Doctoral Dissertation

Disaster Management and Prevention Education for Volcanic Eruption: A Case of Merapi Area Primary Schools in Java Island, Indonesia

TUSWADI

Graduate School for International Development and Cooperation
Hiroshima University

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TUSWADI

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We hereby recommend that the dissertation by Mr. TUSWADI entitled "Disaster Management and Prevention Education for Volcanic Eruption: A Case of Merapi Area Primary Schools in Java Island, Indonesia" be accepted in partial fulfillment of the requirements for the degree of DOCTOR OF PHILOSOPHY IN EDUCATION.

Committee on Final Examination:

HAYASHI Takehiro, Professor (Chairperson)

IKEDA Hideo, Professor

BABA Takuya, Professor

YAMASHITA Takao, Professor

ISOZAKI Tetsuo, Graduate School of Education, Professor

Date: July 30, 2014

Approved:

FUJIWARA Akimasa, Professor
Dean

Date: September 5, 2014

Graduate School for International Development and Cooperation
Hiroshima University

ABSTRACT

This study aims at analyzing the implementation of disaster management and prevention education for a volcanic eruption at the primary schools in Yogyakarta Special Region province in Indonesia which has the most active and dangerous volcano in the country named Merapi.

The study focuses on the schools preparedness to the volcanic eruption disaster and the implementation of the most up-to-date disaster prevention education curriculum among the 24 selected primary schools in Merapi volcano area, through assessment of the current curriculum content for the disaster prevention education in the basic school level and the learning content concerning with the volcanic eruption, the schools preparedness to Merapi volcanic eruption disaster from the headmasters' point of view, the teachers' performance in teaching the disaster prevention, the students' achievement in learning the disaster prevention, and the educational merits of the lecture and the discussion teaching methods for improving the students' achievement in the disaster prevention learning.

The research has been conducted in five phases.

Phase-One: *Disaster Management and Prevention Education in Indonesia*; in this phase, the present policies, act, legislation, etc. related to the disaster management and the disaster prevention education in Indonesia were reviewed. The current curriculum content for the disaster prevention education in the basic school level was explored. The learning content concerning with the volcanic eruption for all grades of the primary school (1-6) was also analysed. Based on the result of this analysis and review of related literature, the research design and framework of this study was formulated.

Phase-Two: *Schools Preparedness to Merapi Volcanic Eruption Disasters*: in this phase the participant headmasters were selected from the 24 primary schools in Merapi volcano area. To assess the school preparedness in anticipating Merapi volcanic eruptions based on their perceptions, the headmasters were given a questionnaire which consisted of 10 main statements to be responded by choosing one of the 3-4 alternative options followed by their brief reasons for each response which were written in the provided column. The collected data were then statistically analyzed. The result shows that, despite the fact that the schools were vulnerable to get the bad impacts of Merapi volcanic eruptions, it was found out that not all the schools had good preparedness system to anticipate the impacts of natural disasters including the volcanic eruption. Using two parameters by looking at the soft and hard components of the preparedness system, this study reveals that only 6 schools had well-preparedness level with both good soft and hard components; Thirteen schools still needed to improve the preparedness level due to either their critical soft or hard components, and five schools were categorized in the worst condition with both critical soft and hard components.

Phase-Three: *Teachers' Performance in the Disaster Prevention Teaching*; in this phase the implementation of the disaster prevention curriculum in the researched schools was assessed based on the teachers' perceptions on their performance in teaching. One hundred

and ninety-one (191) teachers were participating as the research respondents for the purpose of this study. They were given a five-point Likert-type scale questionnaire which consisted of 10 main statements to be responded, followed by their brief reasons written on the provided column in the questionnaire sheet. The research findings show that, firstly, in relation to the teaching materials and media, for the lesson of natural disaster and prevention, 72% of the teachers used textbooks or modules, and 91% of the teachers used teaching media. The common teaching media used by the teachers based on their choice were pictures, maps, video/movie, and toys/puppets. Secondly, in relation to the teaching method, there were only 39 teachers who were consistent in using integrated teaching method. In addition, in relation to the teaching topics, it was found out that most of the teachers had already introduced to the students the topics of earthquake, volcanic eruption, flood, and landslide. Finally, in relation to their professional capacity in teaching the disaster prevention, the teachers admitted that they still lacked knowledge regarding how to teach effectively due to the low frequency of having in-service teacher training. In spite the fact that the teachers had weaknesses, the teachers reported that their students were motivated to learn about natural disaster and prevention.

Phase-Four: *Students' Achievement in Learning Disaster Prevention*; in this phase the attained curriculum of the disaster prevention education in the researched schools was examined through assessment of the students' achievement in terms of their knowledge, attitude, and behavior. For this purpose, 548 students of grade-five participated as the research respondents by taking the questionnaire survey which mainly tested their knowledge, perceived attitude, and perceived behavior in preventing themselves from the negative impacts of the volcanic eruption and its related hazards. The research findings show that in spite the fact the students had already learnt about natural disasters and prevention at schools, there were still confusions or problems regarding their effective knowledge, attitude, and behavior. The first problem was the students' poor knowledge regarding the consequences of an earthquake: there were the students (44%) who did not know that running out of a home while a big earthquake occurred was dangerous to do; that a big earthquake could cause a house fire (51%); that a big earthquake was sometimes followed by a volcanic eruption (29%); and that the phenomenon of many animals going down to people's settlement was one of signs that a volcano might erupt (22%). The second problem was the students' poor attitude: 30% of the students did not feel that their living area was prone to natural disasters; 35% of them still believed about the myth of supernatural being prediction about natural disasters, and 38% of them did not realize that humans' misbehaviour could anger God and result in disasters. The third problem was the students' behavior: there were 20% of the students who did not discuss or share the information about natural disasters from the schools to their family, and there were 22% of them who did not often read books related to the natural disasters and prevention.

Phase-Five: *Toward Improvement of the Students' Knowledge, Attitudes and Behavior in Natural Disaster Prevention*; in this phase an action research through experimental teachings by the researcher himself using two different methods (lecture and discussion) for improving the students' achievement in learning the disaster prevention was conducted which involved the fifth-grade students in the 2 selected primary schools. The result shows that in general, the students' knowledge view-point regarding the consequence of a big earthquake that can cause a house fire disaster changed significantly after the experimental

teaching, in which the change of the students' knowledge in the lecture group was bigger than the change of the students' knowledge in the discussion group. The students' attitude view-point regarding their awareness of living in a disaster-prone area also significantly changed after the experimental teaching. The change of the students' attitude in the lecture group was bigger than the change of the students' attitude in the discussion group. In details, after having the experimental teachings, the students' knowledge view-point regarding the appropriate action indoor when there is a big earthquake for both groups was significantly different. In addition, the students' knowledge view-points regarding the consequence of a big earthquake that can cause house fire disaster was significantly different for the lecture group only. Moreover, the students' attitude view-point regarding their awareness of living in a disaster-prone area was significantly different for the lecture group only, too. In short, the lecture method could improve two viewpoints of students' knowledge, one regarding the appropriate actions while indoors during a big earthquake, and the other regarding the consequences of a big earthquake in relation to a house fire disaster. Students' attitude viewpoint regarding their awareness of living in a disaster-prone area was also found improved by the use of lecture method. The discussion method was found helpful in improving only one viewpoint of students' knowledge about the appropriate actions while indoors during a big earthquake.

Based on the whole research findings, the following recommendations are proposed: Firstly, for the improvement of the school preparedness in terms of the hard components, for example in building construction quality, it is recommended for the headmasters to report their schools' shortage to either a local or central government in order to get immediate appropriate assistance; while, for the improvement of the soft components, each school should set up educational activities, such as dissemination of schools resilience program toward volcanic eruption and in-service teacher-training program for designing and implementing effective lessons on the volcanic eruption disaster prevention. Secondly, due to the fact that there are still problems regarding the students' effective knowledge, attitude and behavior on natural disasters that can be caused by some factors including the ineffective teaching practice; it is highly recommended for the local government and schools to make strategic efforts in order to improve the teachers' performance including in developing their skills of making and using appropriate diverse teaching media for the disaster prevention education through in-service teacher training. In addition, information sharing within families' members about disaster prevention is another important point to be developed through children education at schools. Third, in relation to the educational effort of improving the students' knowledge, attitude and behavior, effort should be taken to develop effective volcanic disaster prevention education at school focusing not only on the changes in the students' knowledge and attitude, but also their behavior. Moreover, due to the fact that both teaching methods have their own educational merits and demerits; in teaching the disaster prevention, teachers are recommended to carefully use either a discussion or a lecture method / or even the combination of the two by firstly considering the teaching objectives, the teaching materials and media, as well as the available time.

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DEDICATION

I truly dedicate this doctoral thesis to:

1. My dearest wife, Wiji Astuti and daughters: Ayu Bening Mahardika T, Gesita Winner Ramadhani T, Jelita Azzahrah Putri T, and Harumi Syifa Ananda T.
2. All of my beloved big families members both in Banjarnegara and Purworejo regencies of Central Java.
3. All teachers who dedicate their life for teaching and educating children throughout of Indonesia.

DECLARATION

I hereby declare that “Disaster Management and Prevention Education for Volcanic Eruption: A Case of Primary Schools in Merapi Area in Java Island, Indonesia” is my own work both in conception and in execution and all resources that I have used and quoted have been indicated and acknowledged by complete references.

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ACRONYM

AIFDR	: Australia–Indonesia Facility for Disaster Reduction
BPBD	: Badan Pencegahan Bencana Daerah/Local Disaster Management Agency
BPPTKG	: Balai Penyelidikan dan Pengembangan Teknologi Kebencanaan Geologi/Volcano Investigation and Technology Development Office
CDE	: Consortium for Disaster Education
CVGHMG	: Centre for Volcanology and Geological Hazard Mitigation, Geological Agency
DPRI	: Disaster Prevention Research Institute
UNICEF	: The United Nations Children's Fund
MVO	: Merapi Volcano Observatory
NGOs	: Non-governmental organizations
IAVCEI	: International Association of Volcanology and Chemistry of Earth's Interior
IFC	: International Finance Cooperation
UNISDR	: United Nations International Strategy for Disaster Reduction
HFA	: Hyogo Framework for Action
KRB	: Kawasan Rawan Bencana
BNPB	: Badan Nasional Pencegahan Bencana/National Disaster Management Agency
DRR	: Disaster Risk Reduction
UNDP	: United Nations Development Program
ISDR	: International Strategy for Disaster Reduction
DPE	: Disaster Prevention Education
SCDRR	: Safer Communities through Disaster Risk Reduction

CHAPTER 1

INTRODUCTION

This chapter presents the Background of the Study, Statement of the Problem, Purpose of the Study, Research Questions, Definition of Terms in the Study, Research Methodology in General, Limitations of the Study, Significance of the Study, Conceptual Framework of the Study, Organization of the Dissertation, and the Originality of the Study.

1.1. Background of the Study

Asian Development Bank (2008) defined disaster is an event, natural or man-made, sudden or progressive, which impacts with such severity that the affected community has to respond by taking exceptional measures; while United Nations International Strategy for Disaster Reduction (2009) stated that a disaster is a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceed the ability of the affected community or society to cope using its own resources. Shaluf (2007) classified disasters as natural, man-made or hybrid, which cover all types of disastrous events. He also stated that natural disasters are catastrophic events resulting from natural causes which are beyond human control and are often termed as "Acts of God." Some of natural disasters such as earthquake, strike with no early warning; while flash floods are sudden and difficult to predict and give people little time to escape from the impacts of the disasters.

Indonesia, the most populated country in South East Asia, is very vulnerable to having many kinds of natural disasters due to its location in the confluence of Eurasian, Indian-Australian, and Pacific active tectonic plates. This biggest Muslim populated country of the world is often stricken by natural disasters, such as earthquakes, volcanic eruptions, floods, landslides, and tsunami. Each of these disasters produces physical, social and economic effects (Institution of Civil Engineers, 1995).

Earthquake and the great tsunami, which occurred in Aceh and Nias islands in 2004 and the earthquake in Yogyakarta Special Region province in 2006, are two examples of natural disasters in Indonesia that cause very serious structural and non-structural damage, fatalities and injuries, as well as socio-economic disruption. In addition, West Sumatra earthquake, on 30th September 2009, is another example of a natural disaster that causes a big loss in the country. It was noted that 1195 people were dead, 249,833 units of houses were damaged (114,797 units were heavily damaged), 2512 units of education facilities were destroyed, and many other public facilities such as health facilities, prayer facilities, roads, bridges, hotel, irrigation, markets, power outages, telecommunications networks, etc. were also disrupted (National Disaster Management Agency, 2011).

Table 1.1 shows the record on damages and losses caused by natural disasters in Indonesia during 2004-2010.

Table 1.1 Damage and losses caused by natural disasters in Indonesia in 2004-2010

NO	NATURAL DISASTERS	DAMAGES AND LOSES (Million IDR)
1.	Flood in Wasior, West Papua, 2010	277,900
2.	Earthquake in West Java, 2009	6,900,000
3.	Earthquake in West Sumatra, 2009	20,866,600
4.	Flood and Landslide in West and East Java, 2008	1,691,470
5.	Earthquake in West Sumatra, 2007	1,080,870
6.	Earthquake in Bengkulu, West Sumatra, 2007	1,790,930
7.	Flood in Jakarta, 2007	5,160,000
8.	Earthquake in Yogyakarta 2006	29,100,000
9.	Mudflow in Sidoarjo, East Java, 2006	7,300,000
10.	Earthquake and Tsunami in Aceh, Nias, 2004	41,400,000,000

Source: Sardjunani & Hadi (2010)

Data and facts show that Indonesia is one of the most natural disaster-vulnerable countries of the world. In 2011, United Nations International Strategy for Disaster Reduction (UNISDR) ranked number of casualties on six types of natural disasters among countries. The data showed that for tsunami, among 196 countries, Indonesia ranked first with 5,402,239 people affected; for landslides among 162 countries, Indonesia also ranked first with 19,7372 people affected; for earthquakes from 153 countries, Indonesia ranked third with 11,056,806 people affected, and for floods among 162 countries, Indonesia ranked sixth with 1,101,507 people affected. Another similar data from the World Bank (2005) describes that, in the overall, Indonesia ranked twelfth among countries with relatively high-mortality risks from multiple hazards. It is among the top 35 countries that have high-mortality risks from multiple hazards with about 40 percent of the population living in hazard-prone areas.

Indonesia is also one of the most volcanically active countries in the world; with over 130 active volcanoes claiming over 130,000 casualties since 1800 (Thouret et al., 2000; Voight et al., 2000a). The country experiences an average of one significant volcanic eruption every year because of intense volcanic activity along the Sumatra and Java subduction zones which comprise one of the longest, most prolific convergent margins on Earth. The country is geographically dominated by volcanoes which are formed because of subduction zones between the Eurasian plate and the Indo-Australian plate. It is noted that about 13 percent of the world's active volcanoes lie along the Indonesian archipelago with potential to generate multiple hazards of different magnitudes and intensity (UNESCO, 2007).

Some volcanoes in Indonesia are very popular for their terrible eruptions, such as Krakatau volcano for its global effects, erupted in 1883, Lake Toba volcano for eruption estimated to have occurred 74,000 years before present that caused six years of volcanic winter, Tambora volcano for the most violent eruption in recorded history in 1815, and Merapi volcano with its deadly pyroclastic flows.

Having lessons from past natural disasters and their impacts to the nation sustainability, at present Indonesia is better equipped legally and institutionally in responding to natural disasters with the change of its disaster management landscape following the 2004 Indian Ocean tsunami and its 2005 commitment to Hyogo Framework for Action (HFA) 2005-2015. The fact that the nation is powerless in facing disasters of unusual magnitude due to the absence of adequate disaster management systems has driven the government of Indonesia to develop proper disaster management system. Disaster management is defined as the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, in particular preparedness, response and recovery in order to lessen impacts of disasters (International Federation of Red Cross and Red Crescent Societies Disaster Management).

Since the introduction of Hyogo Framework for Action on Disaster Risk Reduction in 2005, Indonesia has elaborated on the spirit of the HFA to establish National Disaster Management Action Plan which was developed with the participation of all parties concerned under the initiative of National Disaster Management Agency (BNPB). The spirit of the government in developing disaster management system was reflected by adoption of the Indonesia Law number 24/2007 on Disaster Management which set the legal framework for coordination of disaster management efforts, the management of related funds, as well as the involvement of international agencies and non-governmental organizations (NGOs). The law marked a shift of paradigm from a previously response-oriented disaster management to disaster risk reduction. The law explicitly provides the rights and responsibilities of governments, community and business sectors, whether local, national or international, in the implementation of disaster management in the country. It also brings a consequence to make disasters and efforts to reduce their impacts as a development concern.

With the implementation of the Law number 24/2007, the government of Indonesia developed National Disaster Management System that consists of six components, i.e. legislation, institution, planning, funding, science and technology, and its implementation. For the legal component, in addition to the Law number 24/2007, Indonesia has three Government Regulations (GRs) and one Presidential Decree. The three Government Regulations are Implementation of Disaster Management (GR No.21/2008), Funding and Management of Assistance (GR No.22/2008), and Roles of International Agencies and Foreign Non-Governmental Organizations (GR No.23/2008). Presidential Decree No.8/2008 regulates National Disaster Management Agency (BNPB) which was formally established in January 2008, replacing and revamping the former National Coordinating Agency for Disaster Management.

National Disaster Management Agency is a Government Non-Departmental Agency which has main functions in formulating and issuing policies on disaster management and handling of refugees efficiently and effectively, and coordinating the implementation of disaster management activities in a planned, integrated and comprehensive manner. This agency is headed by a chairman who is equal to a ministerial level; directive components consisting of 19 members from government and community elements, and executing elements consisting of Main Secretariat, Deputy of

Prevention and Preparedness, Deputy of Emergency Response, Deputy of Rehabilitation and Reconstruction, Deputy of Logistics and Equipment, Main Inspectorate, as well as Central and Technical Operations Unit. In addition, to streamline the process of disaster management in local level, there is an establishment of Local Disaster Management Agency (BPBD) in provincial and district / city levels.

BNPB works together with key government and community sector partners to achieve the mitigation and risk reduction components of the Law number 24/2007 through the implementation of National Action Plan for Disaster Risk Reduction (2010-2013) and Disaster Management Plan (2010-2014).

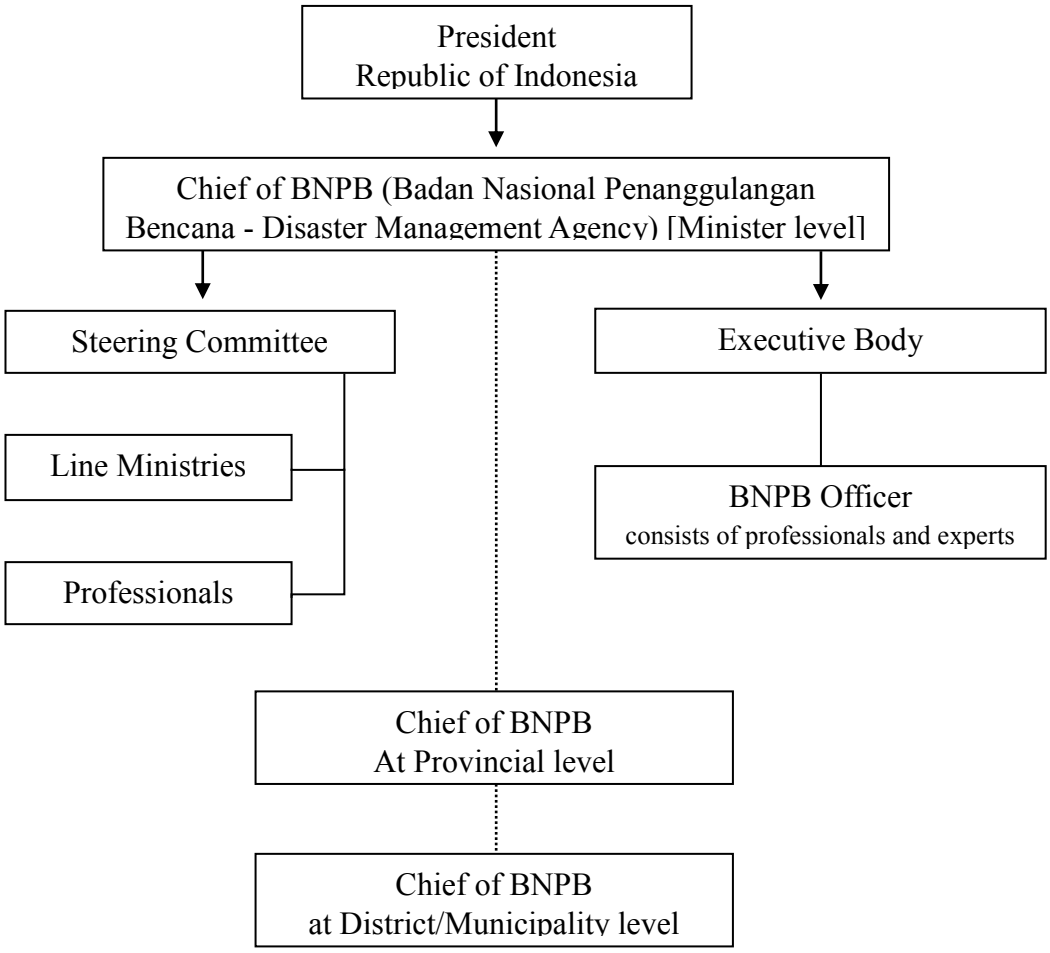


Figure 1.1 Disaster Management Agency (BNPB) organization structure in Indonesia

Natural disasters can damage school facilities and educational systems, threatening the physical safety and psychological well-being of communities and interrupting educational continuity (Anderson, 2010). Many countries of the world have experienced natural disasters that give negative impacts to schools. School buildings were destroyed by earthquakes and cyclones, for examples, and many teachers and students were killed by the disasters.

Table 1.2 lists the countries, the year and the kinds of disasters together with their impacts to schools.

