Development Mathematics Test Based on Education for Sustainble Development to Measure Middle School Students'Creative Thinking Skills

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Abstract. The design of ESD-based math problems to measure creative thinking skills namely contains indicators of creative thinking skills and is applied in everyday life day. The research design used is formative evaluation (self-evaluation, expert reviews, one-to-one, small group, and field tests). The research results show that from the initial design of the questions (47 students), only 28 questions were valid. After conducting large-scale tests shows that only some students can complete it. It is supported by the results of the written interview which said that the question was a moderate level of difficulty. But there are also those who say that the problem is too easy. With the research results is expected to produce guidelines in designing math-based test questions ESD for students.

INTRODUCTION

Mathematics is a major science that cannot be separated from other sciences including everyday life. In education and in life, mathematics plays an important role. The important role of ability mathematics is useful in solving everyday problems. But, at the moment, often the benefits of learning mathematics in everyday life are not widely felt by students. The role of mathematics is only considered as a science to count. Therefore, the ability to count is a small part of the mathematical ability. Mindset that really want to be formed in learning mathematics.

Thinking is a concept that has a broad scope and is relatively abstract often interpreted in various versions or variations of the definition [4]. For thinking this has a broad scope and is relatively abstract, so that mathematical thinking is also classified as relative abstract. This is what causes the benefits of learning mathematics to be felt and covered by the abstract impression attached to mathematics.

Mathematics is the science of certainty and belief, acceptable to reason health, in contrast to other sciences, is an activity and a reality, and mathematics is a concept [3]. Based on this definition it can be seen that mathematics basically it can be mastered by anyone because it can be accepted by common sense and is the science of something that is certain and can be trusted to be true. Therefore, mathematics is basically all around us. Math is all around the environment our life. Mathematics is very close to our lives. Math is not something something new and burdensome because mathematics is an activity, especially an activity think.

Due to the design of math problems that are applied to the social domain, economics, and the environment, it is expected that students are accustomed to solving problems mathematics which is not only solving math problems, looking for problem solutions mathematics given but also familiarizes students to better interpret implied math problem. The implied meaning includes the emergence of a sense of empathy towards social, have sensitivity to economic problems, and have a responsibility to the environment. Therefore, the design of the questions produced can support this achieving the goal of Sustainable Development.

Math test questions are part of the assessment instrument. Math test questions can be in the form of multiple choice or description. The math test questions can be in the form of questions application in everyday life and not a

matter of application. Internal application questions is daily life includes applications in various fields. For example test questions mathematics associated with cultural aspects. Other aspects or domains that can applied in the design of math test items are the social, economic, and domains environment. This domain is relevant to the domain integrated into the Education program for Sustainable Development which includes the social, economic, and environmental domains. Mathematics as part of education should support its realization achievement of ESD goals. Therefore, it should be in learning mathematics already starting to get used to introducing and implementing things related to the application in the social, economic and environmental fields. Application of ESD in learning mathematics requires even greater effort because many parties have not familiar with applying mathematics to the three ESD domains. ESD has 17 Sustainable Development goals to be achieved, namely:

Figure 1. Sustainable Development Goals

Education can be a means to actively promote positive attitudes and part of the behavior that reflects the requirements of Continuing Development [1]. Education for Sustainable Development is defined as all domains from Public awareness, education, and training provided to create or enhance understanding of the relationships between issues for development Sustainability and to develop perspectives, skills, knowledge, and values. That values will empower people of all ages to be accountable to creating a sustainable future [5]. From several definitions of ESD, it can be concluded that Education for Sustainable Development is an effort in the field education to instill individual and social character values to be responsible responsibility and foster a sense of love for the environment, social, culture, and the economy so that through these characters, each individual can maintain life and environment in a sustainable manner [14].

