

# The Importance of Environmental Education as a STEM Education in the Field of Science for Elementary School Students to Anticipate Natural Disasters in Indonesia

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**Abstract:** Along with the many natural disasters that hit the world recently, making Indonesia one of the countries that cannot escape natural disasters that hit the country. Ranging from volcanic eruptions, tsunamis, floods, droughts, earthquakes to forest fires, often occur in Indonesia. Throughout 2018, there were 2,349 disasters, up 39% compared to the number of disasters in 2017. Thus, it is an obligation for all parties to be able to overcome any natural disasters. In the field of STEM education, especially in science subjects in elementary schools, mitigation of natural disasters can be overcome by providing environmental education to students, especially for elementary school students in Indonesia. In this study, the following methods were used: descriptive, classification methods, analysis and synthesis methods, generalization methods and specifications. The results obtained, students can develop a better understanding of environmental problems, have the skills to overcome disasters, and can explain to their families and surrounding communities to be able to support the Indonesian government in preventing natural disasters in their country.

## 1 INTRODUCTION

Environmental education in Indonesia is facing serious problems when compared with environmental education and its application in the life of people in developed countries. When compared with education in Singapore, starting from primary education and continued to higher education, environmental education in Indonesia has not been a real positive impact. It was marked by a change in the faster the environment, disasters come and go, it is a tragic phenomenon that occurs in the country of Indonesia.

Some disasters are largely due to environmental degradation, making the thought that connects these events with the educational process applied. Musing deforestation causes soil erosion and landslides resulted in many casualties due to avalanches befall dense residential areas, the problem of air pollution in large cities due to the use of motor vehicles, the attitude of the population that still littering, and many irregularities of behaviour which can degrade the quality of the environment.

### 1.1 STEM Education

STEM Education is an interdisciplinary approach to learn where rigorous academic concept are coupled with real world lessons as students apply science, technology, engineering, and mathematic in context that make connections between school, community, work, and the global enterprise enabling the development of STEM literacy and with it the ability to compete in the new economy. (Southwest Regional STEM Network, 2009).

STEM education has to be interdisciplinary borderless and require learners to make connections with real life contexts. Thus, it would require integrating concepts of Science, Technology, Education, and Mathematics in project, problem-based learning projects, or case studies to help student connect. All these years, these concepts have been taught through separate subjects in schools and by different teachers who have different fields of expertise. (Suraya, 2018). Being connected is very important for the teachers to acquire STEM thinking in the education. (Reeve, 2015), introduced the term STEM thinking which be defined as purposely thinking about how STEM concepts, principles, and

practices are connected to most of the products and systems we use in our daily lives.

Some research results related with STEM education are as follows: (Tamara et al., 2018), the purpose of this study was to investigate the commonalities and variations in educators' conceptualizations of STEM education. Sense making theory framed our analysis of ideas that were being selected and were retained in relation to professional learning experiences in three contexts: two traditional middle schools, a STEM-focused school, and state-wide STEM professional development. Concept maps and interview transcripts from 34 educators holding different roles were analysed: STEM and non-STEM teachers, administrators, and STEM professional development providers. Results three themes were included on over 70% of the 34 concept maps: interdisciplinary connections; the need for new, ambitious instructional practices in enacting a STEM approach; and the engagement of students in real-world problem solving. Conceptualizations of STEM education were related to educational contexts, which included the STEM education professional development activities in which educators engaged. We also identified differences across educators in different roles (e.g., non-STEM teacher, administrator). Two important attributes of STEM education addressed in the literature appeared infrequently across all contexts and role groups: students' use of technology and the potential of STEM-focused education to provide access and opportunities for all students' successful participation in STEM. Conclusions given the variety of institutionalized practices and school contexts within which STEM education is enacted, we are not convinced that a single worldwide definition of STEM education is critical. This is especially important in the current reform contexts related to STEM education. We also see that common conceptions of STEM education appear across roles and contexts, and these could provide starting points for these discussions. Explicitly, identifying the ideas educators are and are not selecting and retaining can inform professional learning activities at local and larger scales.