Table 1.2 Disasters' impacts to schools in some countries of the world

YEAR	COUNTRY	DISASTERS' IMPACTS TO SCHOOLS
2008	China	An estimated 10,000 children died in their school; An estimated 7,000 classrooms were destroyed due to an earthquake.
2007	Bangladesh	Cyclone destroyed 496 school buildings and damaged 2,110 more.
2006	Leyte Island, Philippines	245 children and their teachers died in mudslide that buried the village elementary schools after five days of rain.
2005	Northern Pakistan, Kashmir	17,000 students died at school, and 50,000 were seriously injured, many disabled. 10,000 school buildings were destroyed, 300,000 children were affected. In some districts 80% of schools were destroyed by an earthquake.
2003	Bingol, Turkey	84 children and teachers died in collapsed school building in a moderate earthquake. Four schools collapsed, 90% of schools were impacted and education was disrupted.
2003	Xinjiang, China	900 classrooms in dozens of schools were collapsed in earthquake 27 minutes before thousands of children returned to their classrooms. Middle school was collapsed killing at least 20 students.
2001	Carioco, Venenzuela	Two schools were collapsed in an earthquake and 46 students died.
2001	Bhuj, India	971 students and 31 teachers were killed by an earthquake. 1,884 schools were collapsed, and it destroyed 5950 classrooms including 78% of public secondary schools; 11,761 schools building suffered majored damage with 36,584 classrooms unusable.

Source: UNISDR, 2008

In Indonesia itself, the impacts of natural disaster toward schools are very clear. Many school buildings were partly and completely damaged by earthquake, tsunami, volcanic eruption and flood. In addition, in some cases of natural disasters those happened during the working time, they also have killed teachers and students who were being inside the classrooms or other school buildings.

Table 1.3 shows some examples of natural disasters in Indonesia and their impacts to schools in 2004-2010.

Table 1.3 Impacts of natural disasters to schools in some provinces in Indonesia

NO	NATURAL DISASTERS	NUMBER OF DAMAGED SCHOOLS	LIFE LOSES
1.	Flood in Wasior, West Papua, 2010	-	144 people
2.	Merapi Eruption, 2010	217	339 people
3.	Earthquake in West Sumatra, 2009	2,358	81 people
4.	Earthquake in Bengkulu, West Sumatra, 2007	1,177	25 people
5.	Earthquake in Yogyakarta, Central Java, 2006	2,907	5,716 people; *36 teachers*
6.	Earthquake and Tsunami in Aceh-Nias, 2004	2,065	200,000 people *(45,000 students; 1,870 teachers)*

Source: Sardjunani & Hadi (2010)

In early 2014, Indonesia was hit by a number of natural disasters such as earthquakes, landslides, floods, and volcanic eruptions. For volcanic eruptions, Sinabung volcano in North Sumatra which erupted since September 2013 until February 2014 had killed at least seventeen residents and caused thousands of people to evacuate; then, Kelud volcano in East Java which erupted in February 2014 killed at least three people and forced more than 76,000 people fled their homes. Seven airports closed due to volcanic ash of Kelud, which filled the skies and could lead to jet engine problems.

Natural disasters give physical, educational, economic and psychological impacts on schools and its constituencies (UNISDR, 2008). Some impacts of disasters on education listed by UNESCO (2010) are as follows:

- Natural disasters, like earthquake, volcanic eruptions, tsunamis, flood, and others can have devastating impacts on formal, non-formal and informal education.
- Disasters can disrupt learning for days, weeks, months, or even for a lifetime. The worst condition is the after effects of the disaster events including trauma, displacement of families, health impacts, the common decrease in food security, and so on that these all can bring bad impacts on the education sector and society in general.

Public understanding and education are the keys to reduce loss of life, personal injuries, and damage from natural disaster. Through education, people will be made to comprehend what natural hazards which they are probably to face in their own communities. People should know in advance what specific preparations to make before the event of a disaster, what to do during an earthquake, volcanic eruption, flood, etc., and what actions to take in its aftermath.

Government of Indonesia has realized the importance of building a culture of nation resilience and safety from disasters through education. Therefore, in order to formally deliver knowledge and skills on disasters to the young generation at schools, Ministry of Education and Culture has already issued school curricula which cover disaster-related learning content in general.

Despite the fact that school curriculum for Indonesia basic education level (nine-year compulsory education from grade one to nine) has already included disaster-related learning content materials, due to the rise of natural disasters in the country during 2010-2011 which claimed many victims, the Indonesia Ministry of Education and Culture decided to issue and implement a recent special disaster prevention education curriculum. This policy is very crucial because children have the rights to be safe from disasters and also play important roles in disaster risk reduction. Children need to be facilitated with appropriate knowledge and skills to save themselves and other people during disasters.

In line with the reason above, since 2010 the Indonesia Ministry of Education and Culture, supported by United Nations Development Program (UNDP) has collaborated in the implementation of disaster prevention knowledge integration into the school curriculum. This decision has been stipulated in national policy through a circular letter by the Ministry of Education and Culture number 70a/SE/MPN/2010 on ***Mainstreaming of Disaster Risk Reduction at School***. The letter which was addressed to all Governors, Regents and Mayors throughout the country, calls for the implementation of disaster management at schools level through three activities, namely: 1). Empowerment of institutional role and capacity of the school community; 2). Disasters-risk reduction integration into formal school level curriculum, both intra as well as extra-curricular programs; and 3). Development of inter-stakeholder partnership and network to support disasters-risk reduction implementation (Ministry of Education and Culture, 2010).

Implementation of the newest school disaster prevention curricula began in the academic year of 2011/2012, especially at schools in the areas which are prone to natural disasters like in Bengkulu, West Sumatra, Yogyakarta, Central Java, Bali, Maluku, Papua, and East Nusa Tenggara provinces. The immediate objective of this policy is to make children safer during disasters and to prepare them as agents of change who can spread out knowledge to larger communities especially to their own families; while the long-term objective is to prepare children, as future generations, with disaster prevention, mitigation and preparedness knowledge (Bambang Indriyanto as cited by UNDP Indonesia, 2010).

Learning materials which are included in disaster prevention curricula cover issues of earthquake, tsunami, volcanic eruption, floods, droughts, and fires which are integrated into each appropriate main school subject in primary and secondary schools such as Natural Science, Social Studies, Geography, Indonesian Language, Mathematics, and Religion (Ministry of Education and Culture, 2010).

1.2. Statement of the Problem

School communities in remote places in Indonesia generally have two problems: limited disaster prevention education opportunities and limited information or knowledge that cause a low level of disaster awareness among its stakeholders.

1.3. Purpose of the Study

This study aims at analyzing the implementation of disaster management and prevention education for a volcanic eruption at primary schools in one of natural disaster-prone provinces in Indonesia.

Yogyakarta Special Region is chosen as the province has a very active and dangerous volcano, **Merapi.** This volcano has produced more lava flows than any other volcano in the world and its eruptions have caused big a loss and damage. Many people live on the slope of Merapi volcano and, therefore, the school children in Merapi area are vulnerable to the volcanic eruption disaster and its associated hazards.

The study focuses on the schools preparedness for the volcanic eruption disaster and the implementation of the most recent disaster prevention education curricula among the primary schools in Merapi volcano area, through assessing:

1. The current curriculum content for the disaster prevention education in the basic school level and the learning content concerning with the volcanic eruption,
2. The schools preparedness for Merapi volcanic eruption disaster from the headmasters' point of view,
3. Teaching performance in disaster prevention lessons based on the teachers' perceptions,
4. Achievement in disaster prevention learning by looking at the students' knowledge, attitude, and behavior,
5. The educational merits of lecturing and discussion methods in teaching disaster prevention for improving the students' achievement.

1.4. Research Questions

Regarding the research on the schools preparedness for Merapi volcanic eruption disaster, there are three-research questions as follows:

1. What do the headmasters perceive about their school risk level to Merapi volcanic eruption?
2. Based on the headmasters' perception, to what extent is the schools' preparedness achieved for anticipating the Merapi volcanic eruption disasters?
3. Is there any relationship between the headmasters' perception on the school risk and the level of preparedness?

Regarding the research on the teachers' performance in teaching disaster prevention, the research question is the following:

What kinds of teaching aspects should be improved in their performance in teaching disaster prevention?

Regarding the research on the students' achievement in disaster prevention education, the research questions are as follows:

1. What do the students in Merapi volcano area primary schools perceive about their experiences in natural disaster events?
2. What topics do the students learn in disaster prevention lessons at schools? When and how do they learn about natural disasters and prevention?
3. What have the students less achieved in their knowledge, attitude and behavior as their achievement in learning disaster and prevention?

Regarding the educational effort to improve the students' achievement in disaster prevention learning, the research question is the following:
Can teaching disaster prevention using lecturing and discussion methods improve the students' knowledge, attitude, and behavior in natural disasters and prevention?

1.5. Definition of Terms in this Study

Disaster can be defined as a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses, which exceed the ability of the affected community or society to cope using its own resources (ISDR, 2002:24). Disasters also can be defined as events that displace the structural, economic, organizational, cultural and spiritual well-being of communities by destroying their means of existence (Paton and Johnson, 2001; Alexander, 1997). Disasters can either be human-induced or natural occurrences.

Hazard is a potentially damaging physical event, phenomenon or human activity, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation (ISDR, 2002:24).

Disaster Risk Reduction is a systematic development and application of policies, strategies and practices to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) adverse impact of hazards, within the broad context of sustainable development as reported in ISDR (2002:25).

Disaster Management is the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, in particular preparedness, response and recovery in order to lessen impacts of disasters (International Federation of Red Cross and Red Crescent Societies Disaster Management).

Disaster Preparedness refers to activities and measures taken in advance to ensure effective response to the impact of disasters, including the issuance of timely and effective early warnings and the temporary removal of people and property from a threatened location.

Disaster Prevention is the activities that give outright avoidance of the adverse impact of hazards and related environmental, technological, and biological disasters.

Disaster Prevention Education is education to facilitate and contribute to the creation of a culture of prevention and for the population and communities to take action to prepare for disasters. From the school perspective, education for disaster prevention is through curricular and non-curricular activities which are expected to newly built upon the principle of integration, that facilitate the process of developing educational work in order to introduce variables and issues related to disaster prevention.

Primary School is a school in which children receive primary or elementary education between the ages of about six to eleven, coming before secondary school and after pre-school. It is the first stage of compulsory education in Indonesia (grade one to grade six).

1.6. Research Methodology in General

Mixed method research (consisting of questionnaires, interviews, observation, and document reviews) was done to collect data. Basically, to gather the primary data in this study, a field survey to the researched schools was done by distributing questionnaires to the research respondents (headmasters, teachers, and students), interviewing some of them in order to get a complete description about the content of their responses in the questionnaire, and observing the condition of the schools. In addition, for the effort of improving the students' achievement in disaster prevention learning, an action research by experimental teachings using lecturing and discussion methods in four classes of the two selected schools was conducted. The collected data was analyzed by employing statistics using SPSS software version 21 in Hayashi Laboratory.

1.7. Significance of the Study

In Indonesia, research on disaster management and prevention education for the volcanic eruption at school level is very important to conduct. This is because, in many areas of Indonesia, there are many active volcanoes which can erupt anytime and when people are not well-prepared to face such kind of natural disaster, they will be getting bad impacts of the disaster. School communities are one of the vulnerable groups to natural disaster, including the volcanic disaster; while, in other side, school communities have an important role as a communicator to the public society regarding the disaster prevention. Shaw et al. (2004) maintain that it is widely acknowledged that schools play an important role in awareness amongst students, teachers and parents because the more a child is aware of hazards and realistic risks, the more potential there is for the adults to be educated through the child sharing that knowledge at home.

Based on our best knowledge, researches which aim to explore the implementation of disaster management and prevention education at school level are still very rarely found in Indonesia, including for the volcanic eruption. Therefore, I believe that this study has at least three significances:

1. It can be used as a feedback for the researched schools in making improvement of the disaster management, especially in their preparedness for Merapi volcanic eruption disaster itself and in the innovation of more effective disaster prevention education.
2. The new findings of this research can be useful for initially constructing the effective school disaster management which is applicable for other schools of the country situating near volcanoes.
3. This study also provides the governments evidence to give appropriate assistance for the development of safe schools and communities resilience for Merapi volcanic eruption disaster.

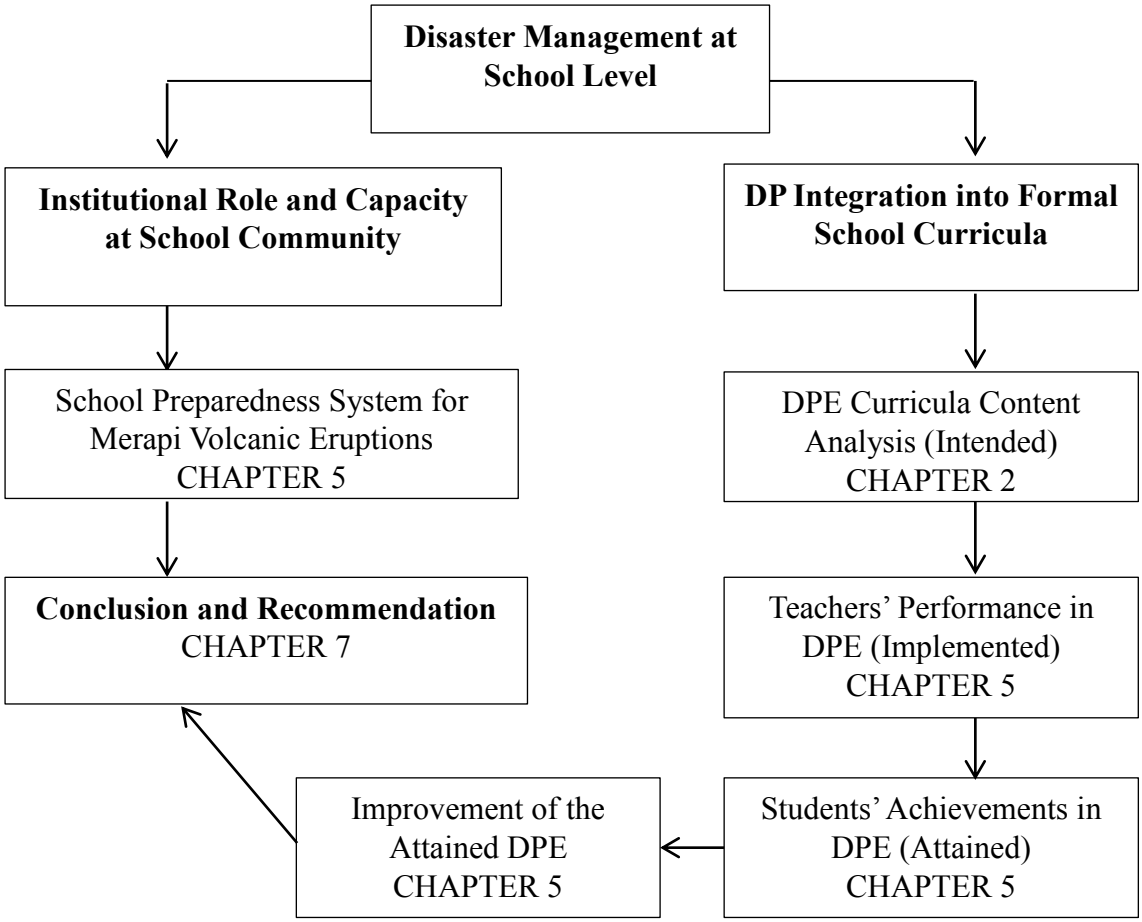
1.8. Limitations of the Study

This case study has limitations as the following:

- The schools where the research was conducted referred to only 24 primary schools in the three districts *(kecamatan)* of Sleman Regency *(kabupaten)* in Yogyakarta Special Region province. Therefore, they did not really represent the condition of the whole primary schools in Merapi volcano area,
- The students participating in the research were only the students of grade five in the researched schools.
- The study mainly focused on the implemented and the attained curricula of disaster prevention education in primary school level, although before constructing the research instruments, the researcher firstly analyzed the content of the intended curricula.
- The study mostly depended on the respondents' perceptions as the primary data through questionnaire survey. Therefore, the school preparedness assessment was based on the headmasters' perception, the teaching performance was based on the teachers' perceptions, and the achievement in learning disaster prevention was based on the students' perceptions.
- Interviews were conducted only with some headmasters, some teachers, and some students for confirming the important points related to the data obtained in the questionnaire survey.
- The experimental teaching in this study was conducted only for one time so that its impacts toward the change of the students' achievement might not be optimal.

1.9. Conceptual Framework

Figure 1.2 briefly describes the conceptual framework of the study which mainly focused on the disaster management and prevention education at primary schools in Merapi volcano area by looking at two dimensions, namely the schools' role and capacity in disaster prevention through assessing the schools' preparedness system to volcanic eruptions; and disaster prevention integration into formal school curricula through assessing the intended, the implemented, and the attained disaster prevention curricula.



DP (E): Disaster Prevention (Education)

Figure 1.2 Conceptual framework

1.10. Organization of the Dissertation

The dissertation consists of seven chapters. **Chapter 1 is the Introduction.** This chapter presents Background of the Study, Statement of the Problem, Purpose of the Study, Research Questions, Definition of Terms in the Study, Research Methodology in General, Significance of the Study, Limitations of the Study, Conceptual Framework of the Study, and Organization of the Dissertation.

Chapter 2 is the Literature Review. It discusses Disaster Management and Prevention Education at Schools which mainly presents School Preparedness to Natural Disasters, Disaster Prevention Education at Schools, Disaster-related Learning Content in Indonesia Basic Education Curricula, Teaching Materials for Disaster Prevention Education, Volcanic Disaster-related Learning Content, and Teaching Methods in Disaster Prevention Lesson.

Chapter 3 briefly describes Merapi Volcano, its Historical Eruptions, Possible Future Eruption, Roles of Center for Volcanology and Geological Hazard Mitigation, Geological Agency, the Importance of Disaster Management for the Volcanic Eruption, and Appropriate Knowledge Concerning with the Volcanic Eruption Disasters.

Chapter 4 is the Research Methodology. It presents Research Site, Reasons for Selection of the Schools, Research Design, Research Population and Sample, Ethical Consideration, Data Collection Tools and Techniques, Data Collection Procedure, and Data Analysis and Interpretation.

Chapter 5 is the Results. It presents School Preparedness to Merapi volcanic Eruption Disaster, Teachers' Performance in Teaching Disaster Prevention, Students' Knowledge, Attitude, and Behavior in Natural Disaster and Prevention, and Improving Students' Achievement in Disaster Prevention Learning through Experimental Teachings Using Lecturing and Discussion Methods.

Chapter 6 is the Discussion. This chapter discusses the research findings.

Chapter 7 is the Conclusion and Recommendation. This chapter briefly concludes the research findings and proposes recommendation to the schools and government for the improvement of school disaster management and prevention education in Merapi volcano area.

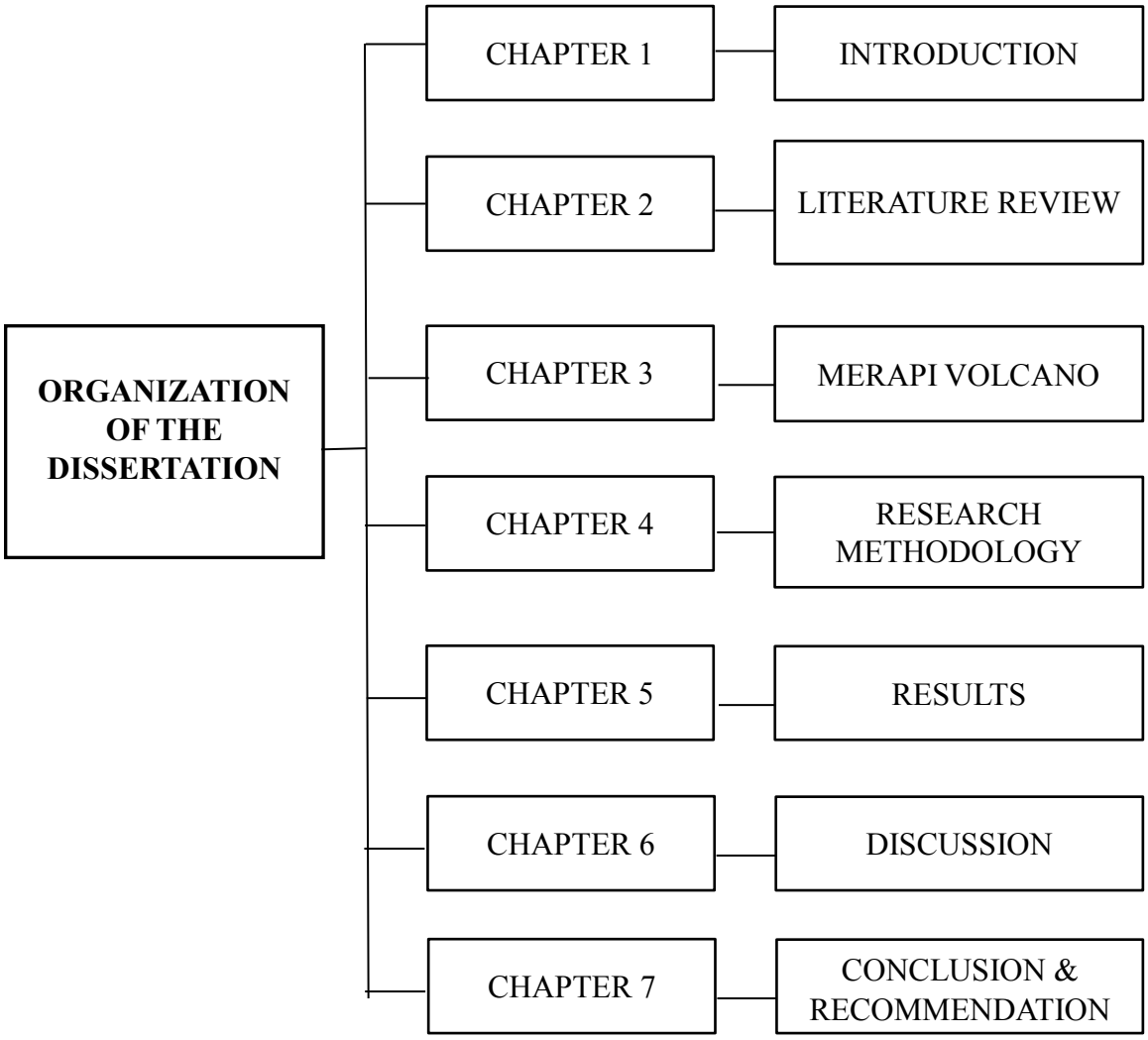


Figure 1.3 Organization of the dissertation

1.11. Originality of the Study

The originality of this study is that based on our best knowledge, it is the first attempt in exploring the implementation of disaster management and prevention education at primary schools level in Merapi volcano area with multiple data sources involving the school headmasters, the teachers, and the students as the research respondents.

CHAPTER 2

LITERATURE REVIEW

This chapter presents Disaster Management and Prevention Education at Schools which mainly discusses the School Preparedness to Natural Disasters, Disaster Prevention Education at Schools, Disaster-related Learning Content in Indonesia Basic Education Curricula, Teaching Materials for Disaster Prevention Education, Volcanic Disaster-related Learning Content, and Teaching Methods in Disaster Prevention Lesson.

