Pre-service mathematics teachers creativity in designing mathematics assessment based on education for sustainable development

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Abstract. Pre-service mathematics teachers often design mathematical test instruments based on the questions contained in the mathematics textbook. The question can be modified or directly using the existing problem. This certainly does not explore students' creativity in designing mathematical test instruments, especially about applications in the social, economic and environmental aspects. This study aims to analyze the creativity of pre-service mathematics teachers in designing mathematical test instruments based on Education for Sustainable Development. This research was carried out qualitatively a type of phenomenology with 4 respondents’ namely Pre-service mathematics teachers. Based on the results of in-depth interviews and documentation of the mathematical test instrument was designs by Pre-service mathematics teachers, the results showed that pre-service mathematics teachers had gotten problems in designing application for the environmental field. Because of students are not used to designing application questions. For social and economic aspects, some students can design the problem but the problems given are limited to using examples in the social and economic aspect without incorporating elements of character values in them.

1. Introduction

Mathematics is a basic science that must be mastered by every student. Moreover, pre-service mathematics teachers who will teach mathematics later. To teach math skills is needed in teaching mathematical concepts so that mathematical concepts can be well understood by students [1]. The ability of pre-service mathematics teachers is not only in the field of mastering mathematical and pedagogical material, but also in the ability of pre-service mathematics teachers to design mathematical test instruments. Designing a mathematical test instrument is part of the assessment. Assessments used by teachers serve to develop students' mathematical skills and monitor student progress in understanding mathematical concepts [2]. In line with this, assessment must function to improve mathematics learning, and support the application of good mathematics teaching [3].
But it is not uncommon for us to meet pre-service mathematics teachers who will become mathematics teachers who have difficulty in designing mathematical test instruments. Though this ability is important to be mastered by pre-service mathematics teachers. Pre-service mathematics teachers also need to understand that later in teaching mathematics, not only must master the material/mathematical concepts, but also master to design the assessment in learning. Assessment cannot be released in the learning process. Pre-service mathematics teachers also need to understand how to design assessments in the learning process including designing mathematical test instruments.

Assessment is a stick/tool that can increase or weaken student learning [4]. But in reality, the assessment is not well understood or not carried out in the framework of education at all levels of life. The main purpose of assessment and evaluation is to enhance student learning [5]. Apart from that, assessment also has a role to know the learning needs of students and how problems/difficulties can be overcome so as to enhance learning [6]. Assessment is not only useful for teachers, but also useful for students. This is reinforced by the statement that assessment is an activity carried out by teachers and students in assessing themselves, providing information that is used as feedback to modify teaching and learning activities in which they are involved [7]. The teacher must develop assessment tasks in a way that activates students' sense of effectiveness in completing assignments and increases the value of their involvement in the assignment [8].

Based on this, it can be understood that assessment has an important role in learning. The assessment is done properly and correctly, it will improve the learning of students or pre-service mathematics teachers. However, if the assessment is not done well, it can weaken the learning of students and pre-service mathematics teachers. Coupled with the fact that the assessment is not well understood. This shows that the understanding of the importance of assessment in learning has not been maximized. Assessment also serves to determine the needs of students in learning and to find out how to overcome difficulties in learning.

At present, the assessment developed by the teacher is expected to encourage the improvement of higher-order thinking skills, increase creativity, and build students' independence to solve problems. Therefore, the assessment is expected to help students in enhancing the ability to think at a higher level (High Order Thinking Skills/HOTS) that measures the metacognitive dimension, not merely measuring the factual, conceptual, or procedural dimensions [9]. When referring to Anderson and Krathwohl's Taxonomy, HOTS is classified as C4 level (analyzing), C5 (evaluating), and C6 (creating) [10]. HOTS also uses contextual and attractive stimulus originating from global issues such as information technology, science, economics, health, education, infrastructure, culture, customs, cases in the regions, or various advantages in the regions. certain. Therefore, teacher creativity greatly influences the quality and variation of stimuli used in designing HOTS question instruments [9].