(Chittum, 2018), Conclusions through this study, the researchers found that students could be motivated in Studio STEM and that the experience had a positive impact on their perceptions about science as a field. Importantly, Studio STEM appeared to halt the decline in these students' motivational beliefs about science that typically occurs during the middle school years, indicating

that afterschool programs can be one way to help students maintain their motivation in science. Studying the program features that the students found motivating may help educators to make connections between research and theory, and their classroom instruction to motivate their students.

(Baker, 2017), the researchers continued to support the school division during monthly academic-year professional development sessions as the teachers and coaches created and enacted prototype lessons. Research integration capacity with a specific focus on mathematics content can offer a model for STEM integration using MEAs that challenges one-size-fits-all professional development, encourages STEM instructional leadership, and promotes mathematical readiness for STEM citizenship and careers.

(Kartal, 2018), the results indicated that the NOS-CPD program improved the teachers' NOS views more effectively than previously reported short-term teacher development programs, and thus, the findings should be useful for future studies in support of the professional development of teachers. The article concludes with practical advice for implementing NOS-focused, in-service teacher development programs.

(Roberts, et. All, 2018), results the research used a naturalistic inquiry, phenomenological approach to examine students' perceptions of STEM while participating in a summer informal learning experience. Data came from students at the summer informal STEM learning experiences at three diverse institutions across the USA. Data were collected from reflection forms and interviews that were designed to explore students' "lived experiences", (Manen, 1990) and how those experiences influenced their STEM learning. As we used a situate lens to examine the research question of how participation in an informal learning environment influences students' perceptions of STEM learning, three prominent themes emerged from the data. The informal learning environment (a) provided context and purpose to formal learning, (b) provided students opportunity and access, and (c) extended STEM content learning and student engagement. Conclusions by using authentic STEM workplaces, the STEM summer learning experience fostered a learning environment that extended and deepened STEM content learning while providing opportunity and access to content, settings, and materials that most middle level students otherwise would not have access to. Students also acknowledged the access they received to hands-on activities in authentic STEM settings and the opportunities they received

to interact with STEM professionals were important components of the summer informal learning experience if connected STEM education, especially for science field, environmental education is important factor for elementary school students. The purpose of environmental education (Stapp, 1969; Meilani 2009; Denkova, 2011) is to make the public more aware of environmental issues, understanding the human responsibility and its role for the environment, and build a sense of environmental preservation and the ability to solve environmental problems. The core purpose of environmental education is about understanding and attitude. Environmental education is based on the four pillars of education (Delor's report in Campbell, 2001). First, education is to know and understand the environment in all its aspects (learning to know). Second, education is to instil an attitude, ability and skills in preserving the environment (learning to do). Third, education is to instil a way of living together on earth to be secured preserved for generations to come (learning to live together). Fourth, education is to instil deep belief that human beings are part of nature, which man is a friend and not foe of nature, as well as in life must act friendly and thoughtful in treating nature (learning to be).

## **2 METHODOLOGY**

In the study, used the following methods: descriptive, the classification method, the method of analysis and synthesis, the methods of generalization and specification (Zelenika, 2000). Data was gathered through analysis of documents (material for Environmental Education STEM education, and natural and social sciences). The research is limited to the material of natural disaster for the six grade of primary school in Indonesia and teaching methods material of natural disaster in the six grade primary school.

## **3 RESULTS AND DISCUSSIONS**

### **3.1 The Development of Environmental Education**

#### **3.1.1 Development of Environmental Education at the International Level**

In 1975, an international workshop on environmental education was held in Belgrade,

Yugoslavia. At the meeting produced a statement among participating countries on environmental education known as "The Belgrade Charter - a Global Framework for Environmental Education". In brief, the purpose of environmental education were formulated in Belgrade Charter mentioned above are follows:

Raising awareness and attention to linkages economic, social, political, and ecology. Provide opportunities for everyone to acquire the knowledge, skills, attitudes / behavior, motivation and commitment, which is needed to work individually and collectively to solve environmental problems today and prevent the emergence of new problems. Creating a whole new behavior patterns for individuals, groups and communities to the environment.