2.1. Disaster Management and Prevention Education at Schools

2.1.1. School Preparedness to Natural Disasters

There are two aspects of natural disasters which are uniquely related to school buildings (Vickery, 2005). The first aspect is location. Schools are generally distributed with population and there is usually a school in every large village of rural areas. The school is, moreover, often the largest of village building. Thus, in places subject to recurring disaster, a school, which is designated to be disaster-resistant, may provide the focus for relief activities and even temporary housing for those injured and uninjured and whose accommodation was unable to withstand the force of phenomenon.

The second aspect is that, school buildings which are occupied during school day, have within them a concentration of human beings. Thus, a disaster which destroys an occupied school can kill or injure the entire school students and teachers from a village and the area around it.

Considering the cases above, it is very important for each school in a disaster-prone area to have a well-organized disaster management and prevention education in order to minimize the disasters' impacts.

One of the important points in school disaster management is the school preparedness system for anticipating natural disasters. Referring to disaster preparedness definition by UNISDR (2007), the school preparedness in this study means activities and measures which are taken in advance by a school to ensure effective response to impacts of natural disasters, including the issuance of timely and effective early warnings and the temporary removal of people and property from a threatened location.

UN-OCHA defined school preparedness as the pre-disaster activities by the schools within the context of disaster risk management and is based on a good risk analysis. This covers development of the whole strategy of preparedness, policy, institutional structure, warning and predicting ability, as well as plans that will determine relevant steps to assist the community at risk in saving their lives and assets by being cautious to disaster and to take the correct steps in alleviating threats that would happen or the actual disaster itself. In short, we can simply define that school preparedness for disasters as a capacity of school to manage disaster risks in its community.

In this study, a number of indicators showing components of the school preparedness for volcanic eruption are divided into two categories: soft and hard components **(Fig. 2.1)**. The first component refers to standard operating system (SOP) recommended by the Indonesia government related to disaster prevention in general. This component consists of six parts, namely special unit/person responsible for emergency preparedness and response, regular risk assessment for natural disasters, coordination with local fire department and medical center, supports from government, teacher-training, and evacuation plan.

The second component refers to tools and or infrastructure such as emergency supply kits, emergency exits, and school building construction.

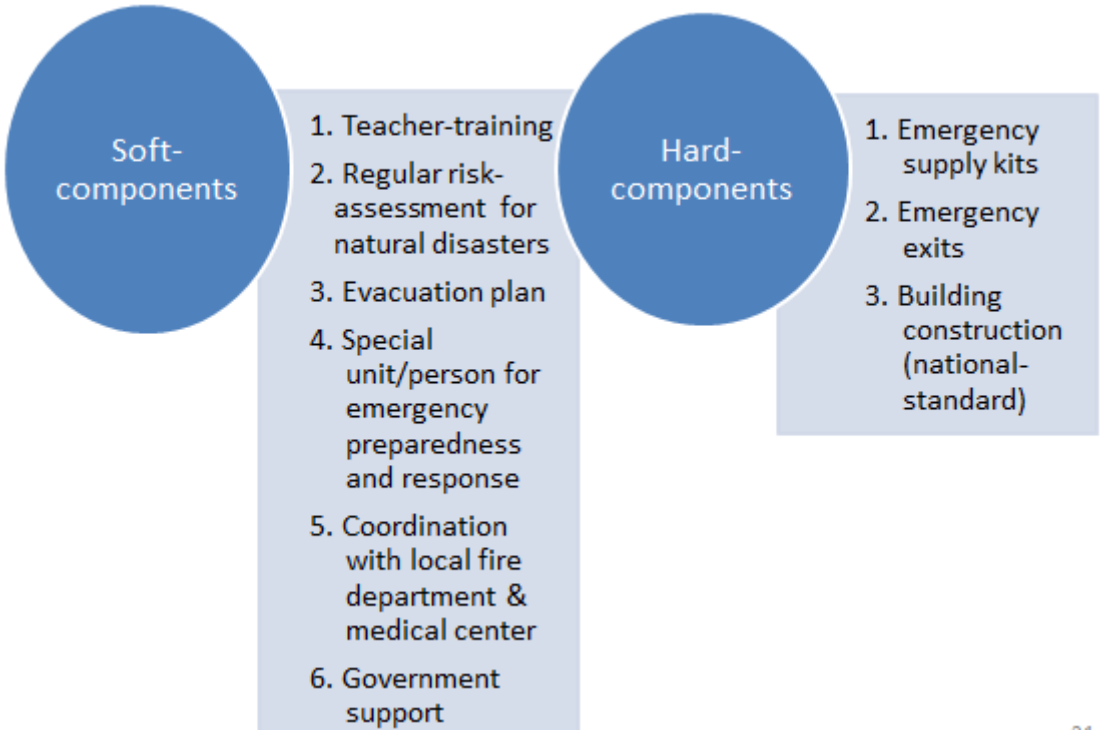


Figure 2.1 Components of the school preparedness system for natural disasters

2.1.2. Disaster Prevention Education at Schools

At present in many parts of the world, both natural and man-made disasters have been threatening the lives, rights and needs of millions of children. Various kinds of natural disasters such as earthquake, volcanic eruption, tsunami, typhoon, and flood which often occur in countries have made people understand that children are becoming the most vulnerable groups getting direct impacts of disasters. It is predicted that day by day, children`s vulnerability to disasters to be increasing as frequency and intensity of natural hazards rises (Webster et al., 2008). Therefore, preparing for disasters has been also the priority on the educational agendas of countries in the world.

Disaster prevention or disaster-risk reduction is about putting in place measures to limit negative impacts of natural disasters, especially the frequent medium-scale disasters that continually erode the development gains of communities (AIFDR, 2012).

Internationally, Kofi Annan, the former Secretary-General of United Nations (UN), has emphasized the importance of disaster prevention by stating: *"We must, above all, shift from a culture of reaction to a culture of prevention. Prevention is not only more humane than cure; it is also much cheaper.... Above all, let us not forget that disaster prevention is a moral imperative, no less than reducing the risks of war"* (Strategy for a Safer World in the 21st Century: Disaster and Risk Reduction, Geneva, 9th July 1999). Moreover, it was mentioned in the third priority of Hyogo Framework for Action, that nations of the world should use the knowledge, innovation and education to build a culture of safety and resilience at all levels in which disaster risk reduction or disaster prevention education and safe school building are two key priority areas for action.

In relation to the issue of disaster prevention education, there are many influencing factors of attitudes development among students who are actively engaged in environmental protection and disaster prevention (ISDR, 2006); however, it is evidenced that the two most important factors are the teaching-learning process at schools and the ties that the students have with their families and communities. As schools are universal institution for sharing knowledge and skills, the expectations for schools to be role models in disaster prevention is high. Successful disaster mitigation is one of the ultimate tests of the success of the education over generations (IFC, 2012).

At schools, disaster-related subjects are most urgent and central among the many topics from school curricula to be taught to students because (i) students need to learn about hazards and risk reduction (ii) schools are the center for community-based disaster risk reduction, and (iii) schools should be physically protected from natural hazards.

Preparing students and people to gain basic knowledge on how to recognize early features of a natural disaster, how to rescue themselves, their families, and the environment, and how to perform self and environment-based prevention and rehabilitation is the basic aim of disaster prevention education (Inayati Dewi, 2010). Through disaster prevention education, people learn to anticipate disasters, reduce the chance of occurrence and mitigate impacts when they occur.

In reviewed literature such as the UNESCO (2007) and ISDR reports (2008), Fothergill and Peek (2004), Paton and Johnston (2001) and Hosseini and Izadkhah (2006) there is strong evidence that the more prepared and knowledgeable community is, the more resilient it becomes to disasters. Shaw et al., (2004), Shiwaku et al., (2007), and Ozmen (2006) also pointed out that school education is important to ensure that learners respond appropriately when they are faced with a disastrous event.

Teaching students about hazards and disaster prevention is important not only for the students themselves but also for their communities, as illustrated by the following story about a young girl who saved many tourists' lives:

It is by now well-known story how a 10-year old British girl, Tilly Smith with her presence of mind and quick thinking saved about 100 lives on that day at one of the Beach Resorts in Phuket, Thailand. All she did was to alert people on the beach about the possible tsunami, when she saw a bubbling on the water, right on the edge and foam sizzling just

like in a frying pan which she had learnt in her geography class a few days before. (Rao 2007:8)

Similarly, a study by Becker et al. (2009) described the effectiveness of disaster prevention education at schools by stating that children would come home with information about preparing for a disaster, and the family or parents and the child would make plans or prepare resources together for their home. This means that homes with children getting disaster prevention education program at school, not only do the children themselves get benefit from an effective program, but potentially the entire family unit becomes better prepared as a result of the information. Preparedness within the home environment, such as having supplies and plans in place, as well as emotional awareness of the possibility of a disaster and understanding that they can get through it, has a positive impact on the likelihood that the child will be able to get through a disaster event both physically and emotionally (Ronan & Johnston, 2005).

Disaster prevention education can reduce anxiety among children (Ronan, Johnston, Daly, & Fairley, 2001). In times of anxiety or stress due to natural disasters, as a child in the family feels overwhelmed, they can model their behaviors on the positive coping of the adults around them. Information from school that effectively flows to homes has great value, both for the family members and the child in order that they have a better understanding of how to protect themselves in a disaster.

Another study by Ronan & Johnston (2001) reported that, students participating in disaster prevention education at schools perceived a higher risk of personal injury from disasters, but in the same time reported significantly lower levels of fear than those who have not taken part in disaster prevention education programs.

In conclusion, effective disaster prevention education will enable the students to have the appropriate knowledge related to disasters and with this knowledge; they will have the right attitude and behavior in coping with any disaster which may happen within their living area.

2.1.2.1. Disaster-related Learning Content in Indonesia Basic Education Curricula

Indonesia Ministry of Education and Culture (2010) stated that the teaching and learning materials content for disaster prevention education at schools comprise matters related to: i). Knowledge on disaster management and practices before disaster, when there is a disaster, and after disaster events, in accordance with thinking skills and physical development of learners, and ii). Development of disaster awareness culture, based on knowledge and attitudes that cover recognition, knowledge, understanding of types, sources and magnitude of natural hazards at school and residence; understanding of disasters history at school; understanding of vulnerability and capacity of school; understanding of efforts in facing disasters; behavior and perception of disaster risk; and vulnerability and capacity.

At present, the newest national curriculum adopted by the Indonesia primary and secondary schools is called School-Level Curriculum that gives wider autonomy for each school to develop or adopt their own textbooks by taking into account potentials

of schools and surrounding region based on guidelines and evaluation standards developed and issued by National Department of Education (DOE). The DOE issues the school-level curriculum that contains competency standard and basic competency.

Competency standards refer to minimum qualifications of learners' ability to describe the mastery of knowledge, attitudes, and skills that are expected to be achieved in each class and/or a semester on the subject learnt, while basic competence is a number of abilities to be mastered by students in certain subjects as a reference for the development of competence-indicators in the lesson.

Formal education curriculum at school levels in Indonesia have a number of subjects that can be grouped into five clusters: Religion and Culture, Language and Arts, Social Studies, Science and Technology, and Health and Physical Education. Based on teaching syllabus under the School Level Curriculum, disaster-related learning content is put in an integrated manner among the main subjects matters.

Pandey (2007) stated that disaster related learning materials in Indonesia schools' curricula were limitedly integrated with school subjects of social studies and science education regardless of the level. Comparatively, higher concentration of disaster learning content can be found in health and physical education subjects. The disaster-related learning content is more dominant in primary and lower secondary school levels than that in upper secondary. While some chapters are devoted in hazard science in primary and lower secondary school science subjects, no material in hazard or disaster theme is provided in science related subjects at upper secondary level.

In comparison to other school subject areas, health and physical education includes the largest number of subsections and units related to disasters and safety (Pandey, 2007). In primary school level grade one to three, basic competency requires students to be able to practice safe and hygienic daily life like sanitation, traffic safety, and safety from physical surroundings. In grades four to six, students are expected to be able to observe safe outdoor activities. In lower secondary school grade seven to nine, more specific subjects are provisioned to enable students use first aid, practice in preservation of a healthy environment, learning value of mutual help, cooperation and support in need. In upper secondary school grades, skills for mountaineering and rescue and broader level understanding of a social system for mutual help and humanitarian ethics are asked for.

Standard and basic competence concerning disaster learning content for all subjects at Indonesia basic education level (primary and lower secondary schools) is shown in the **Table 2.1** and **Table 2.2.**

Table 2.1 Disaster-related content at Indonesian primary school level

GRADE	MAIN SUBJECTS	STANDARD AND BASIC COMPETENCE CONCERNING DISASTER
1	Natural Science	Recognizing various astral objects and natural phenomenon (weather and season) as well as its effects on human activities (2nd semester) - Identifying various astral objects through observation - Identifying surrounding weather conditions - Distinguishing effects of dry and rainy seasons on human activities
	Social Science	Describing surroundings of the house (2nd semester) - Describing position of the house
2	Natural Science	Understanding natural phenomenon and effect of the sun in daily life (2nd semester) - Identifying position of the sun in the morning, noon, and afternoon - Describing the uses of solar heat in daily life
	Social Science	Understanding position and roles of members in a family and in neighborhood (2nd semester) - Providing examples of cooperation activities in neighborhoods
3	Natural Science	Understanding surface of the earth, weather, and its effect on human, as well as its connection with ways of men preserve nature (2nd semester) - Describing surface of the earth in surrounding terrain - Explaining relation between cloud conditions and weather - Describing effects of weather on human activities - Identifying ways of humans preserve nature in surrounding of environments
	Social Science	Understanding surrounding environment and practice cooperative activities around house and school (1st semester) - Talking about natural and artificial environment in surroundings of house and school - Preserving natural and artificial environment around house - Drawing an area-map of house and school - Conducting cooperative activities around house, school, and village
4	Natural Science	Understanding change of physical environment and its effects on land terrain (2nd semester) - Describing various changes of physical

		environment (wind, rain, sunshine, sea waves, etc.) - Describing effects of physical environment changes have upon land terrain (erosion, abrasion, flood, and landslide) - Describing methods of preventing environmental destruction (erosion, abrasion, flood, and landslide)
	Social Science	Understanding history, natural phenomenon, and racial diversity in district/municipal, and provincial level (1st semester) - Reading map of surrounding area (district/municipality and province) on simple scale - Describing natural phenomenon and appearance in district/municipality and province along with relation to social and cultural diversity
5	Natural Science	Understanding changes happening in nature and its connection with use of natural resources (2nd semester) - Identifying natural phenomenon and its impact on living creatures and environment - Identifying various kinds of human activities that could alter the earth surface (agriculture, urbanization)
	Social Science	Respecting various kinds of national historical figure and artefacts in the Hindu-Buddha and Islam period, diversity of nature and race, and economic activities in Indonesia (1st semester) - Recognizing diversity of natural and artificial appearance as well as time zone distribution in Indonesia by using map/atlas/globe and other media
6	Social Science	Understanding development of Indonesia region, natural appearance, and social conditions of countries in South East Asia as well as continents (1st semester) - Comparing natural appearances and social conditions of neighboring countries - Identifying continents - Understanding natural phenomenon occurring in Indonesia and its surrounding area (2nd semester) - Describing natural phenomenon occurring in Indonesia and its surrounding area - Recognizing measures taken in the event of a natural disaster

Table 2.2 Disaster-related content at Indonesian lower secondary school level

GRADE	MAIN SUBJECTS	STANDARD AND BASIC COMPETENCE CONCERNING DISASTER
7	Natural Science	Understanding natural phenomenon through observation (2nd semester) - Conducting systematic and planned objects observation to obtain information on biotic and non-biotic natural phenomenon - Applying safety procedure when conducting observation of natural phenomenon - Describing mutual dependency of ecosystem - Applying roles of human in management of environment in order to minimize pollution and environment degradation
	Social Science	Understanding environment of human life (1st semester) - Learning to use map, atlas, and globe to obtain spatial information - Drawing sketches and map of regions portraying geographical objects - Describing phenomenon occurring in the atmosphere and hydrosphere, as well as its impact on life
8	Social Science	Understanding social issues related to growth of human population (1st semester) - Describing issues and problems of environment and efforts in overcoming them in the frame of sustainable development
	Practical Skills	Appreciating engineering work of water purifying technology (1st semester) - Understanding mechanical technology based on water purifying equipment - Appreciating technical skills in assembling mechanical technology based water purifying equipment - Implementing water purifying technology - Planning working procedure on assembling of mechanical technology based water purifying technology equipment - Assembling mechanical technology based water purifying equipment - Appreciating engineering technology (2nd semester) - Understanding chemical technology based water purifying technology equipment - Appreciating the technical skills in assembling chemical technology based water purifying

		equipment - Assembling water purifying technology - Planning work procedure of the assembling of chemical technology based water purifying technology equipment - Assembling chemical technology equipment based water purifying equipment
9	Natural Science	Understanding solar system and its processes (2nd semester) - Explaining relation between processes occurring in the lithosphere and atmosphere layer with health and environmental problems
	Social Science	Understanding relation between human and earth (2nd semester) - Interpreting map on forms and patterns of the earth surface - Describing interrelation between geographical elements and people in South East Asian region - Describing distribution of the earth surface into continents and oceans
	Physical Education	Implementing healthy way of life (1st semester) - Understanding various kinds of fire hazards - Understanding methods to avoid fire hazards Implementing healthy way of life (2nd semester) - Understanding various kinds of dangers in natural hazards - Understanding methods in dealing with various kinds of natural disasters

2.1.2.2. Teaching Materials for Disaster Prevention Education

After going through a long process of discussion since 2008, the Centre Curriculum, Research and Development Board of the Indonesia Ministry of Education and Culture, working together with a non-governmental organization called Safer Communities through Disaster Risk Reduction (SCDRR) Board-UNDP, have successfully prepared books for disaster prevention education at schools that have been legalized by a letter of the Ministry of Education and Culture number 70a/SE/MPN/2010.

Preparation of text-books on disaster prevention was done through a participatory consultative process with relevant stakeholders in several areas of Indonesia. Consortium for Disaster Education (CDE), which was formed in October 2006, had actively involved in the process of drafting and refinement of these books as co-formulators in every process of preparation.

In implementing disaster prevention education at schools, teachers should use at least 15 teaching modules and a training module. The teaching modules that cover topics on catastrophic earthquake, tsunami, volcanic eruption, landslides, fires and floods, provide

teachers ways in preparing the syllabus and learning indicators as well as teaching model on integration of disaster prevention learning materials into main teaching subjects, local content subjects and extra-curricular activities.

As an initial project in the implementation of disaster prevention education program, SCDRR collaborating with National Curriculum Centre and Disaster Education Consortium had successfully conducted training or training for trainers for teachers and curriculum development teams at national and local level in June 2010, which aimed to enhance community capacity and to empower roles of schools in carrying out disaster management.

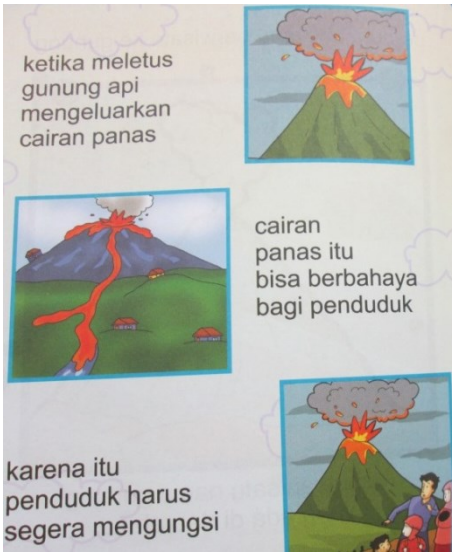
2.1.2.3. Volcanic Disaster-related Learning Content in Primary Schools

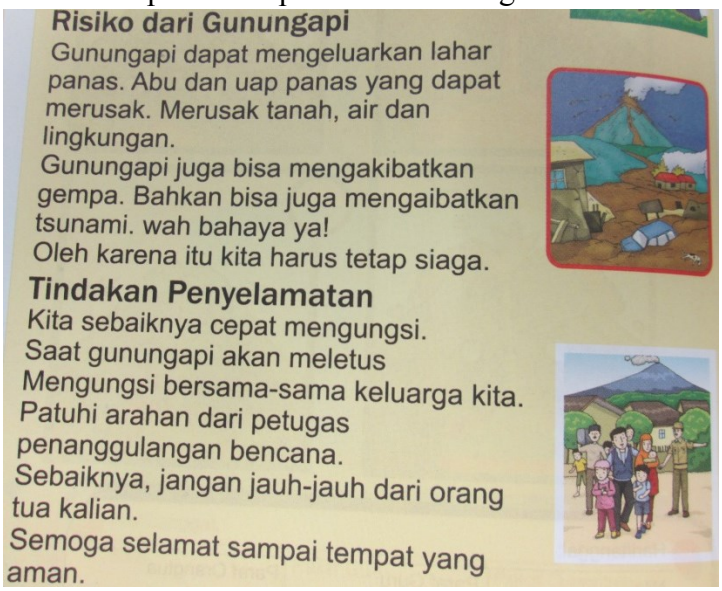
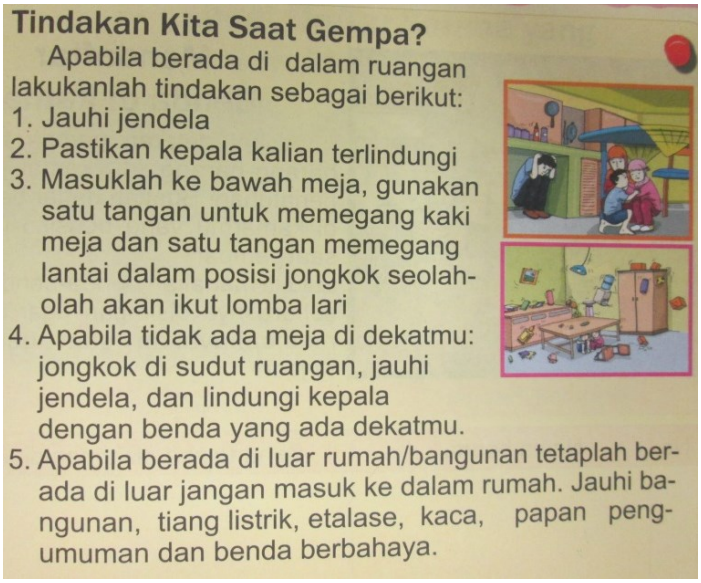
Table 2.3 summarizes the learning contents concerning with volcanic disaster and prevention in primary school level which are taken from Students' Learning Modules as the sub-text-books entitled *"Siaga Bencana"* for grade one to six published by Muhammadiyah Disaster Mitigation Centre. These moduls were also commonly used by teachers in Merapi volcano area primary schools for teaching natural disaster and prevention.

