Student difficulties on understanding word problem based on ESD goals

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Abstract. Education for Sustainable Development (ESD) is a government program to achieve sustainability. This study contains math lessons using the word problem that is integrated in ESD. The purpose of this study is to find out student's response about sustainable development. This research uses a qualitative method. Written tests that integrate with issues of ESD objectives consist of several topics in mathematics that address environmental, social and economic issues are given. This test is followed by interview. The subject of the study were 32 students grade VIII in Bandung and 8 of them were interviewed afterward. Data analysis conducted many students who have difficulty in understanding the word problem. meanwhile the limited knowledge of students about the socioeconomic and environmental aspects becomes a challenge for the realization of ESD goals. From the results, we recommend for teacher to offend something happening in the social life, economy and environment in teaching mathematics so that students are more aware of the importance of sustainable development

1. Introduction

Mathematics as one of the basic science which is the most important element in the development of science and technology. Since mathematics is known to be on the foundation of science and technology, it means that the level of social and economic development is closely related to the level of development in the mathematical sciences [1]. This is agree with Ukeje's statement, It has also confirmed that no society can develop without effective mathematics teaching and learning in schools [2]. Both of these affirm that mathematics deals with social mining. Aghaduino observes that mathematics has been very successful, especially when applied to science. Without exception, mathematics has some unique characteristics that share knowledge to some extent according to Aghaduino, learning is always important because it has unique features [3]. Bishop stated that "individual schools and learners are in the community and in the care of ensuring the maximum effectiveness of school math teaching, we often neglect the educational influence of other aspects of life in a particular society, Schools and pesetas are in communities care about effectiveness in mathematics learning [4].

Based on the opinion of the experts above, mathematics learning is not only limited on science but also can be applied to sustainable development, therefore to realize sustainable development The government has a program of Education for Sustainable Development (ESD).
development is a vision of education that seeks to balance human and economic well-being with cultural traditions and respect for the Earth's natural resources [5]. Governments and civil society and individuals must assume responsibility for a more sustainable future. The World Summit on Sustainable Development Report posits that sustainable development operates at three domains. They are Economic domain- aims at reducing and seeking to eradicate poverty, achieving higher levels of prosperity and enabling continued gains in economic welfare; Social domain- aims at reducing and seeking to eradicate other dimensions of poverty, improving the quality of education, health, housing and other aspects of welfare of individuals and communities, and enhancing the quality of social interaction, engagement and empowerment; Environmental domain- aims at reducing pollution and other negative impacts on environment, mitigating the effects of industrialization and human activity, and seeking to achieve sustainable use of resources in the interest of future generations, so that learning activities conducted in class are expected to provide awareness to students in the context of economic, social and environmental [6].

All should contribute in their own way. Education is an essential element for a more sustainable future. For example, through education, the next generation of citizens, voters, workers, professionals and leader are ready for long-term learning. Without education, progress toward a more sustainable future will be in doubt. The effort is to include the components of ESD objectives in learning. In this case is the learning of mathematics. The inclusion of ESD in the learning of mathematics can be linked to solve the word problem. Math word problems have been a relatively understudied component of math and literacy learning [7]. Thus are important for students to understand the problem in the form of a story. Word problem aimed at students to practice and think deductively, to see the relationships and usefulness of mathematics in daily life, and to achieve mathematical skills and strengthen the mastery of mathematical concepts.

However the real conditions that occur in the field, students' skills in changing the story into the math is still low. mistakes of students in working on math problems in general due to students experiencing misconceptions and interconnection in learning [8]. Interview conducted to teachers in one school in Bandung, in teacher interviews revealed that students still often have difficulty in understanding the problems associated with daily life -day. Inappropriate with Jupri, Drijvers, and Heuvel-Panhuizen [9] in their research that "the most frequently observed difficulty is the ability to translate between situational problems and mathematical situations". It is of concern to know the conditions in depth what kind of mistakes experienced by students in solving the problem in the matter of the story. In addition, students also do not know the purpose of ESD. Therefore, we investigate the difficulties of junior high school students in the understanding of stories related to the ESD problem. Research question: what is the student's difficulty in solving the problem of the story related to ESD?.

2. Experimental method

The approach used is a qualitative approach that emphasizes descriptive research. Instruments are designed on the basis of ESD competence. In this case the data collection used in the form of test are instrument, observation, interview and documentation. The subjects of this study are VIII grade students of one school in Bandung as many as 26 people and 6 of them are interviewed afterwards. Written tests are required to collect data / information on student work and all student responses in solving problems related to ESD. Furthermore, interviews were conducted with students to strengthen the analysis of the ability to solve story problems.