#### **3.1.2 Development Environmental Education in the Nations of ASEAN Region**

Program development of environmental education is not a new thing in the scope of ASEAN. ASEAN member countries have developed programs and activities since the international conference of the first environmental education in Belgrade in 1975. Since the issuance of the ASEAN Environmental Education Action Plan 2000-2005, each ASEAN member countries need to have a framework for the development and implementation of environmental education. Indonesia as the ASEAN member countries actively participate in designing and implementing the ASEAN Environmental Education Action Plan 2000-2005. In essence, the ASEAN Environmental Education Action Plan 2000 - 2005 is an important milestone in the efforts of regional cooperation among fellow ASEAN members to help improve the implementation of environmental education in each of the ASEAN member countries.

#### **3.1.3 Development of Environmental Education in Indonesia Country**

In Indonesia the development of the implementation of environmental education began in 1975 where for the first time in Jakarta Teachers' Training College pioneered the development of environmental education by arranging Outlines Environmental Education Teaching Program being piloted in 15 primary schools in Jakarta in the 1977/1978. In 1979 established and growing Center for Environmental Studies (PSL) in various public and private universities. Along with that also began to study the development of the EIA by all PSL under

the coordination of Minister of State for Development Supervision and the Environment (Minister for State-PPLH). Currently the number of PSL is a member BKPSL has grown to 87 PSL, in addition, various universities, both public and private sector started to develop and establish a special program of environmental education, for example, in the Department of Forestry IPB. At the primary and lower education level (general secondary and vocational), the eye of delivering teaching on population and environment issues in an integrative manner set forth in the curriculum system in 1984 to include the issues of population and environment in almost all subjects. Since the year 1989/1990 to date training on the environment have been introduced by the Ministry of Education for teachers of elementary, junior and senior high schools, including vocational schools.

### 3.1.4 Application of Environmental Education in Primary Schools

Environmental education that is given to students in primary schools include matters relating to the environment, natural disasters and ways to overcome them. Material natural disasters and natural disasters measures given in the sixth grade students in chapter IX. Basic competence of this chapter is that students understand and are able to explain the existence of earthquakes, tsunamis, floods, volcanic eruptions and catastrophic landslides. Each such disasters can be explained as follows:

#### 1) Earthquake

An earthquake is a natural disaster that was terrible. It was because the earthquake resulted in homes and buildings collapsed. Human victims of earthquakes are usually caused by the collapse of the building. Therefore, residents should find a way to save themselves. How to rescue from earthquake disaster covers 2 things; before the earthquake and during the earthquake. Things that must be done before the earthquake are as follow: try to get our building earthquake resistant, placing the location of settlements / housing away from vulnerable areas, educating the public so that the public has the vigilance and nimble in the face of earthquakes, form an organization tackling earthquakes within a community for them to have a cooperative spirit in the face of an earthquake, fire fighting training in order to have the skills to prevent and mitigate fires that occur during earthquakes in the Indonesia country, training in first aid (P3K) so that they have the skills to help the quake victims before being

taken to a hospital, train all family members so they have enough ability in the face of earthquakes, held a simulation of an earthquake that they deftly in an attempt to rescue themselves and their families, storing dangerous goods so that in the event of an earthquake is not lost due to act of people who are not responsible, enroll families on insurance so that each family has a guaranteed soul, setting up siren, gong, or other tools producing sounds to tell the entire community about the earthquake. As for how to save themselves in the event of an earthquake are as follow: leave the house if there is an earthquake, turn off power to avoid fire, wake and led out of the house all members of the family, away from the building, lies down in order not to fall, sound an alarm to notify all members.