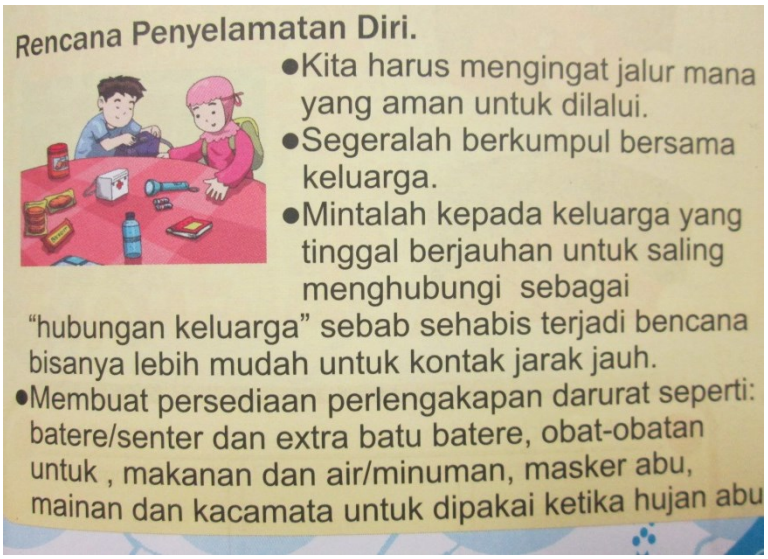
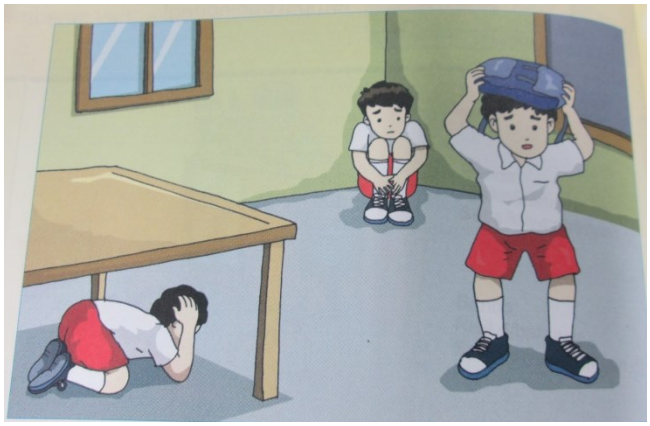
Due to the case of Merapi eruption was usually initiated with the occurence of earthquake, the table also presents the learning contents concerning with that associated hazard to the volcanic eruption.

Table 2.3 Volcanic disaster and associated hazard-related learning content for primary school

GRADE	LEARNING CONTENTS
1.	**Earthquake** When there is an earthquake, we have to immediately protect ourselves. When indoor, we have to protect ourselves under a strong table or bed. Students can identify and use objects to protect their head from the falling objects during earthquake.  (p. 2) **Volcanic eruption** Student can understand the dangerous materials from eruption: hot lava. The importance of early evacuation

	 (p. 26)
2.	**Earthquake** • Simple definition of earthquake • Earthquake risk outdoor • Earthquake risk indoor (in the class) and appropriate actions for self-protection: hiding under a strong table, protecting head with a bag, hiding in the cupboard, after stop immediately going out. • Earthquake at home: protecting head, hiding under strong table • Knowing dangerous objects indoor (at home) when the earthquake happens. Looking for safe place at home to hide when there is an earthquake  (p. 2) **Volcanic eruption** • Simple explanation how volcano erupts • Effects of eruption to land, water and environment • Dangerous materials from eruptions: ash, hot lava • Immediate evacuation is the action to safe from the hazard of eruption

	• Adapting the shape of the home roof for anticipating the volcanic ash accumulation is important to prevent the damage  **Risiko dari Gunungapi** Gunungapi dapat mengeluarkan lahar panas. Abu dan uap panas yang dapat merusak. Merusak tanah, air dan lingkungan. Gunungapi juga bisa mengakibatkan gempa. Bahkan bisa juga mengaibatkan tsunami. wah bahaya ya! Oleh karena itu kita harus tetap siaga. **Tindakan Penyelamatan** Kita sebaiknya cepat mengungsi. Saat gunungapi akan meletus Mengungsi bersama-sama keluarga kita. Patuhi arahan dari petugas penanggulangan bencana. Sebaiknya, jangan jauh-jauh dari orang tua kalian. Semoga selamat sampai tempat yang aman. (p. 34)
3.	**Earthquake** • Mechanism of earthquake and effects of a big earthquake • Appropriate actions indoor while an earthquake: a. Avoid window b. Protect your head c. Hide under a strong table d. When there is no table, kneel in the corner of the room e. When outside, keep outside, avoid buildings, electricity stand, glass, billboard, etc.  **Tindakan Kita Saat Gempa?** Apabila berada di dalam ruangan lakukanlah tindakan sebagai berikut: 1. Jauhi jendela 2. Pastikan kepala kalian terlindungi 3. Masuklah ke bawah meja, gunakan satu tangan untuk memegang kaki meja dan satu tangan memegang lantai dalam posisi jongkok seolah-olah akan ikut lomba lari 4. Apabila tidak ada meja di dekatmu: jongkok di sudut ruangan, jauhi jendela, dan lindungi kepala dengan benda yang ada dekatmu. 5. Apabila berada di luar rumah/bangunan tetaplah berada di luar jangan masuk ke dalam rumah. Jauhi bangunan, tiang listrik, etalase, kaca, papan pengumuman dan benda berbahaya. (p. 3) • Appropriate action to minimize the earthquake risks: a. Constructing earthquake-resistant building/house b. Putting heavy things/objects under a shelf or cupboard

	c. Glasses things are put in the lower part of the cupboard and lock it d. Hanging pictures or mirror far from bedroom, chair, or sofa e. Keeping chemical substances in the safe place **Volcanic eruption** • Dangers of volcanic eruption toward environment • The danger of lahar (volcanic mudflow) • Evacuation process a. Follow the route which is safe b. Gather with family c. Ask family-relatives living far away to contact d. Prepare first-aid kit, emergency supply kit, food, masker, glasses  (p. 35)
4.	**Earthquake** • Earthquake as a natural phenomena • Mechanism of an earthquake, factors affecting the impacts of an earthquake • The driving force/causes of earthquake and appropriate actions indoor  (p. 6)

	• Appropriate actions outdoor: not panic, avoid broken space, follow the officials, avoid buildings • Appropriate actions after earthquake a. Keep calm and not panic b. Evacuate in orderly c. Gather in the decided place d. Check one-self and others e. Keep seeking information and be aware of the next earthquake **Volcanic eruptions** • Preparation for evacuation  (p. 40)
5.	**Earthquake** • Causes of an earthquake between tectonic and volcanic earthquake  (p. 2) • Dangers of an earthquake • Other related hazards to earthquake: tsunami, volcanic eruptions, environmental pollution, flood, landslide • Appropriate actions during an earthquake • Making simple media for earthquake warning from cans and marbles

Volcanic eruptions

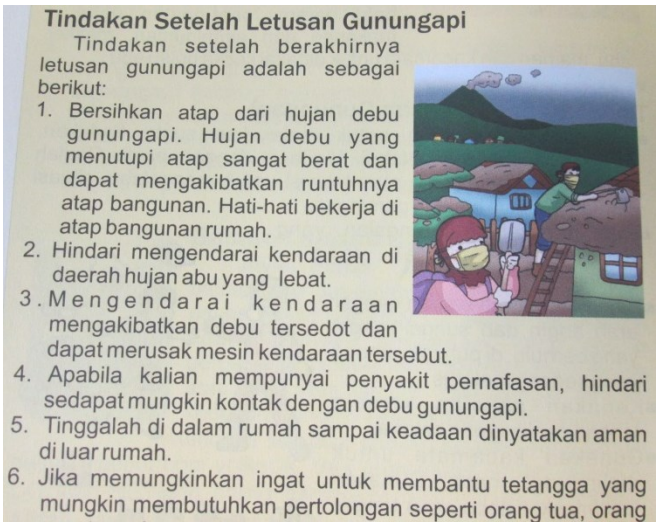
- Types of volcanoes
- Volcanic hazards: hot ash, pyroclastic flows, lahar, volcanic bombs, gas, lava flows.
- Lahar flows along the slopes to hill and rivers in high speed
- Evacuation planning

While eruption is going on

1. Keep listening to radio for important information
2. Follow the evacuation
3. Avoid going to the place where there is a river
4. Wear long sleeve dress and pants
5. Wear glasses and maskers

After eruptions

1. Clean the ash on the roof of the house
2. Don't drive under the road full of ash
3. When you have breath problem, avoid to direct contact to the ash
4. Stay at home until the government announce that it is safe outside
5. Try to help others especially old people and children

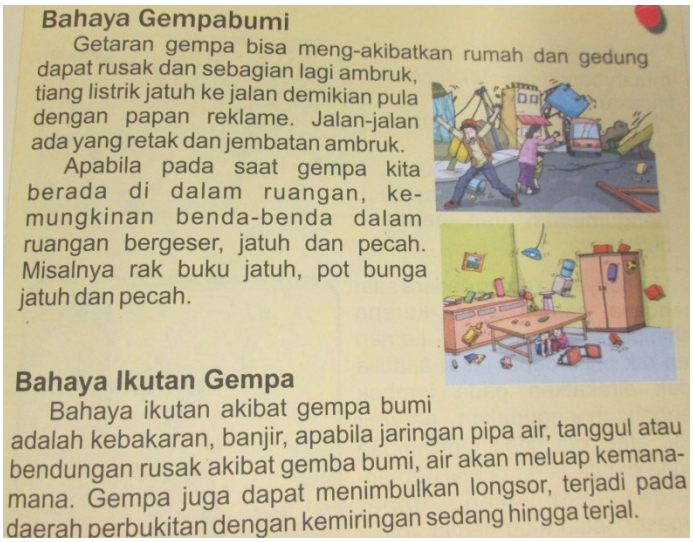
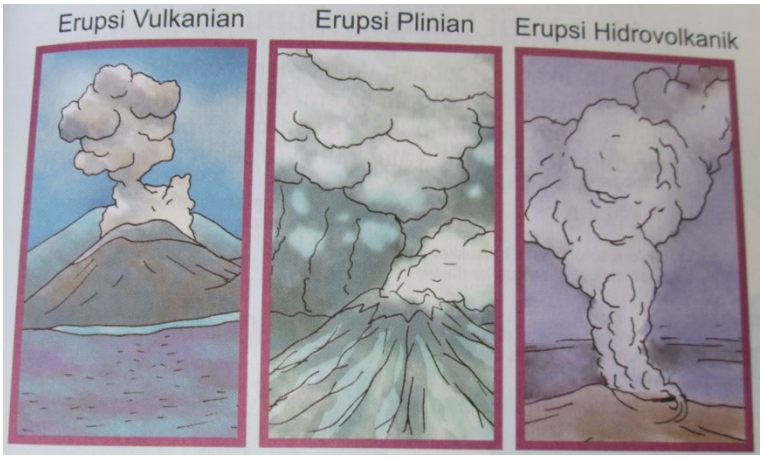


Tindakan Setelah Letusan Gunungapi

Tindakan setelah berakhirnya letusan gunungapi adalah sebagai berikut:

1. Bersihkan atap dari hujan debu gunungapi. Hujan debu yang menutupi atap sangat berat dan dapat mengakibatkan runtuhnya atap bangunan. Hati-hati bekerja di atap bangunan rumah.
2. Hindari mengendarai kendaraan di daerah hujan abu yang lebat.
3. Mengendarai kendaraan mengakibatkan debu tersedot dan dapat merusak mesin kendaraan tersebut.
4. Apabila kalian mempunyai penyakit pernafasan, hindari sedapat mungkin kontak dengan debu gunungapi.
5. Tinggalah di dalam rumah sampai keadaan dinyatakan aman di luar rumah.
6. Jika memungkinkan ingat untuk membantu tetangga yang mungkin membutuhkan pertolongan seperti orang tua, orang

(p. 46)

6.	**Earthquake** • Its mechanism and causes, dangers of earthquake, hazard related to earthquake  **Bahaya Gempabumi** Getaran gempa bisa meng-akibatkan rumah dan gedung dapat rusak dan sebagian lagi ambruk, tiang listrik jatuh ke jalan demikian pula dengan papan reklame. Jalan-jalan ada yang retak dan jembatan ambruk. Apabila pada saat gempa kita berada di dalam ruangan, ke-mungkinan benda-benda dalam ruangan bergeser, jatuh dan pecah. Misalnya rak buku jatuh, pot bunga jatuh dan pecah. **Bahaya Ikutan Gempa** Bahaya ikutan akibat gempa bumi adalah kebakaran, banjir, apabila jaringan pipa air, tanggul atau bendungan rusak akibat gemba bumi, air akan meluap kemana-mana. Gempa juga dapat menimbulkan longsor, terjadi pada daerah perbukitan dengan kemiringan sedang hingga terjal. (p. 3) • How to save ourselves: indoor, outdoor, disaster drills • Knowing earthquake scale power (Scale 1-12) **Volcanic eruptions** • Earth is active • Types of volcanoes • Types of eruptions and its characteristics: (Hawaiian, Strombolian, Vulcanian, Pelean, Plinian, etc.  (p. 57) • Dangers of eruptions: pyroclastic flows, lahar, landslide, tephra, gas, lava flows • Evacuation plan a. Remember the evacuation route b. Gather with family, contact parents, children to go home immediately c. Keep contact with other families d. Prepare emergency supply kits

Based on the analysis result of the text-book, it was found out that basically the learning content related to the volcanic eruption can be divided by two categories: the main and the additional learning content. The main learning content covers:
- Simple explanation how volcano erupts
- Dangerous materials from the volcanic eruption
- Effects of eruption to land, water and environment
- The importance of early evacuation

The additional learning content covers:
- Types of volcanoes
- Types of eruptions and its characteristics

It was also found out in the modules that there is no explanation about the advantages of volcano and its eruption for all grades. In fact, besides bringing disadvantages in the form of disaster, volcano also gives a number of benefits for nature and people.

Children from an early age (at primary school level) need to be well-informed about the advantages of volcanoes. Therefore, it is very important to include the positive aspects of volcanoes in text-books or modules regarding natural disaster and prevention to be introduced to the students. In addition, there is a neccesity of following the local status in introducing the learning materials regarding the volcanic eruption.

During the teaching and learning processes at schools, teachers can use simple language to explain, for example, that volcanoes can provide resources for energy extraction (geothermal resources) which is very clean and the resources are nearly inexhaustible. Volcanic ash, although it is harmful to the environment, but on the long term, the ash layer, which contains many useful materials, will be converted to a very fertile soil which is good for farming. In addition, volcanic materials such as lahar can be used in the manufacture of concrete blocks destined for building construction. Moreover, volcanoes with their attractive attributes can be tourist destination. Around the volcanoes, there may be warm bathing, lakes, hot springs, etc. Tourism industry within the volcano area creates jobs and develops local economy. This information is also can be included in the local material.

Information about the history of Merapi eruption is also needed to be well informed to the students. By knowing such kind of information, students will learn typical characteristics of the volcano eruptions from time to time together with the appropriate mechanism of the community in anticipating the disaster.

2.1.2.4. Teaching Methods in Disaster Prevention Lesson

In teaching disaster prevention, teachers should carefully select the strategy or method according to the needs and ages of the students. Choosing specific teaching methods that best achieves the course objectives is one of the most important decisions that a teacher faces (Rahman et al., 2011).

Josephs (1998) as cited by Rahman et al. (2011) stated that lecturing method is basically narrations that show the explanation or description. Lecturing method is very useful for teachers to transmit information, to create interest, and to promote students' understanding

(Walker, 2003). In other word, lecturing is especially useful to import knowledge, the basic level of Bloom's taxonomy (Bloom, & Krathwohl, 1956).

Discussion is one of the most widely used and valuable method in teaching of social studies (Rahman et al., 2011). It represents a type of teamwork, based on the principle that the knowledge, ideas, and feelings of several members have great merit than those of a single individual. In discussion class, the students are actively involved in processing information and ideas.

In the teaching and learning processes under the discussion method, the class is usually divided into some groups consisting of five to ten students in each group. Teacher has a role as the leader-moderator, and students are as the participants. The students have more chance to communicate with each other. Another student follows the group leader addresses his/her remark to the whole group and each group member has the right to speak. A group member communicates with other members in the group by speech, by facial expressions, gestures and body movement. Other members receive his/her message by listening and by seeing the non-verbal signs (Hyman, 1980). These processes of listening, speaking, and observing are the bases of discussion method (Vedanayagam, 1994).

Both lecturing and discussion methods can be effective for teaching when they are properly used by teachers. In the case that the primary objective of teaching is to supply information, the lecturing format is basically more effective than the discussion method. In contrast, discussion teaching method is better suited when goals of the teaching are more toward changing behavior and acquiring new skills or approaches to problems (Moore, 1999).

CHAPTER 3

MERAPI VOLCANO

This chapter briefly describes Merapi Volcano, its Historical Eruptions, Possible Future Eruption, Roles of Center for Volcanology and Geological Hazard Mitigation, Geological Agency (CVGHMG), the Importance of Disaster Management for the Volcanic Eruption, and the Practical Knowledge Concerning with the Volcanic Eruption Disasters.

3.1. Introduction to Location and Merapi Culture

A volcano is a vent through which molten rock escapes to the earth's surface. Unlike other mountains, which are pushed up from below, volcanoes are built by surface accumulation of their eruptive products — layers of lava, ash flows, and ash (Girty, 2009). When pressure from gases within the molten rock becomes too great, an eruption occurs. The natural hazards associated with volcanic eruptions include lava flows, falling bombs and block, lightening, ash falls, pyroclastic flows, debris avalanche (landslides), and lahars (volcanic mud flows). In addition, fumaroles and poisonous gas (limnic) eruptions can occur, and some large volcanic eruption can produce tsunamis and climate change.

Merapi volcano (*Gunung* Merapi in the Indonesian language) is part of the volcanic front of the Sunda-Banda magmatic arc which was produced by the activity of the Indonesia-Australia plate zone and has caused volcanic activities along the central part of Java Island (Lavigne et al., 2000). This volcano is classified into a very active and very young volcano. Camus et al. (2000) infer the earliest growth of the volcano began at least 40,000 years B.P. (Newhall et al., 2006). Historical records verify that the character of Merapi volcanic eruption is dynamic and changed by time.

The volcano, that has been active for 10,000 years, is situated at 7º32'26''S and 110º26'48''E. It stands on the intersection of two volcanic lineaments, i.e. Ungaran-Telomoyo-Merbabu-Merapi and Lamu-Merapi-Sumbing-Sundoro-Slamet. It also lays on the meeting point of Semarang fault and Solo fault (Bahagiarti, 2012). Its position is about 30 kilometers north of Yogyakarta City, which has more than one million populations. Merapi is administratively situated in two provinces, namely Yogyakarta Special Region and Central Java. Merapi volcano area covers four regencies, namely Sleman of Yogyakarta Special Region, Magelang, Klaten, and Boyolali of Central Java. The outer flanks of Merapi volcano is terraced and actively farmed. Though it is rural countryside, it nevertheless has a substantial population with numerous towns and villages. Merapi is classified as 'stratovolcano' due to the layers of volcanic material that comprise its structure of 2,968 meters in height.

Many local residents call the slopes of Merapi home, with its fertile soil allowing many people to engage in traditional farming methods. The cultivation of rice paddies, corn, and cassava, the growing of particular vegetables and the keeping of livestock provide livelihoods (Lie, 2010). In addition, Merapi produces 1.2 million cubic meters of volcanic materials annually. The volcanic materials are deposited at the slopes of Merapi volcano. The specific gravity of the deposited sediment is between 2.65 and 2.70 and the content of silt is 0.06% to 1.40%. Therefore, it has good quality for construction (Sutikno, 2003). This

condition makes sediment (sand) mining is popular in Merapi area, which brings economic value to residents and local government.

Figure 3.1 Rice paddies field in Merapi volcano area

Figure 3.2 In front of sand mining site in Merapi volcano area

There is a volcanic mythology in Merapi area; Villagers living on the slopes of the volcano believe that Merapi is not just a volcano but also home to many spiritual creatures, referred to as *makhluk alus,* or unseen creatures. Around Merapi volcano, religious beliefs have animist, Hindu, Buddhist, and Muslim influence. Many people believe that actual and potential losses associated with volcanic eruptions are under the control of divine forces (De Coster in Lavigne, 2002). Donovan (2010) who conducted research in two villages on the slopes of Merapi, namely Pelem Sari and Batur, stated that according to Javanese

mysticism, there are two types of *makhluk alus*, ones that are born as creatures and ones that were originally human (Sangga Sarana Persada 1999). Those dominant at Merapi have a human origin attributed to residents that have disappeared mysteriously on the volcano.

People believe that the unseen creatures are able to control eruptions and therefore, many people living high on the volcano attempt to placate the creatures by offering food, clothes, and money during various ceremonies. There are two cultural leaders in the traditional Javanese religion *(Kejawen)*: the Sultan of Yogyakarta and the *Juru Kunci* or the key holder of the volcano. In Pelem Sari, the annual Labuhan ceremony organized by the Kraton of Yogyakarta (the Sultan's palace) provides the creatures with clothing and food, while Mbah Marijan (the *Juru Kunci* who guards a sacred place of Merapi) chants their individual names. This and other similar ceremonies are done to ensure protection from the hazards. The supernatural creatures are feared and respected to such an extent that some residents would not even talk about them for fear of causing another eruption. The influence of these stories is strong enough to stop a community evacuating, and instead prepare offerings or wait for the warnings from the *makhluk alus* (Donovan, 2010).

Figure 3.3 Talking with local people about Merapi volcano eruption

Oral histories are also served as traditional warnings (Donovan, 2010); there are many stories relating to the volcano and its hazards that have a cautionary or even moral subtext. Some of these seem to have originated from actual events, and then been interpreted by the villagers using their own cultural beliefs. For example, during the 1994 eruption, the village of Turgo to the west of Pelem Sari was devastated by pyroclastic flows and, unfortunately the majority of those killed were attending a ceremony in a forbidden day. The residents of Turgo had disobeyed the rules of the local *makhluk alus* and had, therefore, suffered the consequences. Traditional precursors, such as unusual animal movements, intense lightning storms or *wisik* (warning from unseen creatures through humans' dream), have a strong influence, particularly in Pelem Sari. Therefore, when deciding to or not to evacuate in the events of Merapi eruptions, the residents depended on both a traditional and official warning.

