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The Development of Mathematics Authentic Assessment in Applying Model Eliciting Activities to Enhance Students' Creative Thinking

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ABSTRACT
This study aims to determine: 1) The level of validity of the mathematics authentic assessment developed in the application of the Model Eliciting Activities; 2) The practicality of the assessment; 3) The effectiveness of the assessment; 4) And the impact of the assessment on the development of the students' creative thinking in the application of the Model Eliciting Activities. This research was a development study conducted in two stages. From the results of the trial I and trial II, the results demonstrated that the mathematics authentic assessment developed in the application of the Model Eliciting Activities met valid criteria. The assessment also reached the practical standards. Moreover, the assessment was considered feasible to use. As a result, there was an increase in the students' creative thinking by using the mathematics authentic assessment developed in the application of the Model Eliciting Activities as much 0.095 in the trial I and trial II.

Keywords: *creative thinking, mathematics authentic assessment, Model Eliciting Activities, 4-D models*

1. INTRODUCTION

Mathematics has the role of giving various abilities to students, the ability to think, and the ability to solve problems in everyday life. According to Mawaddah, Kartono, and Suyitno [1], "one of the goals of mathematics education in schools is to develop creative activities that involve imagination, intuition, and discovery by developing divergent, original thinking, curiosity, making predictions and guesses and experimenting" (p. 11). Thus, the ability to think mathematically plays an essential role in life. Reference [2] said that "the ability in creative thinking is needed to master and create technology in the future, which means that mathematics needs to be given to all students from elementary school to college to equip students in logical, analytical, systematic, critical, creative skills, and ability to work together" (p. 28).

The importance of the ability to think creatively is not relevant to reality. From the cases in the field, the low ability to think creatively is caused by several factors, including not using LAS that is published by individual institutions in the school, so the students are not trained to solve problems in the flexibility of thinking and authenticity of thought in the ability to think creatively, where the students only address the questions contained in the book whose items only have one correct answer in accordance with the examples by the teacher, without developing the ability to think creatively. Those questions do not lead students to solve problems in the form of story problems from the students' daily lives. Santrock [3] said that "creativity is the ability to think about things in new and unusual ways in producing unique solutions to a problem" (p. 366). Thus, one of the ways that can be used to measure and develop creative thinking skills is to solve problems.

Therefore, learning should direct the ability of the students to increase the flexibility of thinking and the authenticity of thought in the ability to think creatively. One of the lessons learned in accordance with this is through the Model Eliciting Activities approach. One of the principles of learning with the Model Eliciting Activities approach is the problem presented in learning is a real problem as conveyed by Chamberlin and Moon [4], specifically "Making the problem a realistic one is defining the characteristics of MEAs" (p. 7).

The reason for choosing the Model Eliciting Activities approach to improve students' creative thinking abilities is because the Model Eliciting

Activities approach is based on constructivism. The students are directed to develop the flexibility of thinking and authenticity of thinking that students have in solving problems from students' daily lives that lead students to make a mathematical model.

Learning is associated with problems from students' daily lives according to authentic assessments. The current evaluation at school does not provide a real experience for students, it does not make students able to present a problem from different points of view because the assessment does not refer to real-world situations. There are several reasons why an authentic assessment needs to be done in learning, such as 1) providing real experience for students in conducting various creative activities through experiments, demonstrations, and field activities, 2) providing opportunities for students to demonstrate their abilities, both in the form of knowledge, performance and attitude in learning mathematics, 3) can make students learn independently, cooperate, and assess themselves based on their ability to regulate and control cognitive processes.

Based on the thoughts that have been described above, researchers are interested in researching with the title: "The Development of Authentic mathematics assessment of the Students in Applying the Model Eliciting Activities to Enhance Creative Thinking Ability."

2. RESEARCH METHOD

This research includes authentic assessment development research that refers to the 4-D model [5], which consists of four stages: define, design, develop, and disseminate. Authentic assessments are developed in applying Model Eliciting Activities, namely attitude competency assessment, knowledge competency assessment, skills competency assessment, and creative thinking ability tests. An authentic development chart of this research can be seen in Fig. 1.

