

Competencies of Education for Sustainable Development Related to Mathematics Education in Senior High School

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Abstract. Education for Sustainable Development (ESD) is an idea which developed since 1992 as a concept of development that bases 3 pillars as its foundation: environment, social and economic. School is one of the educational media to be a strategic place to develop this concept. Teachers as someone who has an important role in learning must understand this concept. Therefore, this study aims to analyze teachers perceptions to education for sustainable development and analyzing the competencies in the dimensions of ESD that can be integrated into the curriculum of mathematics. The study was conducted using a survey method with questionnaires to 107 mathematics teachers of senior high school in the West Java and Banten grouped according to the geographical location. Data analysis was carried out through descriptive statistics and one way anova using SPSS. The results of the study provide two conclusions: first, the geographical location does not affect the teachers perception, second, almost all competencies in the dimensions of ESD can be integrated into the curriculum of mathematics.

1. Introduction

ESD is a development concept that cares about sustainability related to three dimensions: economic, environmental and social. These three dimensions of development must go hand in hand. UNESCO as an organization that handles education and culture applies this concept as ESD. Minister of Education and Culture in an education socialization meeting for sustainable development conducted in August 2008 stated that ESD is the spirit of education in Indonesia. The school as an educational institution has become a strategic place to develop this concept, and since 2008-2011 the Ministry of Education and Culture has conducted research related to the integration of the concept of ESD in the formal school curriculum.

The concept of ESD is very important to be implemented in schools. Walhi (2017) states that Indonesia is in an ecological emergency. This statement can simply be described as a situation or precarious condition due to environmental damage. This is derived from the monopoly of natural resource control activities that are not environmentally friendly which has an impact on the loss of people's access to livelihoods. "The mental revolution has not succeeded in bringing the people completely free from efforts to silence, criminalize, violence, and seize their rights. This portrait leads to an imbalance in space, while law enforcement is still focused on investment services" (Mongabay, 2018).

In the record of WALHI, about 159 178 237 hectares of land had been divided into licensing which is equivalent to 30.65% of Indonesia (land and sea). As an illustration, Indonesia's land area is around



191,944,000 hectares and the sea area reaches 327,381,000 hectares. Distribution of these permits, 59.77% are on land and 13.57% at sea. Then around 302 environmental and agrarian conflicts occurred throughout 2017, and 163 people were criminalized. This data comes from 13 provinces: Aceh, West Sumatra, Riau, Jambi, Bengkulu, Lampung, DKI Jakarta, West Java, Central Java, East Java, East Kalimantan, South Sulawesi, and Papua (Walhi, 2018).

In the economic field, it does not escape problems including unemployment and poverty. The Central Bureau of Statistics (BPS) recorded the number of Labor Force in Indonesia as of February 2018 as many as 133.94 million people, up 2.39 million people compared to February 2017. Advances in technology, communication and telecommunications and transportation increasingly support the flow of globalization so that economic relations between countries and region becomes very easy. Government support through the ease of customs is increasingly encouraging free trade (Enquete Commission, 2002). However, out of 133.94 million people in the total labor force, as many as 6.87 million people are still looking for work (unemployment). For poverty data in Indonesia, the Central Statistics Agency (BPS) noted that Indonesia experienced the lowest point in terms of percentage of poverty since 1999, namely 9.82 percent in March 2018, this is related to inflation and also government assistance to the poor continues to roll. This shows that the general public has not been able to live independently, most of them rely on the assistance of the government.

Indonesia's slow economic growth is due to investment and capital problems. Indonesia still relies on capital from foreign investment to support its economic activities. Domestic investment is only 40% while 60% is foreign investment due to high interest rates so that foreign investors prefer to spend their capital to be planted in Indonesia (Kalla, *Pikiran Rakyat*, January 2, 2018). In addition, Indonesia's dependence on imported products is also still high. About 64% of National Industry depends on imported raw materials (Ministry of Industry, 30 August 2018).