3.2. History of Merapi Volcanic Eruptions

Knowing the eruption history of a volcano is a vital part of the art and science of intelligent evacuation (Hays, 2010). According to Camus et al. (2000), there are four periods of Merapi volcanic activities, comprising ancient Merapi period, middle Merapi period, recent Merapi period, and modern Merapi period. Ancient Merapi period is characterized by thick olivine andesite lava. The middle Merapi period produced thick andesitic lava flows and nuée ardentes deposits. The products of recent Merapi period are thin lava flows, pyroclastic, and epiclastic deposits. Modern Merapi period is specified by the Merapi types of eruptions, i.e. a continuous growth of the summit dome, followed by collapses and phases of quiescence.

Merapi volcano erupts on average every 5-10 years and is feared for its deadly pyroclastic flows in which the direction of its eruption always changes. Since 1961, the direction of Merapi eruption leads to the southwest toward the headwaters and streams Senowo River. The next eruption occurred in 1986, 1992, 1994, 1997, 2001 and 2006. After the activity of Merapi eruption in 2006, the opening crater turned to the southeast and east so that the flow of hot lava and hot clouds moved toward Gendol River and Opak River in Sleman regency. Sediment yield eruption upstream Gendol and Opak Rivers 3.5 million m^3 and Gendol River basins in radius 6 km from the summit largely had been filled with volcanic deposits causing cold lava flood threat to increase. Avalanche of the lava dome at the summit with heavy rains could trigger a flood of cold lava that has high destructive power (Anjasni, 2013).

The name "Merapi" which is from old Javanese language means "the one-making fire". Despite the danger of living close to the volcano, many people occupy fertile land surrounding Merapi, risking exposure to pyroclastic flow and possible larger explosive eruptions. With this reason, Merapi was selected as one of the focus volcanoes during the International Decade for Natural Disaster Reduction (Newhall et al., 1994).

International Association of Volcanology and Chemistry of Earth's Interior (IAVCEI) in 1994 (Putra, et al., 2011) had declared Merapi as one of the most dangerous volcanoes in the world due to its eruptions which were more than 80 times and killed thousands of people. This volcano frequently caused disasters with many deaths and loss of resources (Sutikno and Santoso, 2006).

Merapi, as a basaltic andesitic volcano with a crater that contains a lava dome, has the main hazard for the population living on its slopes in the forms of pyroclastic flows (nuée ardentes or *wedhus gembel* in Javanese language) which tumble down the slopes of the volcano and move forward along the river beds at a high speed (Ratdomopurbo et al., 2000). A pyroclastic flow (also known scientifically as a pyroclastic density) is a fast-moving current of hot gas and rock (collectively known as tephra), that can travel as far as 8 miles (13 km) from the summit with its speeds moving away from the volcano of up to 700 km/h (450 mph). The gas can reach temperatures of about 1,000 °C (1,830 °F).

Pyroclastic flows normally hug the ground and travel downhill, or spread laterally under gravity. Their speed depends upon the density of the current, the volcanic output rate, and the gradient of the slope. They are a common and devastating result of certain explosive

volcanic eruptions. Almost half of Merapi's nearly 80 reported historical eruptions are known to be accompanied by nuée ardentes-more than any other volcanoes. About a dozen of these nuée ardentes have caused fatalities (SEAN, 1989; Simkin and Siebert, 1994 in Voight, et).

Most of pyroclastic flows of Merapi volcano reached distance of 4-5 km. Length of pyroclastic flows in 1930, 1961, and 1969 exceeded 10 km. The pyroclastic flow in 2006 entered into Gendol River until 7 km. Typically, a sequence of volcanic activity was commenced by occurrence of volcanic-tectonic earthquake at depth of 2-4 km beneath the summit and then followed by emergence and growth of the lava dome at the summit accompanying MP-type earthquakes and rock-falls. Immediately before occurrence of pyroclastic flow, volcano-tectonic earthquake occurred at shallow depth beneath the summit (Ratdomopurbo and Poupinet, 2000; Hidayati et al., 2008).

The other typical hazards from Merapi volcano that have been identified by experts according to the history of Merapi eruptions are lava flows and lahars (Kurniawan, 2008). Lava is the word for magma (molten rock) when it erupts onto the earth' surface. Lava flows are streams of molten rock that either pour from a vent quietly or explosively by lava fountains. Because of their intense heat, lava flows are also great fire hazards. Lava flows destroy everything in their path, but most move slowly enough that people can move out of the way. The speed at which lava moves across the ground depends on several factors, including the type of lava erupted, the steepness of the ground, and the rate of lava production at the vent (National Disaster Education Coalition).

Lahars are mudflows or debris flows composed mostly of volcanic materials on the flanks of a volcano. These flows of mud, rock, and water can rush down valley and stream channels at speeds of 20 to 40 miles per hour and can travel more than 50 miles. Some lahars contain so much rock debris that they look like fast-moving rivers of wet concrete. They can occur both during an eruption and when a volcano is quiet (National Disaster Education Coalition). In 1975, Merapi's lahar in the Krasak River destroyed the bridge on the main road connecting the provinces of Yogyakarta Special Region and Central Java. On 5th December 1996 at Boyong River, 14 mining trucks were buried under the Merapi's lahar flows.

The repose periods of Merapi volcano have not exceeded 3.5 years on average since 1882, where thirteen events were large enough to cause at least 7,000 deaths (Touret et al., 2000). One single historical eruption supposedly created the largest havoc in 1672. Two large-scale eruptions killed 200 people in 1872 and 1369 people in 1930-1931 (Thouret, 2000). The Merapi eruption on 22nd November 1994 consisted gas cloud that rapidly traveled 6 km down the southern slope of Merapi following the Boyong riverbed and 4 km down the south-east slope following the Krasak riverbed (Dove, 2008). At that time, the inhabitants of a dozen villages on the southern and southeastern slopes fled the cloud on foot down the mountain. Of these, fifty-six died on the spot or subsequently of their injuries and 4,452 people were evacuated by the government to refugee camps further down the mountain.

Table 3.1 summarized the Merapi volcanic eruption events in May and June 2006.

Table 3.1 Merapi volcanic eruption events in 2006

NO	DATE OF ERUPTION	ERUPTION EVENTS
1.	15 May 2006	- Merapi emitted lava, debris, and a pyroclastic flow (or cloud) - Hot ash was released - Volcanic ash turned everything white - School children wore masks to counter adverse health effects of breathing volcanic ash - Volcanic ash covered crops and vegetation - Volcanic ash covered automobiles and affected jet airline traffic
2.	6-8 June 2006	- Merapi emitted lava, debris, and pyroclastic flows (superheated clouds of gas) - Explosiveness of 8th June Eruption sent 15,000 fleeing - 11,000 inhabitants from three districts evacuated to schools and other "safe haven" emergency shelter - Many citizens chose to evacuate - Evacuation was ordered - Villagers remembered the 1994 disaster - Many citizens chose not to evacuate because shelters were boring and they wanted to provide for livestock and tend crops
3.	14 June 2006	- Merapi showed its force, and erupted, burying a tourist object at Kaliadem of Cangkringan district, Sleman Regency.

3.2.1. The Sequence and Impacts of 2010 Merapi Volcanic Eruptions

The seismic and volcanic activities of Merapi volcano increased rapidly from the middle of September 2010 (Daryono, 2010). Observers at Babadan 7 km (4.3 mi) west and Kaliurang 8 km (5.0 mi) south of the Merapi volcano reported hearing an avalanche on 12th September 2010. On 13th September 2010 white plumes were observed rising 800 meters (2,600 ft) above the crater. Lava dome inflation, detected since March, increased from background levels of 0.1 millimeters (0.0039 in) to 0.3 millimeters (0.012 in) per day to a rate of 11 millimeters (0.43 in) per day on 16th September. On 19th September 2010 earthquakes continued to be numerous, and the next day the CVGHM raised the Alert Level to 2 (on a scale of 1–4).

One month later, the government raised the alert to level 3. On 23rd -24th October 2010, lava from Merapi volcano began flowing down the Gendol River signalling the likelihood of an imminent eruption. On 25th October, the alert was raised to its highest level (level 4)

and the government warned community in threatened villages to move to safer grounds. People living within 10 km radius especially those who live near the rivers were notified to evacuate (Mei, 2010). The evacuation orders affected at least 19,000 people; however, the number that complied at the time remained unclear to authorities. Pyroclastic flows that caused the most damage during previous eruptions in 2006 and 1996 had not surpassed that radius. The previous eruptions had also led to the creation of evacuation shelters on the periphery of the 10 km evacuation radius. This is where most of the evacuees took refuge in late October (Ferris & Petz, 2011).

Officials said that about 500 volcanic earthquakes had been recorded on the mountain over the weekend of 23rd–24th October, and that the magma had risen to about 1 km (3,300 ft) below the surface due to the seismic activity.

On 26th October 2010, Merapi erupted after nearly two months of enhanced levels of seismicity and ground deformation, which ended a period of low-level activity since the preceding eruptive episode in 2006 (Gertisser, et al., 2011). Two days before the eruption, a sharp increase in the number of volcanic earthquakes and the rate of summit deformation was observed, which prompted the evacuation of several villages within a 10 km radius of the summit. Merapi erupted in a spectacular fury of ash and lava. It produced ash plumes, lahars, and pyroclastic flows which travelled down-slope mostly to southeast, south, and southwest. The volcano also released sulphur dioxide, a colorless gas that could harm human health and cool the Earth's climate.

Evacuation efforts were still in progress when the first major eruption occurred in 26th October 2010. Fifteen thousand local residents had still not left the danger zone; many of whom were reluctant to leave behind their livestock and possessions. In the eruption events on 26th October, at least 34 people were killed including the gatekeeper of the volcano, namely *Mbah* Marijan in Kinahrejo village, who had urged people to follow the government' orders, but he declined evacuation on grounds that it was his duty not to leave the mountain. On that day, a series of pyroclastic flows swept down the southern part flank of the volcano. Based on the data from BNPB (2010), there were only 22,599 registered refugees during the first day of evacuation.

By 30th October, Merapi erupted again, for a longer period and more violently than the previous events. Ash fall was spread as far as 30 km away from the vent, and pyroclastic flows with duration of 22 minutes went to Gendol, Kuning, Krasak, and Boyong Rivers.

After a couple of quieter days, on 1st November, a massive eruption sent a huge pyroclastic flow of ash and hot gases down the volcano' slopes. Hundreds of people fled from emergency shelters located 10 km from the peak to areas that were further away from the volcano. After this incident and another bigger eruption on 3rd November, the authorities decided to move the shelters 15 km away from the summit instead of the initial 10 km. Even more, with the pressure of a climbing death toll, when the 3rd November eruption destroyed 2 villages and killed at least 31 people, the Indonesian president Susilo Bambang Yudhoyono ordered that people who refused to leave the danger zone would be evacuated by force. Furthermore, the government declared a new policy whereby it would buy and evacuate livestock, especially cows, from villagers in the danger zones in order to prevent

them from returning to tend to their livestock. Since that date, the local government could no longer use the contingency plans collectively created by RMDA, MVO, and UNICEF in 2009. On 3rd November, there were 76,031 registered refugees spread over four districts, with about 40,000 people staying in the emergency shelters.

By 4th November, Merapi had been erupting for 24 continuous hours, and pyroclastic flows travelled up to 15 km from the vent at around 11.30 P.M. These events led to further extensions of the "safety zone", to evacuations from several more communities within 20 km radius and to the temporary closure of Yogyakarta airport for two weeks. Some flights were cancelled, but most transferred to Ahmad Yani airport in Semarang, Central Java. In that date, the number of the registered refugees was 399,403.

On 5th November, an unusually large eruption generated pyroclastic flows that were channelled for 15 km along the Gendol valley on Merapi's south flank. Associated ash-cloud surges swept through villages outside the valley, destroying everything in their path and causing hundreds of fatalities (as reported in Geology Today, 2011, v.27, n.1). This eruption swept and buried many villages in Cangkringan district, Sleman regency, and Kemalang district of Klaten regency. Even Borobudur Temple, the biggest Buddhist holy place which is situated about 35 km from Merapi volcano, was covered with volcanic ash. People living between 15 and 20 km from the volcano were ordered to evacuate. The government reported that 265,000 people lived within 20 km danger zone and as of 5th November, a total of 160,000 people had been evacuated to government-run emergency shelters.

After the 5th November eruption, the volcanic activity gradually subsided, yet many people, especially those whose villages had been destroyed, remained displaced for weeks and even months. By 10th November 2010, 153 people had been reported to have been killed and 320,000 were displaced. Later, the eruptive activities again increased requiring a continuation of the Level 4 alert and continued provision of exclusion zones around the volcano.

On 13th November, the safety zone was reduced to 15 km from the vent for Magelang, Boyolali, and Klaten regency and 20 km from Sleman regency. The biggest number of registered refugees was recorded on 14th November; unfortunately, the local authorities were not able to record the refugees outside the official refugee camps. By 18th November the death toll had increased to 275 people.

By 19th November, the authorities modified again the safety zone: 10 km from Klaten, Magelang, and Boyolali regencies. Sleman was divided into two regions with a radius of 15 km to the east side of Boyong River and 10 km to the west side. Discrepancies of the safety zone in Sleman regency was due to the fact that the eruptions were mainly directed to the south, between Boyong and Gendol Rivers. During November, the activity continued with lower intensity, generating rock falls, pyroclastic flows and occasional volcanic mudflows (lahar). The death toll had risen to 324 people by 24th November and Syamsul Maarif, head of the National Disaster Mitigation Agency explained that the death toll had risen after a number of victims succumbed to severe burns and more bodies were found on the volcano's slopes.

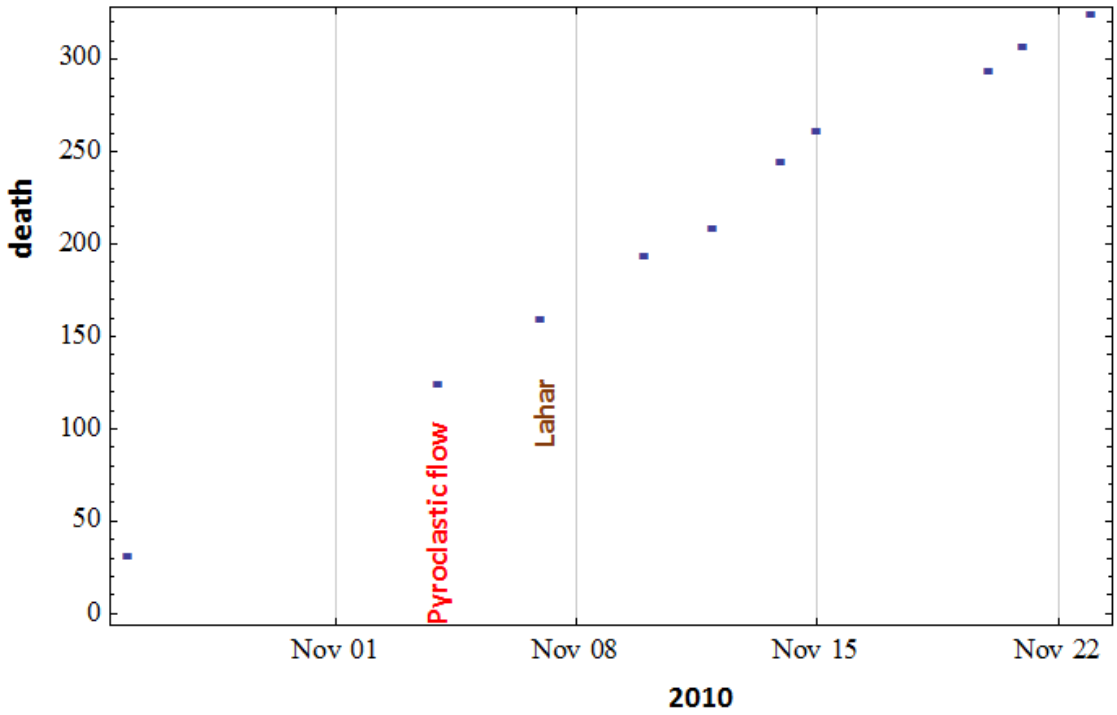


Figure 3.4 Death toll by 2010 Merapi eruption

In early December 2010, the Merapi volcanic eruption subsided (Hidayati et al., 2011). Nevertheless, approximately 130 million cubic meters of volcanic materials were produced and deposited around the slope of the volcano. It caused morphological changes at the summit area and the aperture of the crater toward the south-southeast. By 3rd December, the death toll had risen to 353 people. As of 3rd December 2010, at 09.00 am, the CVGHM lowered the status of Merapi volcano to the level of "Caution Alert" (Level 3). They clarified that with this alert level the potential of hot ash clouds and projected incandescent material remained. The Geological Agency provided several recommendations including there would be no community activities in the disaster prone areas and proclaimed an ongoing exclusion zone of 2.5 km (1.6 mi) radius.

2010 Merapi eruption caused the most homeless people with at least 11,000. In terms of evacuated people, this was also the most with about 350,000 people evacuated to shelters for about a month or so before the alert level was reduced (CATDAT, 2010).

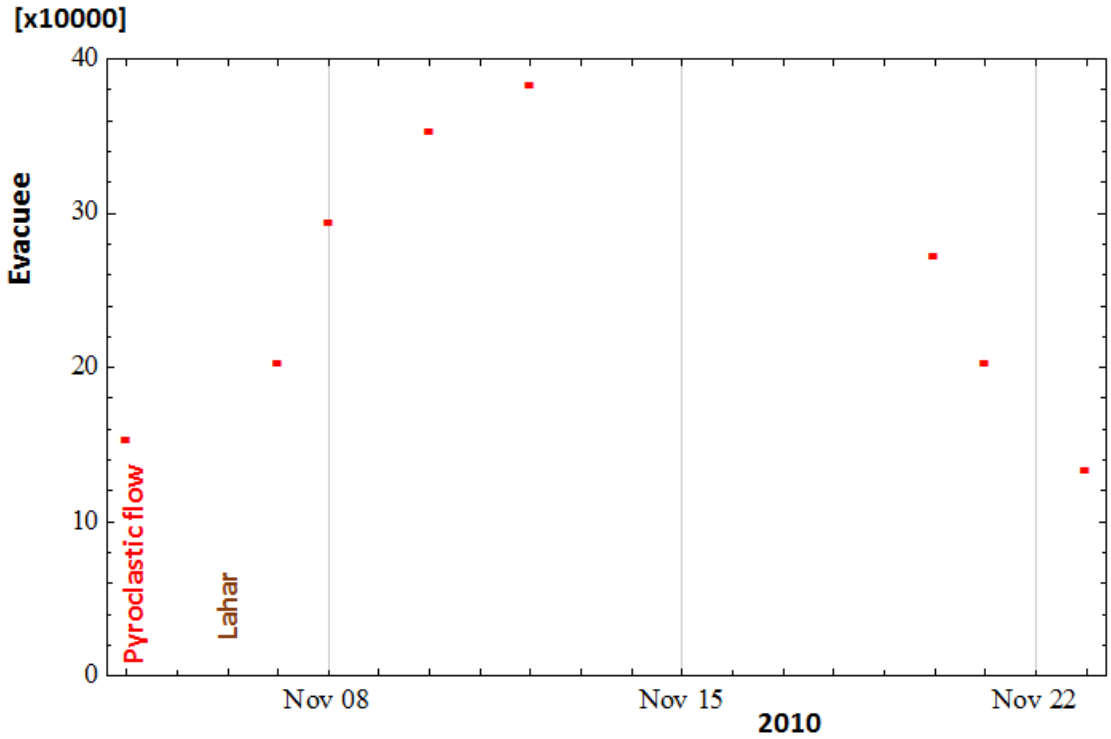


Figure 3.5 Number of refugees in 2010 Merapi eruption

2010 Merapi eruption caused a major amount of damage in the form of forest industry (destruction of trees) and also crops losses, infrastructure and housing (CATDAT, 2010). The economic loss was estimated from IDR 7.1 trillion (USD791 million) to IDR 13.3 trillion (USD 1479 million).

Based on Indonesia Center for Data Information of National Agency for Disaster Management in 27th November 2010, in habitation sector, the Merapi volcanic disaster buried many villages in Yogyakarta Special Region area and destroyed thousands of villagers' houses both in Yogyakarta Special Region and in Central Java. It was noted that 2,636 units of houses were heavily damaged and could not be liveable, 156 were damaged moderately, and 632 houses were in minor damage. Overall, 3,424 houses were damaged in Yogyakarta Special Region. Meanwhile, in Central Java, it was noted that 551 units of houses were heavily damaged and could not be liveable, 950 were damaged moderately, and 2,204 houses were in minor damage. Overall, 3,705 houses were damaged there.

The threat of lahars occurs every rainy season to the inhabitants living around Merapi volcano, mostly in the southern and western slopes. The most dangerous lahars happened in March 2011. On 19th March 2011, the heavy rain has turned volcanic deposit into lahars that hit settlements along Putih River and caused the damage of two bridges and the evacuation of 118 people. On 21st March 2011, powerful lahar occurred and swept the settlements of Sleman's villages, burying 21 houses close to Gendol River. This lahar ran down as far as 20 km and forced about 200 people to be evacuated (Hidayati et al., 2011).

Merapi volcano showed new characteristics after its 2010 eruption. It was seen from the interval of the increase volcanic activity which was getting faster and faster from day to day. Based on the data from Regional Disaster Management Agency of Magelang Regency,

the last activity was in the form of puff accompanied by incandescent lava burst on 20 April 2014. Previously, this volcano had emitted its first major gust in 5th July 2010. The second major gust came out a year later in 22nd July 2013. In 18th November 2013, another gust occurred six months after the previous one, followed in 10th and 27th March 2014 and 20th April 2014.

3.2.2. Community Response to Evacuation in 2010 Merapi Eruption

A number of activities have been done to anticipate the 2010 Merapi eruption: preparations to deal with volcanic crisis, evacuation alert, public responses to evacuation order, transport for the evacuation process, and evacuation of livestock (Mei et al., 2013).

Community education on volcanic disasters before the 2010 eruption was conducted by the members of BPPTK, local authorities, academic institutions and NGOs. These activities were held between April and August 2010. In addition, during 30th May-1st June 2010, a series of volcanic crisis preparation and evacuation drills were carried out in Sleman regency, led by the Police, the local government agencies, and some military personnel from the United States of America. It was noted that more than 2000 people living in Turi, Pakem, and Cangkringan districts were involved in the evacuation drills; although these activities were held with communities from the villages located in KRB *(kawasan rawan bencana)* III only.