3. Results and discussion

3.1. Analysis of student responses

Students are asked to solve 4 problem stories related to ESD problem that is about social problem, environment and economy. After they have completed the questions, they are interviewed to streamline their answers. Based on the test analysis and interview results, the researcher can summarize in detail the student calendar analysis.
3.1.1. **Analyzes the first question.** The first question concerns the presentation of data in statistics, in which case, Dwi is given the task by his teacher to calculate the number of vehicles passing through the Dago intersection. There is a lot of vehicle build up that causes traffic jam, especially on traffic lights to Taman Raya. Below is the data of the number of vehicles passing through Dago intersection at 07.00-12.00.

| Time (am)   | Number of Transportation |
|------------|--------------------------|
| 06.00-07.00| 179                      |
| 07.00-08.00| 156                      |
| 08.00-09.00| 131                      |
| 09.00-10.00| 146                      |
| 10.00-11.00| 110                      |
| 11.00-12.00| 154                      |

Table 1 describes many vehicles passing through the Dago intersection in a given time. This problem contains the concept of statistics to measure students' communication skills, the extent to which students can present data from form to diagram form. The data used are many cars passing Dago intersection. Students are given social moods about congestion. Then the students are instructed to infer the conditions in the table. Students' answers will be analyzed to obtain information on students' difficulties in understanding the problem of the story. At the time of conclusion, the students did not involve the table to explain the students' answers, nor were the students instructed to describe the vehicle conditions contained in the table into the diagram. Below is the student's answer.

![Bar chart drawn by students.](image)

Student work in figure 1 shows that students do not know yet how to draw a bar chart correctly. From the answer, the students do not know the rules and steps in making the bar chart. Students only draw diagrams and include numbers without thinking of readability of data presentation. Students do not use the x-axis and y-axis functions on the diagram correctly. Whereas, the presentation of the data in the
picture should be more explanation of the problem visually. Nevertheless, if you do not understand the basic concepts in making the diagram, it will be difficult to create a bar chart.

3.1.2. Analysis of student answers no 2. The second question presents an economic problem. The story says an insurance company uses XJ mobile phone operators for corporate communications needs. Telephone rates are used as follows: The use of a phone for one minute is charged Rp. 500.00. Initial fee which must be paid on every one phone use Rp.420.00. What is the amount to be paid if an employee calls a client for 25 minutes? How to determine the general form of telephone use problems of this company?

![Figure 2. Students create tables to get answers.](image)

Student answers are as follows. Problem number 2 is designed to represent the situation systematically. To clarify student answers, here are the results of the interview.

- **Researcher**: "can you explain your answer?"
  - **Student**: "in the matter, said the initial calling fee is Rp. 420, then every one minute is charged Rp. 500, so we can create a table like this"
- **Researcher**: "based on the table you created, how to write an equation if time is unknown?"
  - **Student**: "means the equation cannot be written"
- **Researcher**: "why did you say that?"
  - **Student**: "because if anything is unknown, then we will not get the answer"

In answering the question, the student is considered good at making the answer seen from the table, but in the interview, the students express how to change the story form into mathematics, the students can use something that is known to be applied into mathematics. However, there is one interesting point, when asked how to write the equation if time is unknown, the students cannot answer. Though the students can change the unknown time with x. The students assume an answer should be a concrete number. So, if there is a variable present in the question, the student assumes it has not been named as an answer. Many students think better to clear an answer that one of the variables is unknown than answer it because students are afraid of answer wrongly.

3.1.3. Problem analysis no 3. In the third question, students are given ESD problems about the Environment. About the story contains the discourse neighbors piles of garbage in an area. Rubbish that continues to accumulate can cause disease. On the discourse mentioned already many people affected
by diarrhea due to the dirty environment. Students are given information in the form of tables about the amount of garbage that accumulates in the area. Students are required to complete the table below, then students are asked to count the number of garbage piles at 21 weeks n.

**Table 2.** Lots of garbage piles (in kg).

| Weeks | scrap heap |
|-------|------------|
| 1     | 4          |
| 2     | 6          |
| 3     | 8          |
| 4     | ...        |
| 5     | ...        |
| ...   | ...        |
| N     | ...        |

To answer the questions given in question number 3, students can complete the tables provided, but there are so many students who empty the lot of garbage piles in week.