From the ecological and economic problems described above, one of the main problems in economic development as an effort to fulfill the needs of human life is maintaining environmental sustainability because the negative impacts caused by economic development that do not pay attention to environmental sustainability will backfire for us in the future. With all the limited capacity of existing natural resources, we must manage it well so that there are no problems such as lack of natural resources for our next generation (Fauzi, 2004), because so far it has been proven that the more rapid the development of the environment is damaged the gap between concepts, policies and real life (Baiquni & Astuti, 2015, p.3).

The implementation of the ESD concept does not stand alone as a subject but is integrated into all subjects. According to UNESCO ESD should be integrated in all formal education curricula, from early childhood education to higher education (Filho, Mifsud, and Pace, 2018). This implies that even the ESD concept in the economic dimension can be integrated into the mathematics learning curriculum. Economics cannot be separated from mathematics, mathematics is the center of modern economics (Witternberg, 2017). Economic concepts are incomplete without using mathematics. To understand the economy properly we need to use mathematics at every point. By using mathematical techniques, the concept of daily economy can be understood in such a way as to foster a person's interest in the economy. Therefore both are closely related to each other and the use of mathematics cannot be denied in economic analysis (Chaudary, 2017).

Referring to the issues described above, the formulation of the problems put forward in this study are: (1) What competencies in the concept of ESD in the economic dimension can be integrated into the curriculum of high school mathematics subjects? (2) Does the geographical location affect the concept of ESD?

Based on the research problem proposed, this study is aimed to identifying competencies in the concept of ESD in an economic dimension that can be integrated into the curriculum of high school mathematics subjects and identify the geographical location influence on the concept of ESD.

2. Literature Review

2.1. Education for Sustainability Development (ESD)

The concept of sustainable development was defined in 1987 by the Brundtland Commission (World Commission for Environment and Development) as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Ali, 2017; UNESCO, 2012; OECD, 2008; Indonesian National Commission for UNESCO, 2014; Valencia, 2018). The statement has two main words, the first regarding needs and the second regarding limitations. The need in this case is the basic human need to sustain his life, especially the poor of the world which is a priority, while the second is about limitations. Limitations in this case means the ability of the environment to meet human needs both today and in the future. (<http://www.iisd.org/sd/>).

Sustainability is a paradigm of thinking about the future in which development to improve the quality of human life must consider environmental, social and economic balance, therefore these three social, environmental and economic spheres are interrelated (UNESCO, 2012). The concept of sustainable development itself can be understood from three perspectives (Ali, 2014; Summers, 2013; Pradham and Mariam, 2014), that is:

- Socio-cultural perspective, namely sustainable development is seen as an effort to fulfill human rights, realize national security and world peace, national survival, gender equality, cultural diversity and intercultural understanding, health care, prevention and treatment of diseases dangerous like HIV / AIDS.
- Environmental perspective, namely sustainable development as an effort to utilize wealth and natural resources wisely by paying attention to the interests of future generations, anticipating climate change, changes in the rural and urban environment due to urbanization, and prevention of disasters triggered by human activities in exploiting the environment less wisely, such as floods caused by deforestation.
- Economic perspective, namely sustainable development as an effort to reduce poverty, improve welfare, build economic independence and nation's competitiveness.

Based on the concept of sustainable development, this means that ESD aims to develop individual competencies in reflecting their own actions with full responsibility and calculation towards their current and future social, cultural, environmental and economic and from a local and global perspective (UNESCO, 2017) Individuals in this case are people of all ages who are responsible for creating a sustainable future (UNESCO, 2005).

Education for Sustainable Development allows every human being to acquire the knowledge, skills, attitudes and values necessary to shape a sustainable future (UNESCO, 2014, Dannenberg & Graventin, 2016). Therefore according to the Council of the European Union (2010) ESD is very important for a sustainable community achievement so that it is needed both in formal, informal and non-formal education. There are 4 main priority drivers in implementing ESD, namely (1) promoting and improving the quality of education; (2) reorient existing education at all level to address sustainable development; (3) raise public awareness of the concept of sustainable education; (4) the workforce train (Indonesian National Commission for UNESCO, 2014). From this statement it appears that ESD is the learning needed to improve the quality of human life now and in the future, where competencies related to ESD in the form of knowledge, skills and attitudes or ESD values are comprehensively integrated in learning.