Difficult to define mathematical creative thinking clearly, but creative thinking mathematics can be distinguished from the characteristics it has [6]. In contrast to [6], [8] states that mathematical creative thinking is defined as a type of thinking which leads to the acquisition of new insights, new approaches, new perspectives, or ways new to understanding something Mathematical creative thinking can occur when triggered by challenging tasks or problems. Furthermore, it is revealed that creative thinking mathematical is a way of thinking that produces something new in form concepts, inventions and works of art [2]. Further disclosed by [10] that creative thinking skills include fluency, flexibility, originality (originality), elaboration (elaboration), and sensitivity (problem sensitivity). Five skills are indicator of creative thinking skills which can be detailed as follows following:

Table 1. Creative Thinking Skills Indicator

Aspect	Indicators
Fluency	1. generate a lot of ideas in different categories, earn lots of answers, generates lots of problem solving, Generate multiple inquiries seamlessly 2. giving lots of ways or suggestions for doing things; thinking of more than one answer.
Flexibility	1. generate ideas, answers, or questions that vary 2. look at a problem from different points of view

Originality	3. looking for many alternatives or different directions 4. able to change the way of approach or way of thinking. 1. the ability to spark ideas in original ways, it's not a cliché, and it's rarely given to most people 2. able to make unusual combinations of the parts
Elaboration	1. the ability to add to a situation or problem so that it becomes complete, and detail it in detail, in which there is in the form of tables, graphs, pictures, models and words 2. able to enrich and develop an idea product
Problem Sensitivity	the ability to detect, recognize, and understand and respond a statement, situation, or problem.

The most recent aspect of this research is the production of ESD-based mathematics problem designs to develop students' creative thinking skills. This is new because there has been no research that has produced ESD-based mathematics problem designs to develop students' creative thinking skills.

METHOD

This research is development research using stages formative evaluation from Martin Tessmer. The formative evaluation design flow is presented in Figure 1 follows:

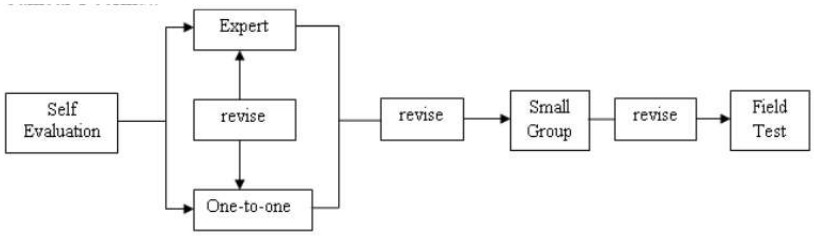

Figure 1. Formative Evaluation Design Flow [7]

The initial step taken was a self-evaluation which the researcher made Education for Sustainable Development-based math problem design to measure students' creative thinking abilities. This research is a continuation of research beforehand where researchers already have a design of math problems that will be developed. The initial design of this math problem is referred to as Prototype 1.

After there is Prototype 1, the researcher validates the content and constructs to expert. After being validated by the expert, the research team revised it. Revision results is declared as a valid prototype. Then equipped with validation readability to 3 junior high school students at the one-to-one stage. For further development Prototype 1 is referred to as Prototype 2.

If Prototype 2 has been obtained, it will be tested on a limited basis to 3 students Junior High School. The findings obtained from the limited trial results were revised and developed become prototype 3. The final stage is a large-scale trial to 2 junior high school students class. After carrying out large-scale trials, the final prototype was declared practical after revised and completed with the results of interviews with students who are the subject study.

This research was conducted at SMPN 37 Pekanbaru, consisting of 2 students in class IX class with a total of 63 students. Data collection instruments include validation sheets and sheets written interview (inventory). Data collection techniques include self-evaluation, prototyping, small groups, and field tests. Data Analysis Techniques Every formative stage evaluation was analyzed descriptively.

RESULTS AND DISCUSSION

Results

The first step taken by the researcher was to rearrange the design of the questions existing ESD-based mathematics. From 108 questions, 47 questions were obtained ESD-based mathematics to measure students' creative thinking skills. Question rearranged based on the ESD domain, namely the social, economic, and environmental domains so that there are 16 questions on social domains, 13 questions on the economic domain, and 18 questions on the domain environment. These questions were then validated by a mathematics education lecturer and tested for readability by 3 junior high school students. The validation results are as follows:

Table 1. The number of ESD domain questions before and after the trial

No	Domain	Number of Questions	
		Before Validation	**After Validation**
1	Social	16	10
2	Economis	13	10
3	Enviromental	18	8

Based on Table 1. it is known that each domain does not have the same number of questions many. But almost balanced. From the results of the validation it is also known that the question on lingan domain that gets the most invalid ratings. For more details suggestions from the validator, can be seen in the table below:

Table 2. The results of the distribution of social, economic and environmental domain questions

No	Domain	Questions Number	Validator's suggestion	Feedback
1	Social	4, 5, 6, 11	Too easy matter	Not used
		10	Revision the typo	used
		13	There are similar types of questions	Not used
		15	To difficult matter	Not used
2	Economic	5, 7, 9	There are similar types of questions	Not used
		6	Revision of the editorial questions	Used
3	Enviromental	8	Editorial revision of questions	Used
		2	Editorial revision of questions	Used
		4, 16	Too easy matter	Not used
		8, 17, 18	The questions do not match the conditions at the time of the test	Not used
		10, 11, 13, 14, 15	There are similar types of questions	Not used
4	Questions doesn't revision	1,2, 3,7,8,9, 12,14,16	No revision of questions (Social)	Problem got direct used
		1, 2, 3, 4, 10, 11, 12, 13	No revision of questions (Economic)	Problem got direct used

	1, 3, 5, 6, 7, 9, 12	No revision of questions (Enviromental)	Problem got direct used

Based on the table it is known that there are 28 questions used for the group test big. The questions are then rearranged in the form of a question script without writing down its ESD domain. The questions were tested on students of SMP 37 Pekanbaru in 2 classes (63 students), namely class IX. The following are the results of the ESD-based math test which consists of 28 questions, namely:

a. All questions can be done by students
b. The question that was the least answered was question number 28, it is suspected that this question is the most difficult question the most difficult
c. Social domain questions are the most difficult questions as well as the easiest questions

Here are some of the results of student answers related to the questions given:

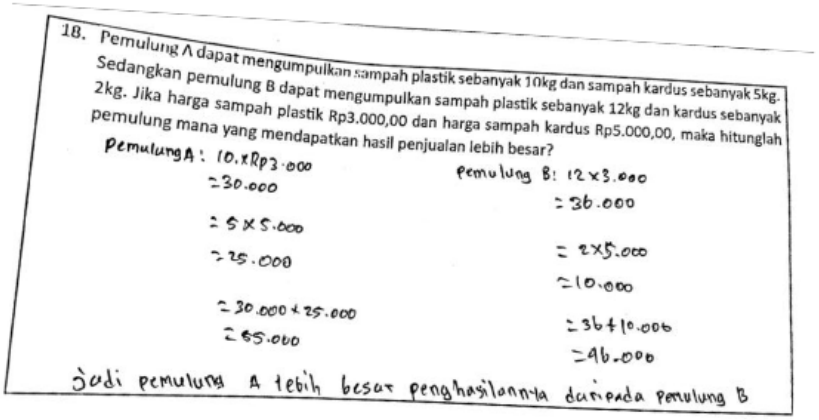

Figure 2. ESD-based question design

Figure 2 is an example of students' answers to the ESD domain-based mathematics test questions environment. Based on the figure it is known that the problem is applied towards the environment by taking the context of scavengers and waste. Which answer given students also have answered the question correctly. Even students too write a summary of the answers to the questions. Examples of questions like these can be used as an example of a math problem associated with the environmental domain and can develop students' creative thinking skills because without using a formula mathematics, but students can solve the problems given with their ideas alone.

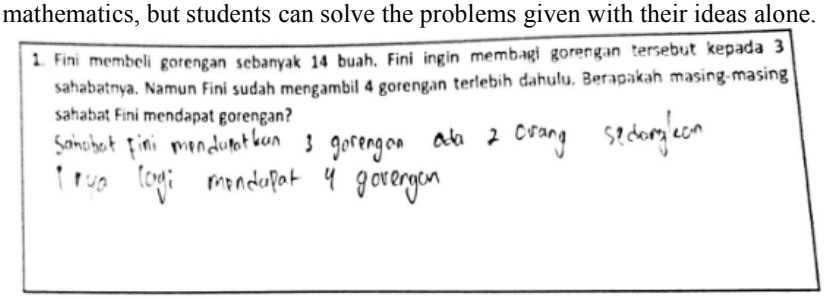

Figure 3. Social Domain ESD-Based Mathematics Test Questions

This test item is a social-based math problem design because it contains the theme of sharingbwith best friend. This problem can also measure student creativity because students are asked to think answer to this question which has several alternative answers. In Fig too looks one type of way of answering students or how students solve problems that given.