#### 2) Tsunami

The tsunami was a high sea waves that strike the ground. Tsunami usually occurs after an earthquake. Examples of the tsunami disaster that occurred in Indonesia is occurring on December 26, 2004 in Nanggroe Aceh Darussalam, which killed about 270 thousand people. Although the tsunami can also be caused by the eruption of the seabed and the seabed rock landslides, but most of the tsunami caused by earthquake. To avoid the enormity of the tsunami, then the things that must be implemented are: education about tsunamis through both formal and non-formal, increase self-awareness of the whole family, government building tsunami early warning system (TEWS = Tsunami Early Warning System), the construction of the barrier / retaining tsunami waves near the shoreline, planting mangrove trees to preserve the mangrove forest that serves as a protective beach from waves, the construction of a safe evacuation order when the tsunami hit the people, much easier to safety, introduction to the public about the signs of a tsunami, construction of houses for tsunami. Ways of dealing with the tsunami is to: report on the tsunami phenomenon, equip yourself with the tools of communication and the formation.

#### 3) Disaster Mount Erupt

The next dangerous natural disaster in Indonesia is Disaster Mount Erupt. The mountain erupted, a natural disaster that is quite dangerous. Indonesia has many active volcanoes, including some very active mountain in East Java.

Some things to note are: recognizing signs of volcanic eruption (heat, strange animal movement,

earthquake), to understand the impacts and disaster (hot cloud, material), to build a house in the safe area and does not affordable volcanic eruptions, forming action groups care disaster, leaving the place / evacuate if there is advice of the government, securing valuables, lock your home when leaving the house, preparing meals and the availability of sufficient clothing, social solidarity, turn off the electricity to prevent fires.

#### **4)Floods**

Floods are disasters that frequently hit the lowland areas. Actually flood was a natural disaster caused by the behavior of humans. The cause of the flood is deforestation, throwing garbage in waterways, building in flood plains region, torrential rains, and so on. Flooding often accompanied by mud in large quantities,

How to save ourselves from the flood: to recognize the signs of flood, understood as a result of floods and disasters, build houses in the safe area which is not affordable by the floods, formed action group concerned catastrophic, leaving the place / refuge if at any time there was a flood , securing valuables in a place that is inaccessible by the flood, locked the house when leaving the house, prepare the availability of food and sufficient clothing, mobilizing social solidarity, help clean the river of garbage, help prevent deforestation, help the reforestation program, turn off the power to prevent Fire.

#### **5)Landslides**

Landslides are a chunk of land located on a cliff, then slid downward. Landslides most likely occur in areas of steep mountain slopes. Often Landslides cause damage such as road closures, hoarding houses, etc.

Some counter measures are as follows: avoid building homes under the slopes prone to landslide, building a house in the safe zone which is not affordable by the disaster, preserving the trees around, recognizing the signs of flood, understanding the implications and disaster, forming action groups concerned disaster, leave / flee in case of landslides, valuables, lock your home when leaving the house, preparing meals and the availability of sufficient clothing, social solidarity. Prevent deforestation, and help the reforestation program. Material about natural disasters and the ways to overcome the above, the students will be able to understand about natural disasters and how to

avoid or how to prevent the occurrence of natural disasters. But in environmental education a student must be supported by good teaching methods and appealing for students, so that the learning objectives will be achieved.

### **3.2 Teaching Methods Material of Natural Disaster in the Six Grade Primary School**

Environmental education in the STEM education process is an environmental system consists of several components that interact in creating the learning process focused on a particular goal. These components, according (Gulo, 2012) is (a) learning objectives, (b) teachers, including his experience and knowledge, (c) learners, (d) the subject matter, (e) the method of teaching, (e) the medium of instruction , (f) administrative and financial factors. In teaching environmental education, a teacher must understand what factors can affect the effectiveness of teaching and learning. The learning process cannot be separated from the teacher's decision in choosing one or more methods to teach a lesson to students. According to (Anas, 2014), there are several factors that influence the selection of teaching methods, namely: (1) learners, including: differences in levels of education, background of learners, and intellectual level; (2) the class dynamics, including: the number of students, the class character, how cooperative people learn, the dominant group in the classroom, as well as the performance and level of class participation; (3) the availability of teaching and learning; (4) the learning objective to be achieved; (5) learning materials; (6) the allocation of instructional time; (7) the ability of teachers.