2.2. Mathematics Learning Objectives

The definition of learning is essentially an effort to learn students. In an effort to learn students / students can be designed not only interact with the teacher as the only source of learning, but interact with all possible learning resources to achieve learning outcomes. (NCTM, 2004).

Mathematical learning is important for all students, especially when they study science. Aghaduno (1999) observed that mathematics has exceeded successful especially when applied to science (Daso & Ojimba, 2012). The need for mathematics can be said to be as old as mankind. Mathematics has

helped humans towards the modern era, this means that mathematics is the foundation of science which is the starting point of modern development (Azuka & Festus, 2015). Obviously in this case the role of mathematics is very important in developing human analysis skills in calculating, measuring, predicting, analogizing and so forth. Learning mathematics can help students understand concepts, solve systematic problems, associate mathematics with everyday life, and can express mathematical ideas both verbally and in writing. It can be seen from here that the focus of mathematics learning is not only intended to master mathematical concepts, but is intended to develop reasoning, personality, and good attitudes (Soedjadi, 1999).

Well-managed mathematics learning also has the potential to foster positive character (Mahmudi Ali, 2016). This is in line with the essence of Curriculum 2013, one of which emphasizes the development of attitudes or characters. Learning attitude is not done directly but is integrated with learning all subjects, including mathematics.

2.3. *Economics, ESD and Mathematics*

Economic development must be carried out sustainably. This is due to three main reasons, namely moral, ecological and economic reasons. These three reasons are related to each other. This means that in exploiting natural resources must pay attention to future generations, so that they have the same rights in enjoying their natural resources. (Fauzi, 2004).

Integrating the environment into the discourse of the mathematics classroom signals the possibility of a more genuine mathematics education (Renert, 2011). When talking about curriculum, we talk about 4 , essential thing namely goals, content, methods and evaluation (Syaodih, 1997). Teachers as professional educators are the main elements that will determine the success or failure of learning (Arifah, 2017). Before starting learning in class, first the teacher must master what content will be delivered and this is important (Llinares, 1998; Blanco, 2011 ;). In line with the above statement, Vistroyu, 2011, stated that "Certainly, the amount of mathematics content that teachers know about their ability to respond to students is faced by involving the hackers and the whys of learning mathematics.

After the teacher has mastered the math content, then the second thing is the teacher must look for ways or methods that are appropriate to teach the content. Mastery and selection of the right method is very important to be done by the teacher. If ESD values on the Environmental and Economic perspective components have been implemented property, a safe environment and viable economic life will be created. If ESD values in the socio-cultural and economic perspective component have been carried out properly, then there will be a society that is safe, respectrul equitable and affluent ESD values are implemented through intra-curricular activities in order to strive for the realization of a Comprehensive and Competitive Indonesian Smart Person. In the implementation of ESD values into learning, it is necessary to set the stages of learning planning, implementation, and assessment of learning outoomes so that intelligent and comprehensive output of Indonesian people can be achieved.

3. Methods

This research was carried out using survey methods. The selection of the survey method is based on the ability of the method to collect data on teachers' perceptions of ESD and also to explain the relationship between various research variables namely the dependent variable on the perception of high school mathematics teachers in ESD in the economic dimension, geographical location variables as independent variables . Data collection was carried out using a questionnaire given to a number of high school mathematics teachers who spread in the West Java-Banten area as the research sample.

Subjects that were sampled in this study were high school mathematics teachers grouped according to geographical location (lowland and highland areas). To accommodate this, the sampling technique used is cluster sampling techniques. The number of samples in this study amounted to 107

respondents with respondents from the highlands amounted to 64 and from the lowlands amounted to 43 with each standard deviation value respectively 0.446 and 0.456.