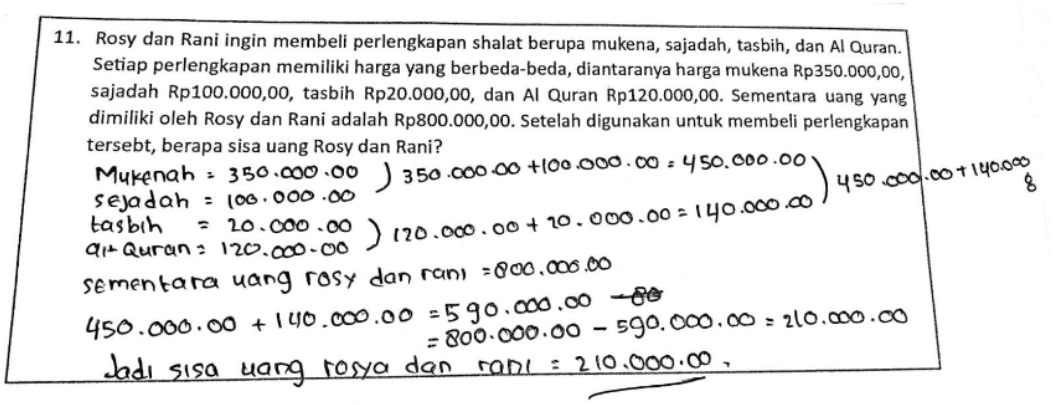

Figure 4. Economics Domain ESD-Based Mathematics Test Questions

This test question is an economics-based math problem design because it contains trading theme. This problem can also measure student creativity because students are asked to solve problems in the economic field in which there is a character value, namely religious. This is important because in ESD-based questions there is also character content.

After conducting large-scale trials, interviews were carried out in person written. The selection of this type of interview is done so that students become more flexible in express what they feel and what they think. The following is some excerpts from the closed interview:

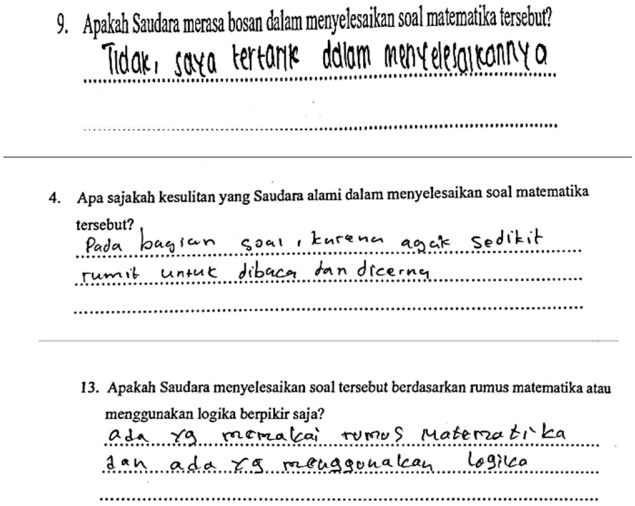

Figure 5. closed interview excerpts

Based on the results of the written interview, it is known that the level questions are a little complicated. It is purposeful to measure creativity. However, there are problems that can be solved using logic. The questions designed are varied and not boring.

Discussion

Based on research results obtained from the results of large-scale trials and interviews it was found that the development of ESD-based mathematics test questions to measure creative thinking skills are quite difficult. Because there are several indicators that must be fulfilled. Apart from that, math problems must be applied in the social field, economy, and environment. ESD-based math questions must also contain character values

through these questions, students not only have creative thinking skills and other mathematical skills, but also has character value. Thus, through the design of the questions raises students' empathy and sensitivity to the environment his life

CONCLUSION

Total of 28 creative thinking skills questions based on education for sustainable development have been produced and tested . Through this problem design, students not only have creative thinking skills, but also have sensitivity and character values when solving given mathematical problems especially when they solve social, economic, and environment mathematics problems.

ACKNOWLEDGEMENTS

Of the 47 initial item designs, 28 valid item designs were obtained based on the validation results from validators. Then from these problems there are those that can be solved and some that are not can be completed by students. The design of this question is a guide in compiling ESD-based math problem design.

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