(Carlson, et all., 2011) and (Dewey in Kochhar, 1992) wrote that many authors agree that the best practice for environmental education is the field experience, as one of the informal environmental education, children should learn through activity. Learning from experience or learning by doing (Gandhi, Kilpatrick and Dewey in Kochhar, 1992) recommended today and is defined as the process of reaching an understanding, knowledge, skills, and attitudes through practical and applied activities. Some of the methods used in teaching environmental education include lectures, discussions, question and answer, experiments, storytelling, demonstrations, practice of direct experience, and so forth. Here are today several types of teaching methods that can be practiced in teaching environmental education in the STEM education:

**1. Method Lecture**—Lecture (Kochlar, 1992; Lee in Kochhar, 1992; Gulo, 2012; Vishwanath, 2006; Anas, 2014), is the way teachers deliver lessons orally, formal, well planned and aimed at clarifying some issues or particular topic to a group of learners. In this lecture method, the teacher can explain to various media that exists to provide direct explanations about natural disasters means of prevention for them.

**2. Discussion**—Discussions (Kochhar, 1992; Gulo, 2012; Rianto, 2006; Lakshmi, 2010; Vishwanath, 2006; Anas, 2014) is a way of presenting the lesson in which the students are active in expressing their opinions, knowledge, or experience from material have been determined. The goal is to solve problems, increase the knowledge of students, exchange knowledge / opinions, but it is not a debate that is both arguments. Having given an explanation, a teacher should also give their lesson with the method of discussion, so that students will be able to exchange opinions and complementarity his opinion when discussing the matter of natural disasters.

**3. Demonstration**—Demonstration (Kochlar, 1992) is a method used to teach participants to act or demonstrate the steps to work on something. Demonstration is a practice that is demonstrated to the participants. On the matter of natural disasters all very well if there is a demonstration method, so it can provide a picture of how the event of natural disasters and how to prevent it through demonstration or demonstrations in act out by the students, in addition to their more familiar.

**4. Assignment**—Recitation (Rianto, 2006; Anas, 2014) is a way of presenting the subject matter by assigning the students to engage in activities outside school hours face to face. This natural disaster on the material the teacher should assign tasks to students to find out the sources from outside depicting natural disasters, so that students have an extensive knowledge of the existence of natural disasters.

**5. Observation**—Observation (Anas, 2014; Lakshmi, 2010) is a way to learn the subject matter by making observations in an attempt to obtain information about objects and particular events by using the senses. The observations made in the students can do at the scene of natural disasters, or can view the video of natural disasters, so student can see it.

**6. Story telling**—Telling method (Lakshmi, 2010) is a way of delivering the lesson by telling the stories or events of a thing, with the aim that students can take lessons, especially moral contained in the story. In storytelling, the teacher should tell stories that happen when a natural disaster occurs, for example, by telling the victims' suffering are at capacity in the camps, the mosque was not damaged when the tsunami, and others that lead students into sympathy to help and provide relief to disaster victims, and tried to keep the surrounding environment so as to avoid natural disasters.

**7. Experiment**—Experiment (Lakshmi, 2010) is the way it is done through a process or experiment in the learning process. Methods experiments were carried tools or specific media and made more than once. This method makes students believe the correctness or conclusions based on experiments rather than simply accept the word from teachers or books. Learners are encouraged to develop exploratory study attitudes about science or technology, and expected to bring new breakthroughs. In this method, for example, students were invited to make compost, which is the processing of the waste bin, so that garbage can be separated from waste-separating organic and non-organic, which then can be process into fertilizer. The benefit is in addition to be able to utilize the existing waste could also preserve the environment with fertilizer on the plants that make the plant can thrive.

