving experts so as to produce an authentic product assessment. The product assessment made has considered the important principles and characteristics of authentic assessment. There is a difference in the average results of students' mathematical problem-solving skills between the results of the post-test compared with the results of the students' pre-test, so it is said that the development of authentic assessment can improve students' mathematical problem-solving abilities.

Authentic assessment products have an effect that causes differences when pre-test and post-test are carried out, because 1) the assessment goals have led to the competencies to be achieved as learning objectives, 2) able to challenge students to apply new academic information or skills to the situation real and for a definite purpose, 3) have measured all aspects of learning, 3) implemented during and after the learning process takes place, 4) using a variety of ways and resources.

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