2.1 Define

The aim is to establish and define the conditions needed for learning. This stage includes 5 (five) main steps, namely: (1) early-final analysis; (2) student analysis; (3) concept analysis; (4) task analysis; and (5) formulation of learning objectives, which will be explained as follows.

1) Early-Final Analysis

The aim is to bring up and establish fundamental problems by examining the mathematics curriculum being used, analysis of the underlying issues of teachers and students, as well as learning theories that underlie the Model Eliciting Activities to obtain a description of learning patterns that are considered ideal.

2) Student Analysis

At this stage, the characteristics of students are examined in accordance with the design and development of authentic assessments. Characteristics of students examined include cognitive development, learning styles, and student motivation. It also includes studying the characteristics of the students to make it easier to set the level of language and the difficulty of the questions. These characteristics include the background knowledge and cognitive development of the students.

3) Concept Analysis

The aim is to identify, give details, and systematically arrange assessment concepts that students will use. Concept analysis is related to assessment analysis that students will use, specifically by creating concept maps that will make it easier for students to understand the subject matter.

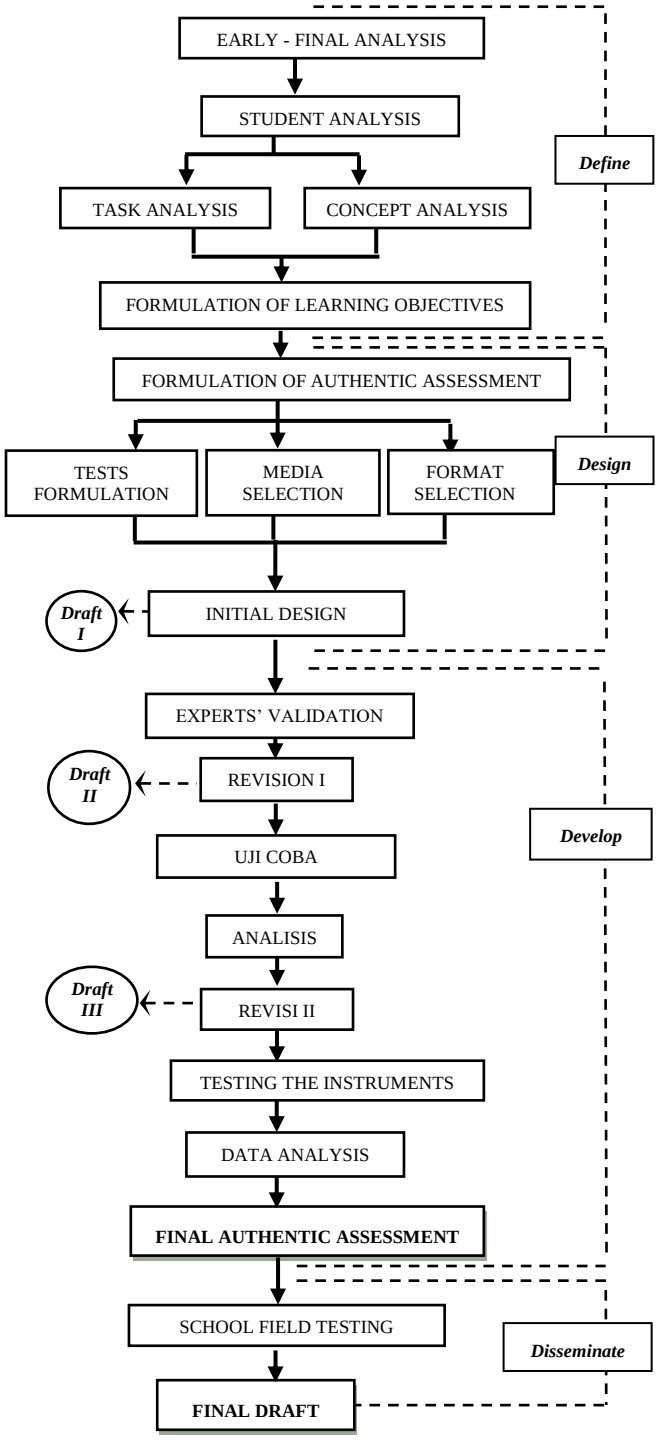

Figure 1. Authentic assessment development chart

4) Task Analysis

The aim is to identify the primary skills that will be studied by the researcher and analyze them into additional sets of skills that might be needed. This analysis ensures a thorough review of the assignments in the learning material.