**8. The practice of direct experience** – experiential (Meilani, 2009) is a way of delivering the subject matter by getting learners interact actively and directly with natural activities to gain understanding and knowledge directly with nature. This practice can be done by the teacher invites students to view composters directly to the people who have done it, so they can get a first-hand how to make compost as part of efforts to green the environment and prevent flooding. As research conducted by (Slobodova, Novakova, Giertlová, 2016) which invites elementary school students to practice direct way of farming in urban areas, in anticipation of greening the urban environment and the prevention of flooding.

**9. Tourism**—Field Trip (Rianto, 2006, Kocchar, 1992) is a way of presenting a lesson by bringing learners directly to the object to be learned outside the classroom. At the time travel works of teachers

and learners only act as a tourist. The work can be done by teachers travel with the students to see the area directly affected by natural disasters, can all provide assistance both physical and non-physical.

**10. Question & Answer** (Rianto, 2006, Kocchhar, 1992) is a method used to convey the lesson by asking questions later learners to answer or otherwise. Question and answer important in doing by teachers at the material related with natural disaster, because it will make students understand and animating how natural disasters and ways to overcome them. So that students will have the critical thinking of the existence of a natural disaster, as well as research results (Serhat, 2012), which examines the Effect of Environmental Education in Critical Thinking and Attitude Environment. The results showed that the subjects in the sample had a critical level thinking skills average in environmental education. ANNOVA and t-test results also showed meaningful statistical significance in critical thinking skills of students and attitudes towards the environment in terms of gender, socio-cultural and other types of schools. In addition, in accordance with the results obtained from this study, it can be stated that the Thinking Test Critical in Environmental Education can be used to identify critical skills to students in elementary school.

**11. Role Playing / Simulation**—Role Playing (Rianto, 2006; Dawson in Rianto, 2006; Anas, 2014). That means the delivery of content through the development of imaginery and appreciation of learners to act it as a character living or inanimate. Ways of presenting the material in the form of impersonation acts, plays to enable learners to have better understanding with the material being taught. This method of learning to play a role in conveying the material chapter of natural disasters is very important, because it can be simulated how to give first aid to victims of natural disasters, which include providing medicines and demonstrations to help victims who have to wear a stretcher, and so on. So the child will feel directly how the situations of natural disasters and the ways to handle it.

From the discussion of several methods that can be applied in the schools in Indonesia are expected no sense of belonging Indonesian students to the environment, so as to have a caring and a good attitude towards the environment, as well as the results of research (Kollmuss, 2010); (Carmi,2014); (Julie Ernst, 2015); (Prati, 2015), which states that

the attitude of students has concern for the environment should have been in shape through environmental education implemented in schools. Natural disasters that will occur can be prevented by good if there is cooperation between the community and local government.

## 4 CONCLUSIONS

Of material discussion about natural disasters and ways to cope natural disasters with learning methods on students in elementary school, it can be concluded that the matter of environmental education is very important to give to the students starts from ground level up to college, so that students will understand and be able to explain to the family and the surrounding community to be able to support the Indonesian government in preventing the occurrence of natural disasters, and also able to provide relief and response to victims of natural disaster when a disaster occurs. For the role of teachers as educators are required to provide the knowledge and example as a good role in the care for the environment, maintain and at the same time be able to cope if a natural disaster occurs. As well as the leader for the students, teacher able to give more attention to the environment. So the effect on the environmental education leadership model is a person to influence his men to have better care for and maintain the surrounding environment. (Kyoungjin, Akiyama, Kim, Hoshiko, Furumai, 2011).

In addition to professional teachers and trainer in providing the needed environmental education is also an environmental education curriculum that is neatly arranged and sustainable ranging from primary school to college level, so that it can achieve the learning objectives given environmental education. As the research results (Huz, 2016), which states in the environmental education program nine years of basic school system in the Republic of Slovenia since 1957 with curricular reform happened.

Therefore, it concluded that it is very important environmental education given to all students from primary school to college, to prevent the occurrence of natural disasters in Indonesia. In addition to other factors that support the curriculum is the professionalism of teachers, teaching methods and approach to students and support of school leaders and the government of the Republic of Indonesia as a whole to support the accomplishment of

environmental education that is given to all students in the country of Indonesia.

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