Here are the interview results:

Researcher : "do you understand this problem?"
Student : "yes I understand"
Researcher : "if you understand why did not you fill the week n?"
Student : "since n is not a number, I cannot answer a question containing the letters"
Researcher : "if you can fill in an empty table, you should also know the value of n. if you cannot fill in the value n, how do you get to know the garbage pile to 21?"
Student : "I will calculate it manually"

From the results of this interview, the researchers concluded that students are not accustomed to facing questions containing variables.

3.1.4. Analysis question no 4. In question number 4 students are given social problems about humanity. About the conversation about three children who want to give their new clothes to children living in conflict countries. One child bought 5 pieces of clothing and 4 pants for 345,000, while another kid bought 7 pieces of clothing and 3 pants for 405,000. about asking what the price of one shirt. Problem story linear equations system of two variables.
It is interesting to calculate the system of two linear equations. In solving this problem required the ability to form the form of the story into the mathematical model. According to Ang mathematical modeling is the process of converting or representing problems in the real world into a mathematical form in an attempt to find solutions to a problem [10]. Mathematical modeling can be one way of bridging abstract mathematical concepts with problems from the real world. The real-world problem was first converted into a mathematical problem, which was then mathematically resolved, the result being re-translated as a real-world problem solution. In this case, the real world problem is one child buying 5 shirts and 4 pants for 345,000 and the second child bought 7 shirts and 3 pants for 405,000. students count the number of clothes and pants. Also, add up the total price of all clothes and pants. when interview session, students claimed want to add up the price of clothes and pants then divided the number of clothes and pants. The result is the price of one shirt. Students consider the price of pants and clothes are same, so the price of one shirt is 39,000.

Another student converts to a mathematical form into $5b + 4c = 345,000$ and adds up the price he will pay. After summed up, the student tries to change again with mathematical modeling ie b as shirt and c as pants. Then the students write their mathematical equations. However unfortunately the process of students is still less precise when eliminating. Visible goal students want to look for value of $b$ and value of $c$ but students cannot find it because it is inappropriate to use elimination rules. In this process, the students are seen to understand the problems contained in this word problem but cannot model it. In the next step, the students want to prove by eliminating the value of $b$ or value of $c$ but the students are incorrect in determining the steps so that the student's work stops there.

4. Conclusions
The analysis shows students' mistakes in changing the most popular math stories. Moreover, many problems related to the concept of ESD such as environmental, social and economic problems. This proves, ESD problems can be developed into mathematics by using the word problem. Difficulties in applying symbols in math still often errors. The student still considers the answer of a question to be a number. Based on this result we directed that the teachers to habituate students to know more closely with the symbols of mathematics, especially to understand the algebra in the budget so that students can solve the problems of mathematics in daily life that is packed in the form of the story of the problem, moreover ESD problem.
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References
[1] Kuku A O 2012 Mathematics as a time-tested resource for scientific, technological, socio-economic and intellectual development Distinguished Mathematics Lecture delivered at the University of Ibadan (Ibadan: Ibadan University Press)
[2] Ukeje B O 2002 Production and retention of mathematical sciences teachers for Nigerian educational system In S O Ale and L O Adetula (Eds) 2005 Reflective and Intellectual Position papers on mathematics Education Issues (Abuja: Marvelous Mike Nigeria Ltd)
[3] Aghaduino M C K 1999 The interrelationship of mathematics and science Technical Education Today 9(1 and 2) 37-43
[4] Bishop A I, Hart K, Lerman S and Nume T 1993 Significant influences on children’s learning of mathematics: Influences from society, Science and technology education UNESCO Document series 47 1-25
[5] Arjen E J Wals Geke Kieft 2003 Education for sustainable development (2010: SIDA)
[6] World Summit on Sustainable Development WSSD 2002 Report of the World Summit on Sustainable Development Retrieved from http://daccessods.un.org/access.nsf
[7] Powell S R., Fuchs L S, Fuchs D, Cirino P T and Fletcher J M 2009 Do word-problem features differentially affect problem difficulty as a function of students’ mathematics difficulty with and without reading difficulty? Journal of Learning Disabilities 42(2) 99-110
[8] Tall D and Razali M 1993 Diagnosing Students’ Difficulties in Learning Mathematics International Journal of Mathematics Education in Science and Technology 24 209-202
[9] Jupri A, Drijvers P and Heuvel-Panhuizen M 2014 Difficulties in initial algebra learning in Indonesia Mathematics Education Research Journal 26 683-710
[10] Ang K C 2001 Teaching mathematical modeling in Singapore school The Mathematics Educator 6(1)