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How to Help and Save Our Children and Our People from the Earthquake and Tsunami Disasters?

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Abstract

Indonesia is vulnerable to natural hazards and is at risk from an array of natural disaster of earthquakes and tsunamis. People's lack of awareness may lead to greater number of victims. Education can play significant role in reducing the unnecessary victims by improving people's awareness on the disaster. This proposed paper aims to develop e-textbooks on mathematics for emergency preparation through Lesson Study approach. The e-textbook will utilize mathematical modeling of the disaster processes and impact so that students can learn both mathematics and the nature of the disaster.

Disasters in Indonesia

There are a number of disasters threats, such as earthquakes, tsunamis, volcanic eruption, fires, landslides, typhoons, and flooding. Those disasters could be natural or as a result of man-made. Indonesia is one of country that is vulnerable to natural hazards especially towards earthquakes and tsunamis.

On 26 December 2004, in Banda Aceh; an earthquake struck 150 km off the coast of Aceh. Reconstruction and Rehabilitation Agency (*Badan Rehabilitasi dan Rekonstruksi* or *BRR,* 2005) states that it was the most powerful one the world has seen in a generation. Forty five minutes later, the first tsunami waves struck the Simeulue Island, Aceh, Indonesia located approximately 40 kilometers from the epicenter. Waves between 15 and 30 meters high then proceeded to the western and northern coasts of Sumatra, causing massive damage to thousands of kilometers of coastline in Aceh and North Sumatra Provinces and the western islands. There were 164,891 people buried, 114,897 people missing and 412,438 people displaced.

On 27 May 2006, at 5:54 local time, a medium-sized earthquake hit the central section of the Java Island, Indonesia. The shaking that lasted about 60 seconds caused widespread death and destruction to the heavily populated region. Most hit were Bantul in Yogyakarta Province and Klaten in Central Java Province. The large and affluent Yogyakarta City was also severely affected. More than 5,700 people were killed, whilst the injury list exceeded 37,000. Over 156,000 houses and other structures were totally destroyed.

Table 1
Earthquakes with Magnitude of 8.0 Richter Scale or more and Tsunamis in Indonesia within the Last 20 Years (1992 – 2011)

Years	Dates	Location	Magnitude of Quakes	Times	Qua-kes	Tsu-nami
1996	17-Feb	Biak	8.0 RS	02.59 p.m	v	v
2004	26-Dec	Aceh	9.0 RS	07.58 a.m	v	v
2005	28-Mar	Nias, Simeleue	8.6 RS	11.09 p.m	v	v
2007	12-Sep	Mentawai Islands	8.5 RS	10.26 p.m	v	v

Source: http://en.wikipedia.org/wiki/List_of_earthquakes_in_Indonesia

Data on Wikipedia (2011) as seen at Table 1 above shows us that Indonesia is at risk from an array of natural disaster of earthquakes and tsunamis. Within the last 20

years (1992 – 2011) there are 4 times earthquakes in Indonesia with magnitude 8.0 or more on Richter scale and all those earthquakes followed by tsunamis.

The Need of Emergency Preparedness Education

UNESCO (2010) has already differentiated between 'hazards' and 'disasters'. Hazards are natural while disasters are not. Hazards such as floods, earthquakes, and tsunamis become disasters only when society lacks the ability to cope with them. In addition, when a natural hazard strikes, children are among the most vulnerable population group, especially those attending school in times of disaster. UNESCO ISDR (2007) states that disasters such as the October 2005 earthquake in Pakistan, where over 16,000 children died in schools that collapsed, or the recent mudslide on Leyte Island in the Philippines, where more than 200 school children were buried alive, are just a few tragic examples of why more needs to be done to protect our children before disasters strikes.