5) Formulation of Learning Objectives

Discuss the results of task analysis and topic analysis into specific learning goals, which are stated in terms of behavior.

The breakdown of specific learning objectives is a reference in developing authentic assessments.

2.2 Design

The aim is to prepare an authentic prototype assessment in the application of the Model Eliciting Activities with number patterns materials. In this stage include preparation of tests, media selection, format selection, and initial design.

2.2.1.1 Criteria for Tests Formulation

The formulation of the test is from the analysis of tasks and concepts outlined in the learning objectives, according to the development of authentic assessments. The attitude competency assessment used attitude observation and peer assessment made based on the grid. The knowledge competency assessment used written tests and assignments made based on the grid and scoring guidelines for creative thinking ability and metacognition of number pattern material. The evaluation of skills competency used performance work and projects based on the grid.

2.2.1.2 Media Selection

Media selection is adjusted to the results of task analysis, concept analysis, and student characteristics because the media is useful to assist students in achieving Basic Competence.

2.2.1.3 Selection of Format

The choice of format in the development of authentic assessments is aimed at designing authentic assessments, selecting strategies, approaches, learning methods, and learning resources. The choice of format or form of presentation of learning is adjusted to the learning media that will be applied.

2.2.1.4 Initial design

The design of authentic assessment produced at this initial design stage is draft I, in the form of an attitude competency assessment, knowledge competency assessment, skills competency assessment, and creative thinking skills test instrument.

2.3 Develop

The development phase is the stage to produce the development of products that are carried out in two steps: (1) expert assessment followed by revisions, (2) development testing. This phase includes draft II, namely: revising authentic assessments that have been reviewed by experts, then authentic assessments are altered and considered suitable by the experts, then tested and analyzed. Next, in draft III, namely: the analyzed data was revised again, and continued to trial II and analyzed again.

2.4 Disseminate

In this research, the distribution phase was limited to the experimental class. If, after testing, the results are excellent and effective, it needs to be considered an authentic assessment solution that can be used in the classroom, however, for widespread distribution left to the next party.

3 RESULTS AMD DISCUSSION

The results of data analysis obtained from the trials 1 and 2 showed: (1) authentic assessment developed in the application of the valid model eliciting activities; (2) authentic assessment developed in the use of the practical model eliciting activities; (3) authentic assessment developed in the use of model eliciting activities; (4) there is an increase in the ability to think creatively by using authentic assessments developed in the use of the model eliciting activities.

3.1 The validity of the Authentic mathematics assessment of Students Developed in the Application of Model Eliciting Activities

It was found that authentic assessment in the application of the model eliciting activities, namely the attitude competency assessment, knowledge competency assessment, and skills competency assessment, was declared valid or had a reasonable degree of validity. Furthermore, the results of the validation of the students' creative thinking ability test are also valid or have a fair degree of validity.

Validity criteria were obtained through expert evaluations of authentic mathematics assessment of students developed in the application of model eliciting activities. The collected valid authentic assessments caused by several factors, including: first, the students designed in the use of model eliciting activities have met the validity of the content. This means that the development of authentic assessments in the application of the model eliciting activities was in accordance with the demands of the existing curriculum. Second, the authentic mathematics of students developed in the use of model eliciting activities has fulfilled construct validity. Thus, it was in accordance with the concepts and indicators of creative thinking abilities, which were then combined with applying the model eliciting activities (adjusted to the characteristics and principles of the model eliciting activities).