The instrument used was a questionnaire developed based on indicators of ESD in the economic dimension which was divided into two parts, namely (1) poverty reduction and (2) exploitation of natural resources. Each statement in the questionnaire was assessed using a Likert scale, which is point 5 for statements that strongly Agree / SS (if the respondent receives without notes), point 4 for statements Agree / S (if the respondent receives with notes), point 2 for the Disagree / TS statement (if the respondent does not accept / reject), and point 1 for the statement Very Disagree / STS (if the respondent strongly does not accept / reject strongly in the given conditions).

Examination of instrument content validity is done through expert judgment. The results obtained state that the content in the instrument is relevant to what is measured. Reliability testing was carried out using the Cronbach Alpha technique using SPSS. The Cronbach Alpha value is 0.98 so it can be concluded that the questionnaire is very reliable for use in research. The distinguishing power inspection is done by using SPSS by measuring each item as a whole using the Pearson Correlation method. There are 27 statements that are all valid so that each statement has a reasonable distinguishing power to be used as a research instrument.

Data collection was done by distributing directly to respondents and distributed online using a digital questionnaire made using Google document software. To analyze the perception of ESD, it is calculated based on the mean score of each item of statement that is grouped based on geographical location and gender. A statement with a value of 5 is a statement that is perceived as strongly agreeing unconditionally to the conditions given by the respondent. To analyze the effect of independent variables (geographical location) on the dependent variable (perception of education) for sustainable development is done using one-way ANOVA. Homogeneity test in the economic dimension is done to find out whether the two regions between the lowlands and the highlands have the same variance or not, which is seen from if $r_{count} > r_{table}$ so both regions have the same and homogeneous variance, using SPSS produces a value of 0.676 for sub-dimensions one and 0.269 for two sub-dimensions. Furthermore, the significance of the geographical location of the concept of ESD is carried out to test significant data. From the results obtained shows that the value of $r_{count} > r_{table}$ means that there is no significant influence between the geographical location of the teacher's perception of ESD in the economic sub-dimension.

4. Result

The question in the formulation of the second problem aims to analyze the influence of geographical location on teachers' perceptions of ESD. The analysis here uses one-way ANOVA using SPSS. The following table shows the acquisition of the mean value of the perception of the mathematics teacher using the t test.:

Tabel 1. Nilai Mean Persepsi Guru Matematika Terhadap ESD

Dimension of ESD		Sum	Mean	Std. Deviation	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
Economics	region							
	poverty reduction	43	4,349	0,425	4,218	4,480	3,522	5,000
		64	4,417	0,416	4,313	4,521	3,391	5,000
	Total	107	4,390	0,419	4,309	4,470	3,391	5,000
exploitation of natural resources	Highland	43	4,273	0,597	4,089	4,457	3,250	5,000
	Lowland	64	4,246	0,548	4,109	4,383	3,250	5,000
	Total	107	4,257	0,566	4,149	4,365	3,250	5,000

The table above shows the mean value of the economic dimension in ESD. In the sub-dimension one, namely the reduction of poverty for respondents in the coastal area has a mean value of 4.349 while for mountainous areas has a mean value of 4.417 with a range of total values between the upper limit with the lower limit is relatively small that is equal to 0.262, and a low standard deviation of 0.419 . Because the mean value is more than 3.6 and the standard deviation is relatively small, the educational competency for sustainable development in this sub-dimension can be integrated into the curriculum of mathematics subjects, meaning that for both coastal and mountainous regions the same curriculum can be made regarding ESD.

5. Discussion And Conclusion

Based on the results of research on the perception of high school mathematics teachers towards ESD there are two interesting things to discuss. First, regarding teacher perceptions of ESD, with no difference in perceptions between teachers in coastal and mountainous regions, this indicates that ESD is not new to teachers, most of them have understood the importance of the concept of education for this sustainable. But the second discussion is in terms of the competencies that exist in every dimension of ESD. Perhaps what will be the problem here is how these teachers design an integrated education learning for sustainable development. Therefore, in the next step a focus group discussion will be arranged to design an educational curriculum for sustainable development that is integrated into the curriculum of mathematics subjects by selecting competencies that are in line with basic competencies in mathematics subjects.

6. References

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