Another preparation that aided the evacuations was related to road quality improvement. The condition of provincial and regency roads near Merapi is relatively good. Local roads linking each municipality are mostly asphalt and the roads in the south-western part of the volcano are in the best condition. Prior to the 2010 Merapi eruption, local people worked collectively to upgrade the condition of evacuation roads. The maintenance of evacuation roads became a major issue for post-crisis management following the 2006 Merapi eruption (Mei and Lavigne, 2012). In response, local governments worked to enhance the quality of roads by paving them with asphalt. Unfortunately, the condition of the roads worsened due to trucks hauling volcanic materials (De Belizal et al., 2011).

In relation to the evacuation alert, the evacuation order was mostly given by the head of the village directly to the villagers. Technology such as mobile phone and talkie-walkies as well as traditional tools like wood gongs *(kentongan)* was used to inform the villagers. Trucks, motorbikes and cars were the main vehicles used for evacuations. Trucks were the main transportation tool because the evacuation process was organized by the authorities before 4th November. After this date, most of the people fled during the night by local means of transportation. The role of local associations was not only limited to aids distribution but also for crisis communication, as exemplified by the actions of **Jalin Merapi** (community radio-stations), a local association supported by some NGOs working in Merapi's flank which has the main role to quickly and accurately convey important information and data to support the decision-making process in the event of Merapi eruption. The information from Jalin Merapi can be accessed through website, social networking such as Twitter and Facebook, SMS, radio communication, telephone and post information in the field which was managed by a voluntary network that runs 24 hours a day.

In relation to public responses to the evacuation order, most of the people evacuated when the first pyroclastic flows were reported on 26th October at 05:30 PM (local time), despite the evacuation orders were given earlier on 25th October at 11:00 A.M. (local time). People tend to wait to evacuate until a pyroclastic flow or ash fall events has taken place, even though the government had previously informed them that the volcano was already at its highest warning level. On 25th October, local authorities had conducted an organized evacuation in order to evacuate persons with special access and functional needs, the elderly, children and pregnant women for villagers who are living in KRB III. Another type of evacuation was undertaken by the Army and Police search and rescue teams, to seek out and evacuate the dead and injured from 26th October eruption, and to locate people missing or who had remained in villages that were affected by the eruption.

Although there have been evacuation orders and efforts of local authorities to evacuate people, there were some residents who refused to leave their villages. As a consequence, Mbah Marijan in Kinahrejo village and 34 other victims were found dead on 26th October due to first pyroclastic flows.

During the paroxysmal eruption on the night of 4th-5th November, evacuations were conducted spontaneously. In some cases, people did not start to evacuate from the new 20-km radius restricted zone until 11.30 P.M. Without detail instructions, people tried to escape by themselves, but many did not know how exactly where to go. In addition, due to an underestimation of the potential for larger-than-normal evacuation areas in the 2009 contingency plan, no refugee camps had been prepared outside of the 20 km radius from the summit. Consequently, on the night of 5th November and in the aftermath of the main explosion, the local authorities of the Sleman regency began preparation of a new refugee camp in Maguwoharjo football stadium which was located 23 km from Merapi volcano. At that time, this place became the largest official refugee camp in Sleman Regency which accommodated more than 21,000 refugees. However, due to the limited space and the fear of a bigger eruption in the future, refugees also moved to other camps, notably community-based camps, or they stayed with family relatives. The disorganization and the rapid pace at this stage of the evacuation made the local authorities face logistical difficulties including recording the number of the refugees and distributing aids and assistance (Mei et al., 2013).

In relation to evacuation of livestock, the residents faced problems due to the limited number of transports while the number of cattle was too many and there was no evacuation system for the cattle. As a consequence, many cattle were abandoned and fed with ash-covered fodder, which reduced milk production and resulted in weight loss. Some residents also had to sell their cattle at low price.

3.2.3. Possible Future Merapi Eruption

Development of methods to predict Merapi volcanic eruptions is very important to provide for early evacuation of densely populated area such as in Sleman Regency of Yogyakarta Special Region province. Unlike some other types of natural disasters, hazard and risk potential of volcanoes can be localized reasonably well. Reliable prediction, to a minimum degree, is possible for Merapi volcano since it is well studied and sufficiently instrumented.

A prediction is a relatively precise statement which describes the part of a volcano that is likely to erupt, the time of the eruption, and the presumable type of eruption. Such predictions must be made public with utmost caution in order to gain credibility within the concerned population, thus enabling adoption of preparedness measures (International Association of Volcanology and Chemistry of the Earth' Interior).

Careful analysis of the history of Merapi volcano becomes the most important method in assessing the long-term probability of the occurrence of a specific eruption type and its eruptive energy. Merapi volcanic eruptions are often announced years, months, days, or hours before (e.g., by harmonic tremors in the deeper conduit system). This micro seismic activity commonly increases prior to an eruption and is characterized by relatively constant amplitudes and wave lengths that are possibly caused by the turbulent motion of the magma ascending to the surface from a magma chamber (IAVCEI, 2014). The relatively slow ascent of viscous magma to the upper crust generates a surface expansion that can be measured with modern geodetic instruments. Temperature increases within Merapi volcano as a result of ascending magma is possible to be detected by infrared signals via satellite. Heat conductivity and the magnetic field are changing. An increase of SO2 emission often has been observed before eruptions. The characteristic behavior of the Merapi volcano can be identified with the help of intensive monitoring by satellite.

There are some questions concerning with the possibility of Merapi volcanic' eruption (Gertisser et. al., 2011). If it erupts again, will it start with relatively begin growth of a new lava dome or will the onset be marked by a sudden explosive event like in 2010? Will the next eruption be on an even larger scale, similar to some of the eruptions in the geological records? Is there a risk of a large flank collapse, as has happened at least once in the history of Merapi? Prior to the onset of volcanic activity, there will be precursory signs, such as an increase in the number and intensity of local earthquakes and detectable ground deformation, which, once they appear, can be used to anticipate several days to weeks in advance when the next eruptions is possibly to occur.

The challenge that the scientists to face in anticipating the volcano's future behavior is to unravel the driving forces behind Merapi's unusual explosive activity and the critical changes that may lead to a change in eruptive style. Merapi's past and present eruptions may well hold the key to its future behavior. As such, the study of these eruptions is crucial to constrain the pre-eruptive processes and timescales of magma storage and ascent operating inside the volcano system. An improved understanding of the physical and chemical processes that lead to magma ascent and eruption will allow more reliable interpretations of volcano monitoring data and will ultimate lead to better monitoring strategies and more accurate short-term hazard assessment during the future unrest (Gertisser et. al., 2011).

3.3. Roles of Center for Volcanology and Geological Hazard Mitigation, Geological Agency (CVGHM)

As mentioned before, there is an institution which is called Center for Volcanology and Geological Hazard Mitigation, Geological Agency, under the Indonesia Ministry of Energy and Mineral Resources. This institution is responsible to issue alert level for 127

active volcanoes in Indonesia and to provide recommendation of hazard mitigation from the volcanoes.

CVGHM is one of the centers belonging to Geological Agency (previous Directorate General of Geology and Mineral Resource), which has collaborated with Disaster Prevention Research Institute (DPRI) of Kyoto University in Japan since 1993 for the studies on volcanic eruption mechanism, volcanic activity and geological hazards in Indonesia (Iguchi et al., 2011). The specific main tasks and functions of CVGHM are as the followings:

- To conduct research, investigate and service of volcanology and geological hazard mitigation (volcanic eruption, earthquake, tsunami, and landslide).
- To issue an early warning for volcanic activities and landslide.
- To disseminate geological hazard knowledge to local government and communities who live in the geological hazard zone.
- To produce the geological hazard map for spatial planning, geological hazard mitigation and education.
- To give technical recommendation to the Local Government to do geological hazard mitigation efforts.
- To evaluate research, investigate and service of volcanology and geological hazard mitigation.

An updated hazard map for Merapi displaying three dangers zones (KRB) ranked from III (high) to I (low) was constructed, printed and made available online by CVGHM in 2002 (Hadisantono et al., 2002).

The KRB III encompasses areas located close to the hazard source, and in the case of Merapi, frequently affected by pyroclastic flows, lava flows, rock falls and ejected rock fragments. The boundaries of KRB III are based on study of the impacts of eruptions that occurred throughout the 20^{th} century and take into account the distribution of mainly small-volume dome-collapse pyroclastic flows as well as morphological changes in the summit area that influence the directions of dome collapse. The danger zones also take into account geologic structure and stability of the summit and the locations of the most recent eruptive activity. The KRB II zone may also be affected by pyroclastic flows, lahars, volcanic ash fall, volcanic bombs and other ejected rocks, although the frequency and severity of impacts are lower than in KRB III. Zone KRB I is potentially affected only by lahar and flood during typical Merapi eruptions (Sayudi et al., 2010).

An updated (post-2006, pre-2010) Merapi hazard map was intended for situations in which (1) the eruption occurs in the central area of the summit dome complex, (2) any associated ash column is vertical, and (3) there has been no drastic morphological change in the volcano' summit. This map was intended to assist volcanologists in describing the pattern of past eruptions and to estimate the areas potentially affected by various hazards (Suryo & Clarke, 1985). The updated Merapi hazard map was used by local authorities as an input for contingency planning that took place in 2009 in each district surrounding the volcano.

CVGHM provides four warning levels of volcanic activities. For each warning level, recommendations are given for what people living on the volcano slopes are supposed to

do. Level 1 is *normally active*, with its criteria is that monitoring of visual, seismicity and other volcanic events does not indicate change. It means that people living in hazard zone III, II, and I are able to perform daily activities. Level II is *on guard*, with its criteria is that increasing activity of seismicity and other volcanic events, and visual changes around the crater. This condition still permits people living in hazard zones II and I to perform daily activities, but people living in hazard zone III should be more aware and attentive to the technical direction issued by CVGHM. Level 3 is *prepared*; with its criteria is that intense increase in seismic activity, and obvious changes of visual observation in the crater. Under this condition, people must be prepared to evacuate. Level 4 is *be aware* with its criteria is that the eruption is about to begin and people must be evacuated to safer places.

There are six observation posts at Merapi, namely in Kaliurang, Ngepos, Babadan, Jrakah, Krinjing and Selo. Each of the observation posts is equipped with a telescope to observe changes in the upper part of the volcano, including rock fall activity; source, direction and distance travelled by avalanches, location of dome build up and height of the volcanic smoke. Information about the condition and the morphology of the volcano is reported from each post to CVGHM's Volcano Investigation and Technology Development Office (BPPTK) and to the Merapi Volcano Observatory (MVO, a section of BPPTK) in Yogyakarta and then transmitted to CVGHM. The same information is also reported to local governments.

The National Disaster Management Agency (BNPB) and the local authorities at district level are in charge of disseminating the alert level to public following the established protocol. Evacuation orders are given by BNPB and local governments at district level. However, if the danger is imminent, the BPPTK can use sirens to inform people directly to evacuate.

3.4. Importance of Disaster Management for the Volcanic Eruption

Theoretically, disaster management can be operated by steps of activities, i.e. pre-disaster, during a disaster, and post-disaster. In Yogyakarta Special Region province, the government set procedures of disaster management activity steps as the following (Paripurno et al., 2011).

- **Research:** It is conducted to study the trends and characteristics of Merapi volcano activities, especially in the area which is frequently affected by Merapi eruption. Culture of the local people including local wisdom is important to be studied and understood.
- **Vulnerability analysis and risk assessment:** There are several threats of Merapi activities, i.e. glowing clouds, volcanic ash and dust, and lahar. Matrix of these threat variants and their risks should be assessed.
- **Socialization and community preparedness:** Local people or community members are taught on natural phenomenon and actions for anticipation. This program is conducted by local and province government in collaboration with Non-Government Organizations (NGOs) and universities in Yogyakarta.
- **Mitigation:** It is the preparedness to facing disaster or alert situation. Preparation for facing Merapi hazards includes providing evacuation lines, disaster centers, evacuation

barracks, and logistic. On the other side, monitoring of Merapi activities is done by IRDVT, and the results will always be communicated and informed to the local government, local community leaders, and NGOs.

- **Warning system:** When Merapi volcano situation is in the second alert level, the possibility of a big eruption should be socialized as soon as possible, not only by persuasive way, but also powered effort. Early warnings can be disseminated by lectures at schools or meetings, sermon at churches or mosques, siren, or short message system (SMS). Early Warning System can function efficiently if the warnings received by people come faster than the approaching danger. EWS system consists of monitoring systems, control systems and conveyor systems. Monitoring system is a system that monitors natural phenomenon of a disaster condition. The control system in master control will process data monitoring and decide the danger level while the conveyor system in the form of a siren is placed in residential communities prone to disasters. When the eruption occurs at a certain intensity that is considered dangerous, immediate early warning system automatically emits a siren to alert the entire community to come together in the next rallying point for evacuated together (Anjasni, 2013).
- **Rescue:** When glowing clouds occurs, the safest method to avoid the risk is escaping from the vulnerable area to places or evacuation barracks with suitable logistic.
- **Communication:** Communication is important in order to detect the threats as early as possible from Yogyakarta as the capital city of the province, and Jakarta as the capital city of the country. It can be done by using satellite telephone system.
- **Emergency handling:** When there is someone injured, need to be medically treated, or even missing, the preparedness of the SAR (Save and Rescue) team must be well organized and coordinated.
- **Sustainability management:** If Merapi volcano does not subside in a short time, the mitigation will need to be proceeding continuously. Good coordination and collaboration must be set up involving local government, province government, central government, and all stakeholders.
- **Restoration:** This activity belongs to post-disaster step, the process may consume such a long time. Renovation planning need to be conducted carefully because the cost may be high.
- **Training and education:** To achieve best results of disaster management, there should be some skilled and trained officers in every vulnerable area. These persons then can train other officers, community members, and NGO members.
- **Simulation:** After the volunteers are prepared, every vulnerable area should hold simulation on disaster management process in order all the community members and their family are able to anticipate and save themselves from disaster threat.

3.5. Practical Knowledge for Volcanic Disaster Prevention

There is a number of important information for volcanic disaster prevention. This information is needed to be disseminated to school children, their family members, and the community as a whole in order to take appropriate actions for volcanic disaster prevention. **Table 3.2, Table 3.3,** and **Table 3.4** shows the types of volcanic hazards and appropriate actions for volcanic disaster prevention which are summarized from the book "*Talking about Disaster: Guide for Standard Message"* by National Disaster Education Coalition (2007).

Table 3.2 Types of volcanic hazards

1. **Lava flows** are less dangerous to human life than to property, traffic, and communication because probable path, of lava flows can be roughly predicted, diversion measures, cool advancing front with water, or disruption of source or advancing front of lava flow by explosives may be taken in principle: however, such measures, often turn out to not be very successful. Highly viscous lava generally does not advance far, but commonly piles, up above an active vent as a lava dome. Such domes can collapse repeatedly and generate dangerous hot block and ash flows and hot surges and blasts.
2. **Poisonous**, even lethal, gases can be ejected during the eruption of a volcano or can be released without a triggering eruption. The gases are transported away from vent as acid aerosols, as compounds absorbed on tephra and as microscopic salt particles. Sulphur compounds, chlorine and fluorine react with water to form poisonous acids damaging to the eyes, skin and respiratory systems of animals even in small concentrations. Most volcanic gases are noxious and smell bad, but they can cause mass fatalities. The time available for early warning of gas release is extremely short, and intensified investigation on such gas eruption, as well as keen observation of the respective locations, is absolutely necessary.
3. **Ash falls** during volcanic eruption generally do not directly endanger life, although the collapse of roof and houses under the ash load are not uncommon. Considerable damage may be caused, however, for agriculture and industry even at distances up to tens of kilometers from a vent. Many of the hazards of tephra falls can be mitigated with proper planning and preparation. This includes clearing tephra from roofs as it accumulates, designing roofs with steep slopes, strengthening roofs and walls, designing filters for machinery, wearing respirators or wet clothes over the mouth and nose.
4. **Pyroclastic flows** and low-density surges that are frequently associated with blast are extremely hazardous types of volcanic eruptions. Pyroclastic flows consist of a mixture of volcanic gases and ash and are generated during many volcanic eruptions. Some may be as hot as 900°C; they move swiftly with velocities of up to several 100 m/s. Early warning for this volcanic phenomenon is virtually impossible. The only effective method of risk mitigation is evacuation prior to such eruption from areas likely to be affected by pyroclastic flows.
5. **Lahars** (volcanic mud and debris flows) are a common major volcanic hazard for people and property. Lahars likewise proceed very quickly and possess great destructive power. They develop either as a direct consequence of a volcanic

eruption, if, for instance, crater lake are blown out, or as a secondary event as a result of heavy rainfall during or after the eruption. Areas farther away may be warned several hours in advance. A sufficient monitoring of individual volcanoes, however, rarely is guaranteed. Small lahars can be diverted by barriers or by artificial channels which lead them away from valuable land or property, but in most cases the volume and force of the lahar is such that it beyond human power to control.
6. **Volcanic debris avalanches** generated by sliding of larger portions of volcanic cones are common. These avalanches are highly mobile and may not only bury large tracts of land and dam stream to form lakes than can drain catastrophically and generate lahars and floods but also cause devastating tidal waves (tsunamis) if they advance into lakes or the sea. The only effective method of risk mitigation is evacuation prior to such debris avalanche or tsunamis (if expecting) from areas likely to be affected by this kind of phenomena.

Source: National Disaster Education Coalition (2007)

Table 3.3 Appropriate actions for volcanic disaster prevention

PHASE	APPROPRIATE ACTIONS
During a volcanic eruption	• Be prepared for the hazards that can accompany volcanic eruptions, and know how to respond to reduce risk. • Follow the evacuation order issued by authorities and put your disaster plan into action. The advice of local authorities is your best advice for staying safe. • Avoid areas downwind and river valleys downstream of the volcano. Stay in areas where you will not be further exposed to volcanic eruption hazards • Stay out of the area defined as a restricted zone by government officials. Effects of a volcanic eruption can be experienced many miles from a volcano. Mudflows and flash flooding, wild land fires, and even deadly hot ash flow can reach you even if you cannot see the volcano during an eruption. • Avoid river valleys and low-lying areas. Trying to watch an erupting volcano up close is a deadly idea. • Listen to a portable, battery-operated radio or television for updated emergency information and

	instructions. Local radio and local officials provide the most appropriate advice for your particular situation.
During Ash fall	• Volcanic ash is actually fine, glassy fragments and particles that can cause severe injury to breathing passages, eyes, and open wounds, and irritation to skin. • Wear long-sleeved shirts and long pants. • Use goggles to protect your eyes. • Wear eyeglasses instead of contact lenses. • Use a dust mask or hold a damp cloth over your face to help breathing. • Keep car or truck engines off.
After a Volcanic Eruption	• Help a neighbor who may require special assistance — infants, elderly people, and people with disabilities. Elderly people and people with disabilities may require additional assistance. People who care for them or who have large families may need additional assistance in emergency situations. • If possible, stay away from volcanic ash fall areas. The fine, glassy particles of volcanic ash can increase the health risk to children and people with existing respiratory conditions such as asthma, chronic bronchitis, or emphysema. Stay indoors, wear face masks designed to protect against lung damage from small particles, use eyeglasses instead of contacts, and protective goggles to protect eyes. • When outside, protect yourself from the fine, glassy particles of volcanic ash. - Cover your mouth and nose. - Wear goggles to protect your eyes. - Wear eyeglasses instead of contact lenses. - Keep skin covered to avoid irritation from contact with ash. • Clear roofs of ash fall. Ash fall is very heavy and can cause buildings to collapse, especially if made wet by rainfall. Exercise great caution when working on a roof. • Avoid driving in heavy ash fall. Driving will stir up volcanic ash that can clog engines and stall vehicles. Moving parts can be damaged from abrasion, including bearings, brakes, and transmissions.

	• If you have a respiratory ailment, avoid contact with any amount of ash. Stay indoors until local health officials advise it is safe to go outside. Volcanic ash can cause great damage to breathing passages and the respiratory system.

Source: National Disaster Education Coalition (2007)

Table 3.4 Appropriate actions when caught by volcanic eruption

ACTIONS IF CAUGHT INDOOR	ACTIONS IF CAUGHT OUTDOOR
• Close all windows, doors, and dampers to keep volcanic ash from entering. • Put all machinery inside a garage or barn to protect it from volcanic ash. If buildings are not available, cover machinery with large tarps. • Bring animals and livestock into closed shelters to protect them from breathing volcanic ash.	• Seek shelter indoors. • If caught in a rock fall, roll into a ball to protect your head and neck. A tight ball will provide the best protection for your body. Your head and neck are more easily injured than other parts of your body. • If caught near a stream, be aware of mudflows, especially if you hear the roar of an approaching mudflow. Mudflows often accompany volcanic eruptions. Move quickly out of the path.

Source: National Disaster Education Coalition (2007)

CHAPTER 4

RESEARCH METHODOLOGY

Chapter 4 describes in detail the procedures and the methods which are used in the study. First of all, the Research Site is presented and followed by the Reasons for Choosing the Schools, the Research Design, the Research Population and Sample, the Ethical Considerations, the Data Collection Tools and Techniques, the Validity of the Research Instrument, the Data Collection Procedure, and the Data Analysis.

4.1. Research Site

The research was successfully carried out in the 24 purposely selected primary schools in Merapi volcano area, which belong to Sleman regency, Yogyakarta Special Region province.

4.1.1. Location of the Researched Schools

The schools participating in the study are located in Cangkringan (13 schools), Pakem (6 schools), and Turi (5 schools) districts of Sleman regency in Yogyakarta Special Region province that have been determined by the government as high-risk areas of having impacts from Merapi volcanic eruption (Figure 10).

Cangkringan is located in north-east of Sleman regency capital city. The distance from Cangkringan district capital city to Sleman regency capital city is 25 km. Cangkringan district capital city is situated in 7, 66406' LS and 110, 46143' BT. This district has total area of 4,799 Ha and 16 public primary schools. During 2010 Merapi volcanic eruption, the number of population in Cangkringan district reached 4,492 people with 1,116 of them were included in the risk prone group (Antara, 2010). It was noted that there were at least 114 victims by 2010 Merapi volcanic eruption from Cangkringan whom was hospitalized in Dr Sardjito Hospital (Bella Donna et al., 2013).

Pakem is located in the highlands on the slopes of Merapi volcano, in the north of Sleman regency capital city. The distance from Pakem district capital city to Sleman regency capital city is 14 km. It is situated in 77, 66708 'LS and 110, 42011' BT with the total area of 4384, 04 Ha. The number of public primary schools in this district is 21 schools. During 2010 Merapi volcanic eruption, Pakem had a population of 6,871 with 2,102 people included in the risk prone group and with a capacity of accommodating 6,900 refugees (Antara, 2010). The data in Dr. Sardjito Hospital showed that there were 33 victims from Pakem whom were hospitalized there due to 2010 Merapi eruption (Bella Donna et al., 2013).