Fulfillment of functional validity aspects, as stated above, is in line with [6], which says that the validity aspect refers to the extent to which the design of the developed device is based on content validity and construct validity (p. 207).

3.2 The practicality of Authentic mathematics assessments of the Students Developed in the Application of Model Eliciting Activities

The results of the assessment of the practicality of authentic assessments were obtained from expert/practitioner assessments, which state that the authentic assessment developed can be used with little or no revision. Based on the results of expert assessments, authentic assessment components designed in the form of attitude competency assessment, knowledge competency assessment and skills competency assessment, and creative thinking ability tests are practical/can be used with minor revisions.

The indicators of the practicality of authentic assessment, specifically authentic assessment developed, are said to be practical if the average performance (teacher responses in using the assessment) is at least in the good category ($3 \leqslant Rg < 4$). Moreover, the average readability (student responses in understanding the assessment) is at least in the good category ($3 \leqslant Rs < 4$). Practicality indicators in terms of the teacher's response to the assessment (feasibility) in this study obtained an average score of 3.16. Then the practicality indicators in terms of students' responses to the assessment (readability) in this study received an average rating of 3.25. Average teacher responses and student responses have met the practical indicators of authentic assessment, so the assessment developed can be said to be functional in the trial I so that in the trial II, the researcher no longer analyzes the practicality of authentic assessment.

Based on the description above, it can be concluded that the authentic mathematics assessment of students developed in the application of model eliciting activities has fulfilled the practicality as expected. Thus, the authentic assessment of student mathematics emerged in the use of the model eliciting activities was easy and could be carried out by the teacher and students.

3.3 The Effectiveness of Student Authentic Mathematics Assessments developed in the Application of Electronic Activities Model

Based on the results of trial I and trial II, the authentic mathematics assessment of students developed in the application of model eliciting activities has met the valid category in terms of classical student mastery learning and the ability of teachers to manage knowledge in either category. The aspects of each effective category above are explained as follows.

a) Classical Learning Completeness of the Students

Classical completeness of the ability to think creatively in the trial I obtained at the pre-test was 30%, and at the post-test was 56.67%. In accordance with the completeness criteria of student learning outcomes in a traditional way, at least 75% of students who take the creative thinking ability test were able to achieve a score of 2.67. Thus, the results of creative thinking ability post-test have not yet met the classical completeness because it only obtained a percentage of completeness of 56.67%. So, it can be concluded that in Test I authentic assessment in the application of the model eliciting activities that were developed did not meet the standard achievement criteria for completeness. The results in the trial I can be seen in Table 1.

Table 1. Classical Learning Completeness of the Students' Creative Thinking in Trial I

Category	Pre-test[a]	Classical Completeness Percentage	Post-test[a]	Classical Completeness Percentage
Complete	9	30%	17	56.67%
Incomplete	21	70%	13	43.33%
Total	30	100%	30	100%

[a.] Number of students

Classical completeness of the ability to think creatively in trial II obtained at the pre-test was 43.33%, and at the post-test was 80%. In accordance with the completeness criteria of student learning outcomes in a traditional way, at least 75% of students who take the creative thinking ability test can achieve a score of 67 2.67. Thus, the results of the post-test creative thinking ability have met the completeness of classical because it has obtained an 80% completeness percentage. So it can be concluded that in Trial II, authentic assessment in the application of the developed model eliciting activities has met the criteria for achieving classical completeness. The results of classical completeness of the ability to think creatively in the trial can be seen in Table 2.

Table 2. Classical Learning Completeness of the Students' Creative Thinking in Trial II

Category	Pre-test[a]	Classical Completeness Percentage	Post-test[a]	Classical Completeness Percentage
Complete	13	43.33%	24	80%
Incomplete	17	56.67%	6	20%
Total	30	100%	30	100%

[b.] Number of students

Based on the results of the post-test analysis of trial I and trial II, it was found that the ability to think creatively had met the classical completeness criteria. This was because authentic assessments are developed in accordance with the conditions of the student learning

environment and refer to the application of the model eliciting activities. According to Gilat and Amit [7], "AEC learning based on situations that occur in real-life students can stimulate student motivation and involvement in the learning process" (p. 57). The same thing was also explained that the multifaceted nature of MEA learning makes the right path making it easier for students to learn many things, especially in solving problems with real-world scenarios" [8].