The test instrument especially the mathematics test instrument is part of the assessment. Mathematical test instruments can be in the form of description or multiple choice. Mathematical test questions can also be in the form of application problems in daily life or not applications in everyday life. To find out how the creativity of pre-service mathematics teachers in designing mathematical test instruments, the researchers conducted interviews with 4 Mathematics Education students who had taken a learning evaluation course.

Creativity in designing mathematical test instruments is also important. It is intended that the test instrument produced is not the result of duplication or copying the questions that are already in the mathematics textbooks. Therefore, the ability to think creatively is needed to produce a variety of mathematical test instruments. However, pre-service mathematics teachers still experience difficulties in developing their creative thinking abilities, where creative thinking will also lead to critical thinking skills. This is in line with what was expressed by Haberlin that the ability to think critically is still a difficulty for students and for pre-service mathematics teachers [11].

In this study, researchers discussed the creativity of pre-service mathematics teachers in designing mathematical test instruments. The importance of creativity in teaching is because good teaching is creative teaching [12]. Creativity in teaching is a way for a teacher to attract the attention of students [13]. Thus when designing a mathematical test instrument. Creative teachers are teachers who are able
to design creative mathematical test instruments. The teacher's creativity in designing mathematical test instruments is also about how the teacher chooses the application of questions that are suitable for daily life. In this case, researchers focus on applications in the social, economic, and environmental fields as this relates to Education for Sustainable Development. Education for Sustainable Development is an effort made in the field of education to grow the value of character to social, economic, and environmental conditions so that through this character can sustain their lives in a sustainable manner [14].

Creativity in designing mathematical test instruments is tailored to the 17 objectives of Education for Sustainable Development. The 17 objectives are (1) no poverty; (2) zero hunger; (3) good health and well-being; (4) quality education; (5) gender equality; (6) clean water and sanitation; (7) affordable and clean energy; (8) decent work and economic growth; (9) industry, innovation and infrastructure; (10) reduced inequalities; (11) sustainable cities and communities; (12) responsible consumption and production; (13) climate action; (14) life below water, (15) life on land; (16) peace, justice and strong institutions; and (17) partnership for the goals [15].

2. Methods
This research is a qualitative approach with a type of phenomenology. This research involved 4 respondents namely pre-service mathematics teachers who have taken the learning evaluation course. All respondents are certain to have learned about compiling a good and correct mathematical test instrument. The step taken by researchers in collecting data is to provide respondents with tests to design mathematical test instruments in the form of application questions that are specific to the social, economic, and environmental aspects as a component of Education for Sustainable Development. Then the researchers conducted interviews with respondents to obtain further information based on the mathematical test instrument that had been designed. Phenomenology design procedures are used, namely: (a) establishing an environmental phenomenon; (b) compile a list of questions; (c) data collection; (d) data analysis; (e) phase description of essence; (f) research report [16].

3. Result and Discussion
Through interviews obtained information that pre-service mathematics teachers have difficulty in designing mathematical test questions in the form of a description which is an application in life. This is because pre-service mathematics teachers have difficulty in finding relevant ideas between the mathematics material being taught and its application in everyday life. Researchers also asked pre-service mathematics teachers to design mathematical problem descriptions in the form of application questions that are specific to the social, economic, and environmental aspects as a component of Education for Sustainable Development. Then the researchers conducted interviews with respondents to obtain further information based on the mathematical test instrument that had been designed. Phenomenology design procedures are used, namely: (a) establishing an environmental phenomenon; (b) compile a list of questions; (c) data collection; (d) data analysis; (e) phase description of essence; (f) research report [16].
Based on Figure 1. It is known that the environmental aspects in this problem are only in the form of environmental selection (rice fields) as the context of the problem, but there are no elements so that students have a concern for the environment and a desire to protect the environment. The same thing was also shown through mathematical test questions that were designed related to economic and social aspects as follows:

**Figure 1. Mathematical Test Questions Design by Pre-Service Mathematics Teachers (Environmental Aspects)**

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A farmer wants to buy rice fields. The farmer wants to buy 3 types of rice fields. The first rice field wants to be planted with corn, the second rice field wants to be planted with rice, and the third rice field wants to be planted with oranges. Rice fields 1, 2, 3 respectively are 40 million, 30 million and 20 million per one share. If the farmer is given a bonus cut for the purchase of more than 4 fields with various types. Farmers plan to buy 3 plots of type 1, 4 types of 2, and 1 type 3. How much money should he have to buy the fields?

**Figure 2. Mathematical Test Questions Design by Pre-Service Mathematics Teachers (Economic Aspects)**

Figure 2 shows that the application problem in the economic aspect only uses examples of problems in the economic field and then is associated with mathematical material, but does not contain sensitivity to existing economic problems.

Andi buys 3kg of apples and 2kg of oranges for Rp26,400.00. Ujang bought 2 kg of apples and 3 kg of oranges for Rp24,600.00. From the sentence above, what is the price of 1 kg of apples and 1 kg of oranges?

**Figure 3. Mathematical Test Questions Design by Pre-Service Mathematics Teachers (Social Aspects)**

Figure 3 shows that the social aspect is only to choose the context of the problem story without arousing the desire of students to be sensitive to social problems, without arising a desire to be sensitive to the social life around us. Based on the three examples of question design by pre-service mathematics teachers, it is known that social, economic, and environmental problems are only limited to the choice of the context of the questions without including a sense of sensitivity to social and economic problems, as well as love of the environment.

Yadi is 16 meters from the flagpole. Ari is 4 meters from Yadi’s right. Whereas Popy is 6 meters from Aris’ left. If the flagpole is considered zero, then how many meters is Popy’s distance from the flagpole?

Based on this, it is important to dig up more information about the ability of pre-service mathematics teachers in designing mathematical test instruments especially in the form of mathematical test questions that are applied in life. In this study, researchers focused on the application of mathematics in social, economic, and environmental contexts. This is based on the philosophy of Education for Sustainable Development (ESD) where ESD focuses on social, economic, and environmental aspects. ESD has 17 goals known as Sustainable Development Goals (SDG’s). To realize this goal, all disciplines must work together, including mathematics. Mathematics can take a role to realize the goals of Sustainable Development.

Mathematics can take a role through familiarizing students with mathematical problems related to social, economic, and environmental contexts. This is in line with what was expressed by the World
Summit on the Sustainable Development Report (2002) which argues that sustainable development operates in three domains, namely (1) the economic domain, aims to reduce and try to eradicate poverty, achieve higher levels of prosperity and enable sustainable improvement in economic welfare; (2) social domain, aims to reduce and strive to eradicate other dimensions of poverty, improve the quality of education, health, housing, and other aspects of individual and community welfare, and improve the quality of social interaction, involvement and empowerment; (3) the environmental domain, aims to reduce pollution and other negative impacts on the environment, reduce the impact of industrialization and human activities, and strive to achieve sustainable use of resources for the benefit of future generations [17].

Through the presentation of mathematical problems that are applied in these three aspects/domains, it is expected to be able to support the achievement of Sustainable Development goals. This is because students are accustomed to not only looking for solutions to mathematical problems, but are also accustomed to understanding the implicit meaning of the problem such as the emergence of empathy for the environment, social responsibility, and sensitivity to economic problems in the surrounding environment.

4. Conclusion
Pre-service mathematics teachers have difficulty in designing mathematical test instruments specifically those that are applied in social, economic and environmental contexts as components of Education for Sustainable Development. Even if the pre-service mathematics teachers can design a mathematical test instrument that is applied in a social, economic, and environmental context, the content of Education for Sustainable Development does not exist. Purely just a matter of ordinary mathematical applications in the sense of mathematical test questions but the problem uses problems in the social, economic, and environmental fields.

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