Turi is the northernmost district in Sleman regency, directly adjacent with Magelang regency of Central Java. The distance from Turi district capital city to Sleman regency capital city is about 20 km**.** There are 15 public primary schools in this district. During 2010 Merapi volcanic eruption, Turi had 2,218 villagers with 527 people were grouped in the risk prone area and it had a barrack capacity of accommodating 2,400 refugees (Antara,

2010). It was noted that there were 43 victims by 2010 Merapi eruption from Turi whom was hospitalized in Dr Sardjito Hospital (Bella Donna et al., 2013).

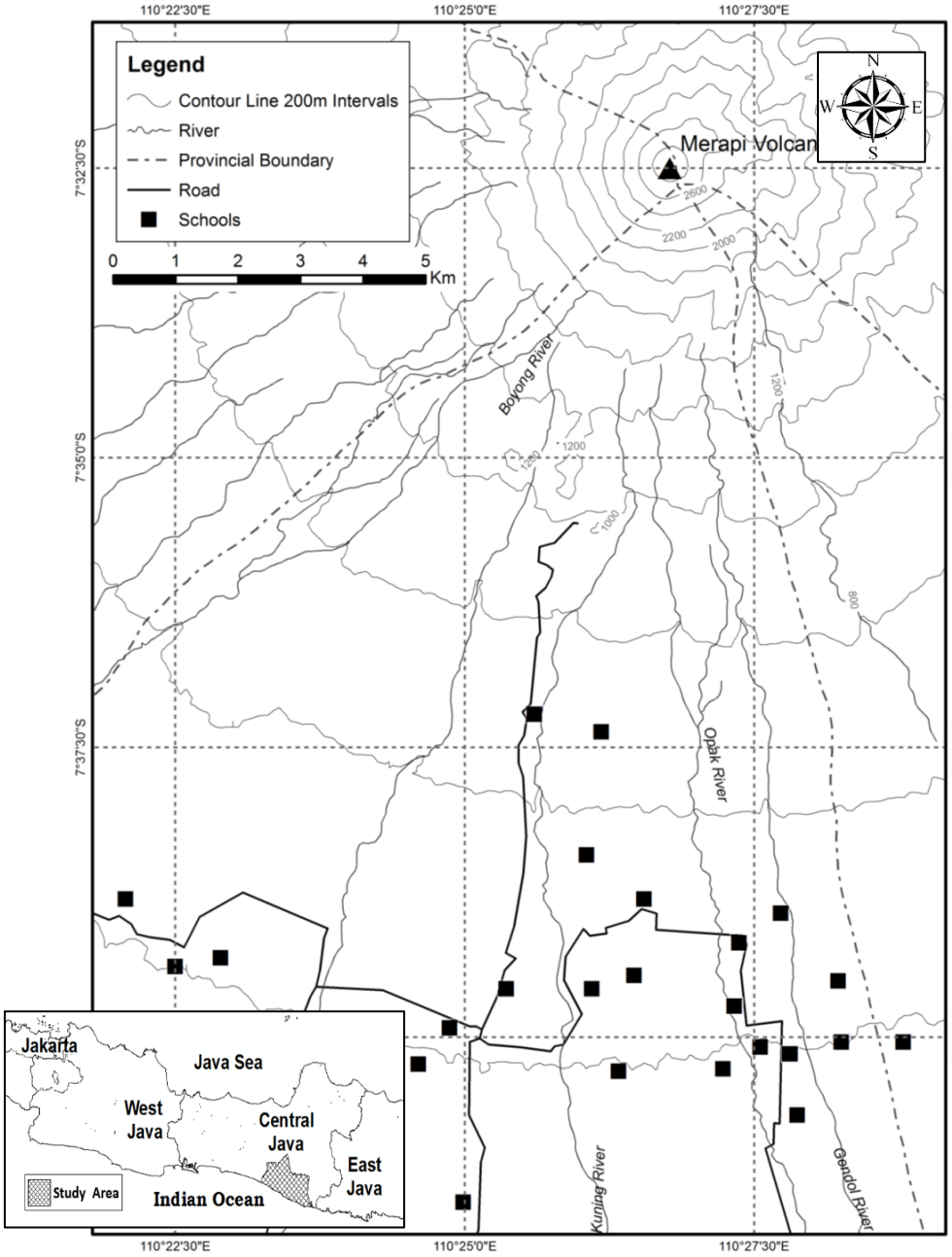


Figure 4.1 Researched schools' location

The data from the field survey show that among the 24 primary schools, only one school is relatively new because it was established in 2011; while the other twenty-three schools are relatively old because they were established within 1939-1986. In addition, most of the schools have the population more than 100 people.

4.1.2. Reasons for Selection of the Schools

There are several considerations to select 24 primary schools in the three districts of Sleman regency in Yogyakarta Special Region for the purpose of this study. Firstly, the

three districts were considered by the government as high-risk area to be affected by Merapi volcanic eruption. Secondly, the 24 primary schools were relatively highly-populated because they had between 100 – 210 population consisting of headmaster, teachers, staff, and students. Third, the schools were accessible enough; although they were located in relatively remote area, they could be visited by the researcher riding a motorbike, and the headmaster of each school also agreed that his/her school to be taken as the research sample. Fourth, the researchers fulfilled the advice from the local government that those 24 primary schools needed to be researched in order to get assistance in developing a good system of preparedness for natural disaster prevention through education.

4.2. Research Design

The study employed mixed methods in which both qualitative and quantitative processes were used to collect and analyze the data. As defined by **Mare (2010),** mixed method is a procedure for collecting, analyzing and mixing both quantitative and qualitative data at some stage of the research processes within a single study to understand the research problem more completely.

4.3. Research Population and Sample

The population in the study comprised headmasters, teachers, and students in the 24 primary schools in Merapi volcano area; while for the research sample, the explanation is as the following:

For assessing the school preparedness to Merapi volcanic eruption, all the headmasters of the 24 primary schools were taken as the research respondents. They were selected because at schools, structurally the headmasters had position as the most responsible person for guarantying their school preparedness in facing any natural disasters.

For assessing the teachers' performance in disaster prevention teaching, teachers in the researched schools composing of 112 home-room teachers (teaching almost all subjects) and 79 specialized ones (teaching only one subject) took part as the research respondents. The 191 teachers were selected because of their involvement in teaching learners and it was thought that they would be able to provide insightful data on whether learners were taught about hazards and disasters. Other demographics characteristics of the teacher respondents, with additional basic information, were provided in **Table 4.1**.

Table 4.1 Characteristics of all teacher respondents

Characteristics (N=191)	%
Gender	
Male	31.94
Female	68.06
Age	
Less than 31	18.32
31-40	12.56
41-50	36.13
51-65	31.41
Not identified	1.57
Education background	
Diploma	23.56
Bachelor	66.50
Not identified	9.95
Teaching experience	
Less than 4 year	10.47
4-10 years	26.70
11-20 years	12.56
More than 20 years	49.21
Not identified	1.05

Source: Field survey, 2012

For assessing the students' knowledge, attitude, and behavior in natural disaster and prevention, the research respondents were the entire 548 students of grade five in the researched schools; while for conducting experimental disaster prevention teaching, four classes of the grade five students in the 2 researched schools were taken as the research sample. The grade five students were selected as they have already learnt about disaster prevention at school for relatively longer time compared to the students in the lower grades; while for the case of students of grade six, it was difficult to request them to participate in this study due to their tight schedule for facing the national final examination. In addition, the students at the age of 10-11 years old are believed to be good communicators to their family members and community in general. Therefore, by getting effective education on disaster prevention at schools, those students may import the useful information regarding disaster prevention to their father, mother, and siblings at home.

Table 4.2 Number of Research Sample in the 24 Primary Schools

NO	RESEARCH SAMPLE	NUMBER OF THE SAMPLE
1.	Headmasters	24 persons
2.	Teachers	191 persons
3.	Students	548 persons
	Total	763 persons

Source: Field survey, 2012

4.4. Ethical Consideration

Graduate School for International Development and Cooperation, Hiroshima University in Japan and Government of Sleman regency in Yogyakarta Special Region province in Indonesia had already approved the study. The objectives and purposes of the research were explained to the research respondents (headmasters, teachers, and students); all the respondents were given chance to make an independent decision to voluntarily participating in this study. In addition, all the research respondents' identities as well as the names of the schools in this study were kept confidential.

4.5. Data Collection Tools and Techniques

Data of the research was collected from both primary and secondary sources. The primary data was gathered from the research respondents by using questionnaires, interview, and observation checklists. The secondary data was obtained from the literature review of relevantly written sources of information about the research problems and research questions through reading books, articles in academic journals, research reports, policy documents, conference reports, and internets.

The primary data were collected through the questionnaires-survey, observation, and interview the headmaster, the teacher, and the student respondents. A total of 763 respondents completed and returned the questionnaires. For qualitative data collection, a purposely sampling method was used in which three headmasters, four teachers, and five students were interviewed. To know the physical conditions of the school buildings, observation was done by using an observation-check list.

4.5.1. Questionnaires

Bulmer (2004) stated that a questionnaire is a well-established tool within social science research for acquiring information on participant social characteristics, present and past behavior, standards of behavior or attitudes and their beliefs and reasons for action within respect to the topic under investigation. Within natural hazards research, questionnaires are popular and fundamental tools for acquiring information on public knowledge and perception of natural hazards (Bird, 2009).

Table 4.3 Examples of the use of questionnaire survey instrument as a fundamental tool within natural hazard research

LOCATION	PURPOSE OF QUESTIONNAIRE	REFERENCES
Sleman in Yogyakarta	To analyze the community response to evacuation.	Estuning Tyas Wulan Mei et. al.(2013)
Banda Aceh, Indonesia	To examine the effect of different disaster education program on school children' knowledge, risk perception, awareness and preparedness behavior	Wignyo Adiyoso & Hidehiko Kanagae (2012)

Sleman in Yogyakarta	To identify the relationship between person-and community-level factors and intention to prepare for volcanic risks in communities surrounding the Mount Merapi	Saut Sagala & Norio Okada
Sleman in Yogyakarta	To identify how children in Merapi perceive threats within their space of activities	Risye Dwiyani & Norio Okada (2009)
Taiwan	To investigate the primary and secondary schools' teachers' perception toward and knowledge of climatic hazard mitigation.	Chun-Yen Chang et.al. (2009)
Montserrat, Caribbean	To explore volcanogenic knowledge and generate perception data on risk communication, management of volcanic crisis, and public behavior	Haynes et al. (2008)
Java Island	To determine the level of perception of volcanic risk and behavior in the face of volcanic threat among Javanese communities.	F Lagivne et al. (2008)
Indonesia, Srilanka, the Maldives	To assess and evaluate the capacity of communities to respond to natural disaster (tsunami) among residents, students, teachers, and government officials.	Tetsushi Kurita et al. (2007)

In this study, to assess the school preparedness level in anticipating Merapi volcanic eruptions based on the headmasters' perceptions, the main questionnaire which was used to gather the data consisted of ten main items, in which the headmasters could respond them by choosing one of the 3-4 alternative options and writing their brief reasons for each answer in the column provided. The first item in the questionnaire was related to risk-level of each school to Merapi volcanic eruption; while the other nine items were about indicators of the schools preparedness (see Appendix 1).

For teachers, to assess their performance in teaching disaster prevention, the questionnaire included the personal data of the respondents and self-assessment toward their teaching performance. The questionnaire had 10 main items in 5 points Likert scale from strongly agree (SA), agree (A), disagree (D), to strongly disagree (SD) followed by the column to state the teachers' reasons for each item (see Appendix 3).

For students, to assess their knowledge, attitude, and behavior, the questionnaire had two parts. Part I consisted of 4 items focusing on the students' personal information, frequency

of experiencing natural disasters, perception toward the damage level of their schools and homes by Merapi volcanic eruption, and experience in learning natural disasters and prevention. Part II focused on the students' perceptions (20 items) for exploring their knowledge, attitudes, and behavior on natural disasters and prevention in a simplified three-point Likert scale from agree (A), no idea (NA), to disagree (D) (see Appendix 5).

4.5.2. Interviews

Face-to-face interview was conducted in this study. This activity was useful as stated by Maree (2010), that the aim of qualitative interviews is to see the world through the eyes of the participants, and they can be a valuable source of information and also to obtain rich descriptive data that will help the researcher to understand the participants' construction of knowledge and social reality.

Interview guidelines were developed based on the research questions. Interviews were conducted with each purposely selected individual: headmasters, teachers, and students.

4.6. Validity of the Research Instruments

Validity refers to the extent to which an instrument measures what it is supposed to measure (Maree, 2010). To ensure the content validity of research instruments in this research, the following activities were done:

1. In constructing the questionnaire for headmaster respondents to assess the school preparedness for anticipating Merapi volcanic eruption, the researcher analyzed the indicators of school preparedness for disaster prevention proposed by the government. After that, the question items (both in Indonesian and English languages) were constructed and checked by the academic supervisor. After little modification was made, the Indonesian version of the questionnaire was ready to be distributed to the headmaster respondents for getting the data.
2. In constructing the questionnaires for teacher and student respondents, the researcher analyzed the disaster prevention education curricula for primary school level, focusing on the volcanic eruption disaster. Based on **Competency Standards** and **Basic Competence**, the questionnaire items were constructed. To make the students really understand the meaning of each statement in the questionnaire in order to avoid misinterpretation, the researcher was very careful in constructing the statement as simply as possible. After that, the constructed questionnaire items were checked by the academic supervisor. The modified version of the questionnaire (in the Indonesian language) was then ready to distribute to the research respondents for gathering the data.

4.7. Data Collection Procedure

Procedure for collecting the data in the study can be explained as follows: First, permission to conduct research in schools located in the three districts was requested and gained. The researcher visited the Sleman regency Government Office to pass the research proposal

and a request letter for conducting the research signed by the academic supervisor; after that, the Government Office staff issued the permission letter for the researcher.

With the permission letter from the Sleman regency Government Office, the researcher visited the designated primary schools and explained the objectives and purposes of the research to the headmasters. Next, with the consent from the headmaster of each school, the research was conducted.

The schedule of the research activities was shown in **Table 4.4**.

Table 4.4 Research schedule

NO	RESEARCH ACTIVITIES	DURATION
1.	Questionnaire survey for the headmasters, teachers, and students	1st -31st July 2012
2.	The 2nd questionnaire survey for headmasters, experimental teachings	1st -31st November 2012
3.	Interviews and observations	30th August-29th September 2013

In distributing the questionnaires to the respondents in the 24 primary schools, the researcher was assisted by five surveyors. They were given orientation first before going to the schools together with the researcher to distribute the questionnaires and to collect the answered questionnaire from the research respondents.

To give enough time for the headmasters and the teachers in filling in the questionnaire, they were advised to return the completed questionnaire a week after they got the questionnaire; while for students, they had to submit the completed questionnaire in the day they got and filled it.

4.8. Data Analysis and Interpretation

Data collected in the research was statistically analyzed in excel spreadsheet and SPSS software version 21, including descriptive statistics and non-parametric tests.

CHAPTER 5

RESULTS

In this chapter, the research findings are presented based on the research questions. It consists of four parts through five phases of research: the School Preparedness to Merapi Volcanic Eruption, the Teachers' Performance in Disaster Prevention Lesson, the Students' Achievement in Learning Disaster Prevention as well as the Educational Merits of the Lecture and the Discussion Method for Improving the Students' Achievement in Learning the Disaster Prevention.

5.1. School Preparedness to Merapi Volcanic Eruptions

5.1. 1. Schools-Risk to Merapi Volcanic Eruption

Based on geological information and risk-level of a volcanic eruption, as stated in Indonesia Law number 26/2007 on Space Management; typology of areas which are prone to volcanic eruptions has three categories in the order of the risk-level:

Type A: The area which is potentially flooded by lava and possibly affected by the expansion pyroclastic and lava flows. During the eruption enlarged, the area is potentially affected by falling material in the form of heavy ash and incandescent rocks hurl. The area has a low level of risk (quite far from the source of the eruption), and in the event of the eruption, it is still possible for human beings living there to save themselves, so the risk of an affected area can be avoided.

Type B: The area which is potentially knocked by pyroclastic, lava flows and lahars, burst or incandescent rock avalanches, heavy ash, hot mud, the flow of heat and toxic gases. The area has a moderate risk level (within fairly close to the source of the eruption). The risk of human beings living there to save themselves at the time of the eruption is quite difficult; therefore, the possibility of the area to be affected is very big).

Type C: The area is often knocked by pyroclastic flows, avalanches, dense ash, heavy hot mud, the flow of heat and toxic gases. This area has a high risk (very close to the source of eruption). At the time of magmatic activity, the region would be rapidly affected so that living things around the volcano are not possible to save themselves).

Schools in the study were mainly located in type B area in which the headmasters had sub-divided the school-risk levels to the volcanic eruption into three categories as shown in **Table 5.1:** lower, middle, and higher on the basis of each school location that was relatively estimated by geographic view-points which were mainly distance from both the peak of Merapi volcano and rivers due to high risk-hazard of pyroclastic flows, lava flows, and lahars.

Table 5.1 Reasons by headmasters for determination of the school risk

RISK LEVEL	NUMBER OF SCHOOLS	REASONS BY HEADMASTERS
Relatively lower	2 schools	Schools are physically strong and far (more than 15 km) from the peak of Merapi volcano and rivers.
Relatively middle	17 schools	Schools are located (8-15 km) from the peak of Merapi volcano and they are also near rivers (e.g. Opak and Gendol rivers).
Relatively higher	5 schools	Schools are very near (less than 8 km) to the peak of Merapi volcano as well the rivers which are passed by lahars and lava during the eruptions.

Total schools: 24 schools (Field survey, 2012)

Information in **Table 5.1** shows misunderstanding among the headmasters in determining the distance or the schools' geographical location to the peak of Merapi volcano. For example, two headmasters thought that their schools' location was more than 15 km to the peak of Merapi volcano; in fact, based on the geographical map in **Figure 4.1,** no school in this study has the distance more than 15 km to the peak of Merapi volcano.

5.1.2. School Preparedness Level to Merapi Volcanic Eruption

5.1.2.1. Soft Components

As stated in chapter 2, the school preparedness system in this study was evaluated based on the headmasters' perceptions by looking at two components: soft and hard components. The findings related to soft components of the school preparedness are shown in **Table 5.2.**

Table 5.2 Schools preparedness related to soft components

NO	SOFT COMPONENTS	GOOD SCHOOLS	CRITICAL SCHOOLS
1.	Special unit/persons responsible for emergency preparedness and response	11 schools	13 schools
2.	Regular risk assessment toward disasters	8 schools	16 schools
3.	Teacher-training	5 schools	19 schools
4.	Evacuation plan	10 schools	14 schools
5.	Coordination with local fire department and medical center	15 schools	9 schools
6.	Supports from government	15 schools	9 schools

Total schools: 24 schools (Field survey, 2012)

From the data in **Table 5.2**, the schools' weak points in soft components of the preparedness can be explained as follows: firstly, in relation to special unit/person responsible for emergency preparedness and response, 13 schools had no special unit for disaster prevention; while 11 schools were prepared in having such kind of unit. Some reasons for the unprepared schools, as stated by the headmasters, were due to the rare occurrence of natural disasters, no clear job description among teachers dealing with natural disasters, a limited number of personnel at school, and no guidance from the government in setting up a special unit.

Special unit for emergency preparedness and response is very important in dealing with and anticipating the impacts of natural disasters in school environment. Emergency preparedness means taking action to be ready for emergencies before the disasters happen. The objective of emergency preparedness is to simplify decision-making during emergencies (USNRC, 2012).

Secondly, in relation to regular risk assessment, 16 schools did not conduct any regular risk assessment; 5 schools conducted risk assessment annually; 2 schools conducted risk assessment monthly; and only 1 school conducted it weekly. A headmaster stated that his school made a report on the result of regular risk assessment to the regency office monthly, while at schools without having any regular risk assessment, the headmasters confessed to doing risk-evaluation when there was a natural disaster only.

In addition, in relation to teacher-training, teachers in 9 schools seldom (only 2-3 times in a year) got training related to disaster prevention; teachers in 8 schools almost never (0-1 time in a year) had the training, and teachers in 2 schools completely never got the training. Only 5 schools had their teachers' often-got training (4-5 times in a year). In fact, this professional program is very important, because without sufficient understanding and knowledge of teachers, disaster prevention education program at school cannot be implemented effectively.

Moreover, in relation to the evacuation plan, among 24 schools, only 10 schools had a well-prepared evacuation plan; while 8 schools had poor, and 6 schools had no evacuation plan at all. Schools with the well-prepared evacuation plan should have at least six features of evacuation plan: detection of the problem area, decision, alarms, the control reaction of people, movement of the crowd to safety and transportation, as well as evacuation maps along with signs and symbols installed and, easily understood and identified by all school elements.

Headmasters of the schools with unprepared evacuation plan stated that their schools did not have any program and standard operational procedure (SOP) dealing with disasters; the schools just adapted to situation and condition whenever any disaster happened; and so far, the schools had not experienced serious natural disaster, except 2010 Merapi volcano eruption when all people in the area were evacuated by the government. Evacuation is necessary before, after or during a disaster (Ronaldo, 2011) and a well-established evacuation plans hasten the process of evacuation and thus can save more individuals.

In another side, the strong points of soft components in the school preparedness based on the **Table 5.2** can be described as follows: first, in relation to coordination with local fire department and medical center, 15 schools made good coordination with them. Seven schools had fair coordination, and 2 schools were evaluated to be having poor coordination. In this perspective, coordination, communication, and collaboration of schools with public health and medical partners during all four phases of emergency management (preparedness, response, recovery, and mitigation) are very important.

Secondly, in relation to support from government, 15 schools got sufficient support, while 9 schools got only some and few support respectively. As stated by the headmasters, the forms of government support given to schools were things as posters and books on natural disasters for school libraries, communication equipment, and other tools related to the evacuation process. The schools were also given financial assistance for class room building-renovation, disaster drills and training program.

5.1.2.2. Hard Components

The findings related to hard components of the school preparedness based on the headmasters' perception are shown in **Table 5.3.**

Table 5.3 Schools preparedness related to hard components

NO	HARD COMPONENTS	GOOD SCHOOLS	CRITICAL SCHOOLS
1.	Emergency supply kits	9 schools	15 schools
2.	Emergency exits	2 schools	22 schools
3.	Building construction	19 schools	5 schools

Total schools: 24 schools (Field survey, 2012)

Weak points of the hard components in the school preparedness based on the **Table 5.3** can be clearly explained as follows:

First is related to emergency supply kits. A good school with at least 100 students in total should have at least three boxes of emergency supply kits. Each box is for two grades students (grade one and two, three and four, five and six). The boxes contain a number of medicine and other emergency equipment and they are stored either in the cupboard of the school health center room or in the teachers' room.