Based on the results of the previous research above, it can be seen that the authentic mathematics assessment of students developed in the application of model eliciting activities can help students achieve classical learning completeness. Thus, it can be concluded that the use of authentic mathematics assessment of students developed in the application of model eliciting activities has met the effective criteria.

b) Teachers' Ability to Manage Learning

In the trial I and trial II the ability of the teachers to manage to learn fulfilled the good category ($3 \leqslant RSP < 4$) . Based on data analysis, the results of trial I obtained of the ability of teachers to manage to learn is 3.14 in the good category and trial II got an average value of 3.34 where the criteria for the strength of teachers to manage to learn set in chapter III, then the average score of the ability of teachers to manage to learn was in the good category of ($3 \leqslant RSP < 4$).

This is supported by Widiyasari's research [9], which showed that "the ability of teachers to manage to learn based on the observations, the ability of teachers to manage to learn has reached an average total score, meaning that learning has been implemented well" (p. 5). Thus it can be concluded that the authentic mathematical assessment in the application of the developed model eliciting activities has fulfilled the effectiveness criteria as expected.

3.4 The Improvement of Creative Thinking Abilities Using Authentic mathematics assessment of the Student Developed in the Application of Model Eliciting Activities

One of the objectives obtained from the development of authentic mathematics assessment in the application of the model eliciting activities in this study is to improve the ability to think creatively. Reference [10] said, "MEA learning fosters students in solving real problems creatively and trains students on how to apply mathematics to other situations" (p. 25). In another study [11] also showed that the first goal of MEA learning is to invite students to be able to create mathematical models in solving complex mathematical problems to develop students' mathematical creative thinking abilities [12-13].

Based on the results of the trial I analyzed, the ability to think creatively has increased by 0.67 of the average value. As seen from the average N-Gain calculation, it has increased by 0.322. Furthermore, based on the results of the trial II analysis, the ability to think creatively has increased by 0.75 from the average value. Moreover, as seen from the average calculation of N-Gain, it has increased by 0.417. It can be concluded that there is an increase in every indicator of creative thinking ability. In this study, the increasing values were seen by using N-Gain so that there was no bias arises. This showed that the creative thinking ability of students' authentic mathematics assessment in the application of the model eliciting activities has increased from trial I to trial II [14].

4. CONCLUSION

The validity of authentic assessment developed is included in the valid category with an average value of total validity (1) attitude competency assessment which includes attitude observation of 4.4, and interpersonal assessment has been in the valid category; (2) knowledge competency assessment which provides for written tests and assignments is in the valid category; (3) skills competency assessment which includes a performance by 4.5 and projects by 4.5; (4) items of students' creative thinking ability tests are in the valid category.

The authentic assessment of students' mathematics developed in the application of model eliciting activities has fulfilled practicality. The practicality indicators are (1) the teacher's response to the assessment (feasibility) which in this study obtained an average score of 3.16 in the good category; (2) students' responses to the assessment (readability) in which obtained an average rating of 3.25 in the good category.

The authentic assessment of students' mathematics developed in the application of model eliciting activities has fulfilled the effectiveness. The effectiveness is in terms of (1) classical completeness of student learning, in which the ability to think creatively increased from the trial I by 56.67% and 80% in trial II and (2) teachers' ability to manage the class increased from the trial I by 3.14 to 3.34 in the trial II which can be classified as a good criterion.

The improvement of students' creative thinking skills using authentic mathematics assessment of developed in the application of model eliciting activities on the number patterns material was 23.33%; in the post-test trial I the classical completeness was 56.67% and trial II was 80%. While N-Gain trial I was 0.322 in the low category and N-Gain trial II was 0.417 in the medium category.

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