The lack of knowledge on disaster phenomena leads to a tremendous number of victims. People living along the coastline failed to recognize that the receding of water quickly and unexpectedly from the coast may be the sign of tsunami will be coming. People followed it instead of running toward higher ground and inland. Many lost their lives because they did not know the meaning of receding coast. UNESCO ISDR (2007) gives two good examples that what people know is more important that what they have when it comes to saving lives and reducing loss. The first example, on a beach in Thailand, when the December 2004 Tsunami struck, British schoolgirl Tilly Smith saved many lives by urging people to flee the shore: her geography class in Britain had enabled her to recognize the first signs of a tsunami. The second example, at the same time, Anto, a young boy on the Indonesian island of Simeulue had learned from his grandfather what to do when an earthquake strikes. He and all the other islanders ran to higher ground before the tsunami struck, sparing all but eight members of the community.

During the 2011 Tohoku earthquake and tsunami in Japan, ITIC (2011) reports that one minute before the earthquake was felt in Tokyo, the Earthquake Early Warning System, which includes more than 1,000 seismometers in Japan, sent out warnings of impending strong shaking to millions. It is believed that the early warning by the Japan Meteorological Agency (JMA) saved many lives. The warning for the general public was delivered about 8 seconds after the first wave was detected, or about 31 seconds after the earthquake occurred. The earthquake, tsunami, or both caused an enormous numbers of property damage as well.

The Ministry of Education and Culture of the Republic of Indonesia (MoEC) with other institutions nevertheless has an important role in providing guidance, expertise and scientific and technical support in addressing every aspect of disasters. As soon as possible, Indonesian people must learn about those disasters threats and its impact on their lives. In all societies, children represent hope for the future. For saving our life, 'Emergency Preparedness Education' is one of the most urgently needed topics for school education. More importantly, it should be attached to provide the necessary scientific and practical knowledge about disaster risks and related competencies through the integration of disaster risk reduction education into school curricula. UNESCO Director-General Koïchiro Matsuura (UNESCO, 2007) stated: "Anticipating, educating and informing are the keys to reducing the deadly effect of such natural disasters. Unfortunately such activities have not been given priority." Therefore, the SEAMEO QITEP in Mathematics strongly supports this project: 'Emergency Preparedness Education: Learning from Experience, Science of Disasters, and Preparing for the Future' (HRD 04 11A) which was proposed by Japan (CRICED, University of Tsukuba) and Thailand (Khon Kaen University).

Purposes

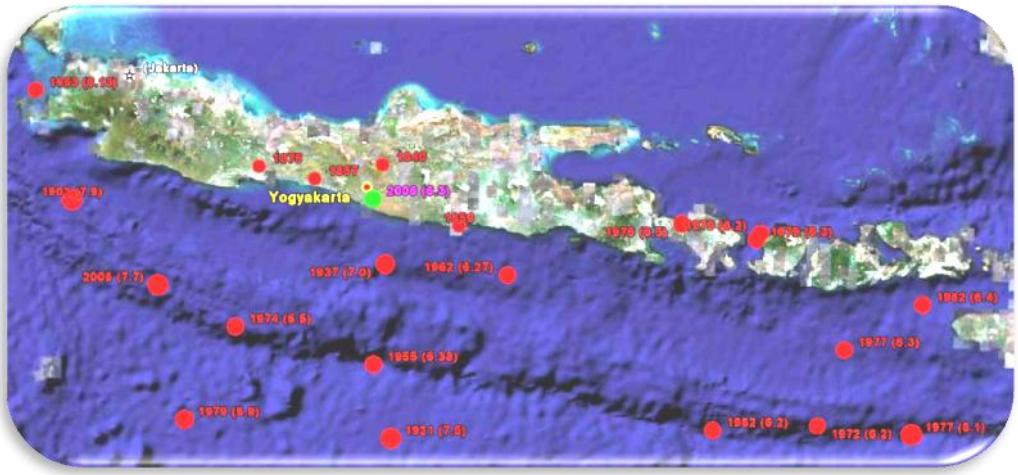
In general, this project aims to develop e-textbooks on mathematics for emergency preparation through the Lesson Study done by the specialists. Specifically, the goals of the development of the e-textbooks for students are as follows.

1. To increase the awareness of Indonesian students on the danger of disasters in their daily lives.
2. To help and facilitate Indonesian students with the scientific and practical knowledge about disaster risks (before, during, and after the disasters) and related skills to reduce or minimize it.
3. To increase Indonesian students' beliefs on the importance of mathematics, science, and technology that will motivate them having good attitudes toward mathematics, science, and technology.
4. To increase the awareness of Indonesian students to predict and anticipate the earthquakes and tsunamis.

The Importance of Modeling

During the learning of earthquakes and tsunamis, students can learn and apply mathematical concept. The examples are as follows.

1. In contexts to the earthquakes and tsunamis data or its presentation that require students to solve problems or model situations, students should be able to: (a) investigate questions by using the statistical enquiry, gathering, displaying, and/or identifying similarities and differences in categorical data; and (b) describe the likelihoods of outcomes for a simple situation involving chance using daily language.
2. The figure below with its presentation on another table (Elnashai, Kim, Yun, Djoni Sidarta, 2006:14) is an example to indicate that there were many strong events affecting Java and confirm that the tectonics of the region are dominated by the subduction of the Australia plate north-northeastward beneath the Sunda micro-plate. From Table 4.1 (see Elnashai et.al, 2006:14), students can learn that major earthquakes larger than magnitude 7 occur every about 25 years. The mathematical concept related to this finding is about periodic functions.



3. From the Yogyakarta earthquake report (Elnashai, A.S., et all), we can learn that the contour map for horizontal and vertical ground motion have geometrical concept like ellipse and circle. The students can learn that the larger the radius, the less the affected region will be.
4. In contexts to the magnitude of earthquakes in Richter Scale in which operates on a logarithmic basis so there is a 10-fold increase from one unit to the next (Jacobs, 1982:227). He also states that an earthquake rated 4 on the Richter

scale has been assigned a relative intensity of 1 unit. Based on this table, students can learn about the comparison of magnitude.

Table 2
The Relationship between Richter Scale and Relative Intensity

Richter Scale (RS)	4	5	6	7	8	9
Relative Intensity	1	10	-	-	-	-

If students are facilitated to draw its relationship, they can learn about the magnitude of 7.5 RS or 8.25 RS.

5. Related to the propagation of earthquake energy, there are three types of wave, namely s, p, and surface waves. The suitable mathematical concept to these waves is trigonometric function. The seismograph will represent the geometrical concept of the three waves. The students will be able to learn the concept of differentiation and integration from acceleration and velocity data.

The Lesson Study Plan

1. Theme: How can we reduce the disaster risk of earthquakes or tsunamis by using the mathematical model?
2. This lesson study focuses on two issues as follows.
    a. How to save people's lives and to prevent people from injuries in case of earthquakes and tsunamis?
    b. How to model the situation of earthquakes and tsunamis disaster into mathematical terms, concept, or principles?
3. The team may consist of specialist, mathematics teachers, mathematics educators, mathematicians, and geologist.
4. During the 'plan' step, the team should:
    a. collect data and information from several sources such as mathematics or science books, artifacts, websites, reports, journals, and resource persons;
    b. fit or match the knowledge into the topics in the curriculum or syllabus;
    c. write the e-textbook;
    d. layout the e-textbook;
    e. try out the e-textbook;
    f. discuss the try-out results among the team; and
    g. revise the e-textbook.

    The 4e, 4f, and 4g activities above may be done more than once.
5. During the 'do' step, the team should:
    a. try out the e-textbook in mathematics classes;
    b. take note on the advantages and disadvantages of the e-textbook from the point of view of both sides (team and students);
6. During the 'see' step, the team should:
    a. discuss the results of the 'do' step;
    b. revise or modify the e-textbook.
7. The 'plan', 'do' and 'see' above may be done more than once in improving the quality of the e-textbook.
8. Finalize the e-textbook by using dbook program.

Timeline

Phase	Dates	Activity
1	Jan-Feb, 2012	Sharing experiences and developing the tentative materials for lesson study and plan of lesson study
2	Mar-Aug, 2012	Writing the e-textbook
3	Sep-Dec, 2012	Reporting the e-textbook on APEC-Khon Kaen International Conference on September 7-11, 2012

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