It was found out that among the 24 primary schools, only 9 of them had sufficient emergency supply kits; 10 schools had some, and 5 schools had few emergency supply kits. For schools with enough amounts of emergency supply kits, the headmasters mentioned that there was enough medicine supplies kept in the boxes of the school health center room. They confirmed that the emergency supply kits were among others: betadine and revanol (liquid wound cleaner), vicks vabroub and paracetamols (kids fever medicine), eucalyptus oil (stomachache healer), cotton, gauze, and handsaplas (solid wound protection).

Headmasters of the schools with few emergency supply kits stated that the very limited amount of supply kits stored in only one box was not for anticipating natural disasters, but it was prepared for small accident or illnesses among students, and the school had not yet had a health center room, either. Headmasters of the schools with few emergency supply kits, in detail mentioned that, although the number of the students reached to 100 in total, the schools only had a single small bottle of betadine and revanol, a pack of vicks vabroub and paracetamols, a small bottle of eucalyptus oil, cotton, gauze, and handsaplas which were kept in a box inside the cupboard of the teachers' room.

To enhance school preparedness, it is necessary for the schools to have emergency supply kits. This supply kits may be stored in a portable place and should contain a stockpile of essential emergency supplies. It can be in the form of backpacks or buckets kept in a secure and readily accessible location that can be easily taken and carried out of school in case of an emergency (The Emergency Response and Crisis Management (ERCM) Technical Assistance Center, 2006)

Secondly, in relation to emergency exits, only 2 schools had many (more than 4) emergency exits; and 10 schools had some (more than 2) emergency exits. Two schools had few (more than 1) emergency exits, and 10 schools had no emergency exits. Two schools did not give any response to this issue. Headmasters of the schools with no emergency exits stated that the schools only had common doors of the classrooms and one main school gate.

The strong point of hard component in the school preparedness was only in terms of the school building construction quality. Criteria used by the headmasters to self-assess their school building quality are shown in **Table 5.4.**

Table 5.4 Criteria of school building construction-quality

CLASSIFICATION	PHYSICAL ASPECTS	MAINTENANCE STATUS FOR FACILITIES AND EQUIPMENT
Good Schools	Condition of building site, facility structure, painting, flooring, windows, etc., school utilities (water, electricity, etc.), ceilings and roofs, and school furniture was on level A	- Facilities are kept very clean - Materials are posted in classrooms and the teachers' room, and rooms are nicely decorated. - Broken furniture is immediately removed and replaced with new one. - Students, teachers and community members participate in repair and cleaning activities. - Local communities provide labor, equipment and funds for repair and maintenance.

Fair Schools	Condition of building site, facility structure, painting, flooring, windows, etc., school utilities (water, electricity, etc.), ceilings and roofs, and school furniture was on level B and C	- Facilities are kept reasonably clean. - Some of the broken furniture is left as it is. - Part of the lavatory section is closed. - Funds for building additional facilities or remodelling facilities are used for maintenance.
Bad Schools	Condition of building site, facility structure, painting, flooring, windows, etc., school utilities (water, electricity, etc.), ceilings and roofs, and school furniture was on level D and E	- Facilities are dirty and trash is found here and there. - Broken furniture and equipment is left as it is in the classroom and is never replaced. - Lavatories are broken. - Teachers are not willing to work with, and lack close ties with local communities.

Source: Ministry of National Education and special assistance for project sustainability (SAPS) reports, in 2002

Standards for levels A to E are qualitative, and judgment standards are established for each item. For all items, level A denotes that facilities are in a good condition, and the degree and types of problems broaden as the scale goes down from level B to level E.

Figure 5.1 Typical school buildings in the research site

Among the 24 primary schools, it was found out that 19 schools had good quality in building construction and 5 schools had fair quality of the building construction.

Headmasters of the schools with good buildings-quality, in more detail, stated that, recently their schools were newly-renovated by local government based on the national standard in order to be disasters resistant. Furthermore, some schools had been already physically examined by local authorities to have the required national standard. Meanwhile, headmasters of the schools with fair building-quality specifically confessed that, some classrooms in their schools were built without appropriate foundation so that they were risky of being collapsed anytime when a big natural disaster hits the area.

5.1.2.3. Relationship between the School-Risk and the Preparedness

After statistically checked (the cross table between subdivided risk level and preparedness level) by Fisher's exact test (extended), it was found out that the frequency of subdivided risk level to Merapi volcanic eruption was associated with the school preparedness level (value=10.586, p=0.041). It meant that the higher was the risk, the better school preparedness was required.

Table 5.5 Relationship between the risk-level and the school preparedness

		School preparedness				
		Good Sc & Hc	Critical Sc	Critical Hc	Critical Sc & Hc	Total
School risk level	Rl	0	1	0	1	**2**
	Rm	3	11	1	2	**17**
	Rh	3	0	0	2	**5**
	Total	**6**	**12**	**1**	**5**	**24**

Sc= Soft components Rl=relatively lower Rh=relatively higher
Hc=Hard components Rm=relatively middle

5.2. Teachers' Performance in Teaching Disaster Prevention

In this study, to assess the teachers' performance in teaching the disaster prevention based on their perceptions, the teacher respondents were given 10 main statements to be responded by choosing one of the alternative options: strongly disagree (SD), disagree (D), agree (A), or strongly agree (SA). The statement are related to the teaching materials and media (number 1 and 8), teaching method (number 2 and 5), teaching contents (number 3 and 4), knowledge and teaching ability (number 6 and 7), as well as evaluation and students' motivation in learning natural disasters and prevention-related content (number 9 and 10).

Table 5.6 shows the frequency distribution of the teacher respondents' answers in the questionnaire.

Table 5.6 The frequency distribution of the teacher respondents' answers in the questionnaire

STATEMENTS	RESPONSE			
	SD (%)	D (%)	A (%)	SA (%)
1. I use textbooks or modules to teach children about natural disasters and prevention.	22	6	60	12
2. I would rather teach about natural disasters alone than integrate it to the main subject such as natural science and social science.	2	60	31	7
3. I have ever taught about earthquake and volcanic eruption to my students.	1	5	68	26
4. I never teach about flood and landslides to my students.	25	61	12	2
5. I only use chalk and talk when teaching about natural disasters.	12	73	14	1
6. I still lack of knowledge about natural disaster prevention.	2	11	78	9
7. I can effectively integrate the natural disaster-related content to my teaching subjects.	1	22	69	8
8. I use media for teaching students about natural disasters prevention.	1	8	74	17
9. I check the students' learning understanding on disasters prevention lesson.	1	6	76	16
10. My students have motivation to learn disaster prevention.	2	3	87	8

Note: 100% of the responses in each item only refer to the teacher respondents who gave the answers (no answer teachers were ignored), Field survey, 2012

Based on the data in **Table 5.6**, among the teacher respondents who gave the answer for each statement, it was noted that: first, in relation to teaching materials and media, for the lesson of natural disaster and prevention, 72% of the teachers used textbooks or modules, and 91% of the teachers used teaching media. The textbooks or modules that the teachers used were supplied either by the government or non-governmental organization (NGO) like Muhammadiyah Disaster Mitigation Centre in Yogyakarta City. The common teaching media used by the teachers based on their choice were pictures, maps, video/movie, and toys/puppets.

The usage of text-books or modules among the teachers (statement number 1) had a significant correlation with the usage of teaching media (statement number 8). It was evidenced by the Fisher's exact test (extended) in which the correlation coefficient was 0.000 (less than 0.001).

In more detail, **Table 5.7** showing the relationship between the usage of textbook and teaching media is presented as follows:

Table 5.7 Cross table of textbook and teaching media

		The use of teaching media				Total
		Pictures	Map	Toys	Video/ Movie	
The use of textbook	Strongly disagree	2	1	0	1	4
	Disagree	25	15	2	10	52
	Agree	**70**	45	14	30	159
	Strongly agree	**13**	8	4	10	35
Total		110	69	20	51	250

Source: Field survey, 2012

In the questionnaire, the teachers could choose teaching media more than one which based on the data in **Table 5.7**, most of them (110) chose picture as their teaching media. The frequency of the teacher respondents who strongly agreed and agreed to use textbook and pictures was the highest one (83) compared with those who used textbook with map, textbook with video/movie, and textbook with toys.

Secondly, in relation to teaching method, there were the teachers who adopted integrated teaching of disaster prevention. It was evidenced that 78 of them agreed to the statement number 7: *"I can effectively integrate the natural disaster content to my teaching subjects"* while disagreed with the statement number 2: *"I would rather teach about natural disasters alone than integrate it to the main subject."* Interview with 4 teachers also supported this finding (see **Table 5.8**).

Figure 5.2 Interviewing teachers

Table 5.8 Teachers' response in the interview regarding the teaching method

QUESTIONS	TEACHERS' RESPONSES
When delivering information regarding disaster prevention including Merapi volcanic eruption to the students, do you use specified time or you do it while teaching the main subject?	**Teacher 1 (teaching grade 5 students):** *"I often do that within Social Studies subject. Some topics in that subject have relation with natural disasters."* **Teacher 2 (teaching grade 5 students):** *"I integrate the disasters-related learning content with the main teaching subjects such as Social Studies and Moral Education."* **Teacher 3 (teaching grade 6 students):** *"When I teach Indonesian language subject, sometimes we discuss texts about natural disasters for example about Merapi eruption to make the students more aware about how to act in the event of disaster."* **Teacher 4 (teaching grade 4 students):** *"I teach disaster-related content not as a separate subject, but I do it within the main teaching subjects."*

Table 5.9 explained the usage of textbook in the integrated teaching of disaster prevention.

Table 5.9 The usage of textbook in the integrated teaching

		Integrated teaching practice				Total
		Strongly disagree	Disagree	Agree	Strongly agree	
The use of textbook	Strongly disagree	0	3	0	1	4
	Disagree	2	20	22	2	46
	Agree	0	17	**87**	5	109
	Strongly agree	0	2	13	5	20
Total		2	42	122	13	179

Source: Field survey, 2012

Data in **Table 5.9** showed that among the 179 teacher respondents who gave the answer, 135 teachers chose integrated teaching method in which 87 respondents in this group agreed to use text-book. This finding was strengthened with the data in **Table 5.10** which explained the usage of textbook in the isolated teaching.

Table 5.10 Cross table of the usage of textbook in the isolated teaching

		Isolated teaching practice				Total
		Strongly disagree	Disagree	Agree	Strongly agree	
The use of textbook	Strongly disagree	1	3	0	1	5
	Disagree	3	12	31	1	47
	Agree	4	36	**68**	0	108
	Strongly agree	4	7	8	1	20
Total		12	58	107	3	180

Source: Field survey, 2012

Based on the data in **Table 5.10,** among the 180 teacher respondents who gave the answer, it was found out that 110 teachers strongly agreed and agreed to use isolated teaching method in which 68 of them agreed to use textbooks.

Table 5.11 shows the consistency of the teachers in using the teaching methods.

Table 5.11 Cross table of integrated and isolated teaching methods.

		Integrated teaching practice				Total
		Strongly disagree	Disagree	Agree	Strongly agree	
Isolated teaching practice	Strongly disagree	1	3	1	6	11
	Disagree	0	17	**39**	0	56
	Agree	1	**20**	**78**	6	105
	Strongly agree	0	1	1	0	2
Total		2	41	119	12	174

Source: Field survey, 2012

Data in **Table 5.11** showed that among the 174 teacher respondents, who gave the answer, 39 teachers were consistent in using integrated teaching method and 20 teachers were consistent in using isolated teaching method.

Third, in relation to teaching topics content, 94% of the teachers stated to have already introduced earthquake and volcanic eruption topics to the students; while 86% of them had already taught about flood and landslide topics. In addition, in relation to their professional capacity in teaching, 87% of the teachers admitted that they still lacked knowledge about natural disaster prevention. Furthermore, in relation to evaluation, 92% of the teachers checked their students' understanding toward the materials they have learnt.

Finally, when being asked about their students' motivation in learning disaster prevention, 33 (17%) teachers stated that their students' learning motivation was very strong; 83 (43%) teachers had their students' motivation was strong; 15 (8%) teachers had their students' motivation was fair and only 1 (0.5%) teacher had his/her students' motivation was low.

5.3. Disaster Prevention Education from Students' Point of View

5.3.1. Students' Experience to Natural Disasters

The research findings indicated that besides Merapi volcanic eruption, there were three other common associated natural disasters to the volcanic eruption that the students of grade five had experienced within their living area: earthquake, mud flood, and landslide as shown in **Table 5.12.**

Table 5.12 Frequency of students' experience to natural disasters

No	Natural Disasters	Experience frequency and number of students			
		0 times (N)	1-3 times (N)	4-6 times (N)	>6 times (N)
1.	Volcanic eruption	10	532	5	1
2.	Earthquake	55	474	16	3
3.	Mud flow	200	194	56	98
4.	Landslide	529	18	1	0

Source: Field survey, 2012

Table 5.13 shows the confessions of 5 students through an interview in one primary school in Banaran village of Cangkringan district about their experience on 2010 Merapi eruptions.

Figure 5.3 Interviewing affected students by Merapi eruptions

Table 5.13 Students' confessions on their experience during 2010 Merapi eruption

NO	STUDENTS' NAME	EXPERIENCE IN OCTOBER 2010
1.	R (female)	*"That night I was sleeping with my parents. I heard "roaring" voice from the volcano. When I woke up, from the window I also saw red flash on air. At that time my father tried to go out, but as soon as he opened the door, he stepped on the hot lava on the ground. He got injured. In Friday morning, SAR team brought us to the refugees camp and then to the hospital in order to care of my father."*
2.	T (male)	*"On Thursday I did not go to school. My family decided to evacuate to Klaten. My mother was being pregnant at that time. We went to Klaten by a motor bike and saw many people on the road. We stayed in Klaten for 5 weeks. Our home was not damaged; but we had to stay in the shelters."*
3.	F (male)	*"My family and I went to evacuate bringing our important belongings. We took a truck provided by the government. We lived in our relative' house. In the evening we saw pyroclastic flows. My house was fired."*
4.	R (female)	*"That night we went to evacuate to the village hall. One day later my family decided to move to another village, in our relative' house. We stayed there for 4 weeks. Then we moved to the shelter provided by the government. At that time, from home I could see pyroclastic flows. The day became dark and very hot.*
5.	D (female)	*"On Thursday people were panic. I did not go to school. My house is near a river. We moved to our grandmother' home. We watched TV about the Merapi eruption news and saw the river; many people were there. On Thursday mid-night, when my mother was praying, we heard warning for evacuation. We went to evacuate; but unfortunately our neighbor, an old woman and her grandson was killed because they failed to evacuate. My house' windows were broken and the roof of the cattle' cage was also damaged. Our cow died. Since then, we had to leave our house and stay in a new home provided by the government."*

In relation to the damage level of their homes and schools due to Merapi volcanic eruption in 25th October 2010, 325 students found their homes safe, 149 students found their homes partly damaged, and 66 students found their homes seriously damaged; while 319 students

noticed their school was safe, 158 students found their school was partly damaged, and 67 students noted their school was seriously damaged.

5.3.2. Students' Learning Experience about Disasters Prevention

Students of grade five in the researched schools had formally learnt about natural disasters and prevention with their teachers since they were in kindergarten. The common topic learning contents based on their answers in the questionnaire were among others: volcanic eruption, earthquake, flood, typhoon, and tsunami.

Table 5.14 Grades of the students' learning about natural disasters and prevention

No	Topics	Grades						
		Kindergarten	1	2	3	4	5	6
1.	Volcanic eruption	✓			✓	✓		
2.	Earthquake	✓	✓		✓	✓	✓	
3.	Flood and Typhoon	✓	✓	✓	✓	✓	✓	
4.	Tsunami						✓	

Source: Field Survey, 2012

At primary schools, the students learned about natural disasters and prevention in the integrated lessons of Natural Science, Social Studies, Sport/Physical education, Religion/Moral, and other subjects. Moreover, beside at school, the students also got information about natural disasters from TV, radio, newspapers, family, neighbor, and internet.

Table 5.15 Students' learning sources for disaster prevention

SCHOOL EDUCATION	(%)	ADDITIONAL INFORMATION	(%)
Natural Science	63	TV	31
Social Studies	20	Radio	18
Sport	6	Newspaper	16
Religion/Moral	6	Family	13
Others	5	Neighbor	13
		Internet	10

Source: Field survey, 2012

5.3.3. Students' Achievement in Learning Natural Disasters and Prevention

As it has been mentioned, the students' achievement in this study refer to their knowledge (statement number 1-6), perceived attitude (statement number 7-13), and perceived behavior (statement number 14-20) in natural disasters and prevention.

Table 5.16 described the frequency of the students' responses in the questionnaire.

Table 5.16 Frequency of the students' responses in the questionnaire

STATEMENTS	RESPONSE (N: 548)		
	Agree (%)	No Idea (%)	Disagree (%)
1. When a big earthquake occurs, running out of home is very dangerous to do.	56	6	38
2. Hot ashes from Merapi volcano are not dangerous for health.	12	4	84
3. Big earthquake can cause house fire.	49	11	40
4. A big earthquake sometimes is followed by volcanic eruption.	71	19	10
5. Frequent raining can cause flood and landslide.	86	10	4
6. When there are many animals going down from the mountain, it is one of the signs that Merapi volcano will erupt.	78	14	8
7. I think watching weather forecast is useless.	7	7	86
8. I think joining disaster training is useful.	94	3	3
9. When there is a super natural person says that tomorrow there will be a disaster in my living area, I believe it.	7	28	65
10. I think we need to plant trees in bare hills.	98	1	1
11. I am aware that my living area is prone to natural disasters.	70	20	10
12. I think humans' misbehaviours can make God angry and result in disasters.	62	23	15
13. I think colleting photos, pictures on natural disaster is useful for learning.	79	9	12
14. When there is a warning from authorities that Merapi Volcano will erupt and my family is advised to evacuate, my family and I just stay at home.	3	3	94
15. When there is a big earthquake, indoor I hide under a strong table.	90	4	6
16. I dispose garbage to rivers.	4	5	90
17. I discuss with family about information on natural disaster prevention that I have got from school.	80	14	6

18. I wear masker when Merapi Volcano is erupting.	98	2	0
19. My family and I keep important documents in a safe box.	90	6	4
20. I often read books about natural disasters.	78	12	10

Source: Field survey, 2012

Data in the **Table 5.16** showed that: first, in relation to the students' knowledge; 84% of the students understood that hot ashes from Merapi volcano could be dangerous for health, with the evidence that during Merapi volcanic eruption, 98% of the students admitted to wearing maskers to protect themselves from the ashes. In addition, 86% of the students were aware that frequent rains could cause flood and landslides. However, the findings also showed the students' poor knowledge regarding the consequences of a big earthquake, such as 44% of the students did not know that running out of home during a big earthquake was dangerous to do; that a big earthquake could cause a house fire (51%); that a big earthquake was sometimes followed by volcanic eruption (29%); and that the phenomenon of many animals going down to people's settlement was one of signs that the volcano might erupt (22%).

Secondly, in relation to the perceived attitudes toward natural disaster and prevention, 86% of the students felt the importance of watching weather forecast program as well as joining disaster training or drill (94%).

Table 5.17 shows examples of the reasons by the students why they think that joining disaster training or drill is useful. Among 17 students in one of the 24 primary schools which are located in Umbulharjo village of Cangkringan district, 15 of them wrote their logical reason as the following:

Table 5.17 Students' reasons for their agreement to statement number 8 in the questionnaire

STATEMENT	REASONS BY EACH STUDENT RESPONDENT (IDENTIFIED BY NUMBER)
I think joining disaster training is useful	S36: In order that when there is disaster, we can save ourselves. S37: By joining it, we will get important knowledge and experience. S38: It can save community. S40: Because it is very important for us to face disaster. S41: It will make us act properly in facing disaster. S43: It will enable us to anticipate the coming disaster.

	S44: It will make us aware about disasters that may happen within our living area. S45: In order to be able to save ourselves when the disaster happens. S46: In order that any time a disaster happens, we will not be confused to take an action for saving our lives. S47: In order to understand the phenomena before a disaster happens and to save our lives. S48: In order to know the characteristics of disasters. S49: In order to understand many things about disasters. S50: In order to be able to anticipate disasters. S51: We can practice to work together in the event of disaster. S52: In order to know when and where we should evacuate during the event of disaster.

The problems regarding the students' perceived attitudes are as follows: 30% of them were not aware that their living area was prone to natural disasters; 35% of them still believed about the myth of supernatural being prediction regarding natural disasters within their area, and 38% of them did not realize that humans' misbehaviours could anger God and result in disasters.

In relation to their perceived behavior, it was noted that during disaster events, 94% of the students together with their family members followed the warning from the government to evacuate. Ninety percent (90%) of the students also hide under a strong table when they were indoor in the event of an earthquake; 90% of the students admitted to keeping important documents in a safe box and did not dispose of garbage to rivers.

Table 5.18 shows examples of the reasons by the students why they had to follow the government command for evacuation before Merapi volcanic eruption. Among 11 students in one of the 24 primary schools which are located in Turi village of Turi district, they wrote their logical reason as the following:

Table 5.18 Students' reasons for their disagreement to statement number 14 in the questionnaire

STATEMENT	REASONS BY EACH STUDENT RESPONDENT (IDENTIFIED BY NUMBER)
When there is a warning from authorities that Merapi Volcano will erupt and my family is advised to evacuate, my family and I just stay at home.	S55: When we keep staying at home, we can get impact of volcanic ash and lahar. S56: In order to be safe from the impact of eruption. S57: If we do not evacuate, we can be killed. S58: It would be very dangerous for us if we did not go to evacuation. S59: When we just stay at home, I am afraid something bad could happen to us. S60: In order that my family is safe from the danger of eruption. S61: When we did not evacuate oourselves, we could be attacked by pyroclastic flow. S62: Staying at home will endager ourselves. S63: It is too dangerous to stay at home when Merapi is erupting. S64: Evacuating is one of the best way for escaping from the death by eruption. S65: It is too dangerous to stay at home.

The problems regarding the students' perceived behavior are as follows: 20% of the students did not discuss or share the information about natural disasters that they have got from school to their family, and 22% of them did not often read books which are related to natural disasters and prevention.

5.4. Improving Students' Knowledge, Attitude, and Behavior in Disaster Prevention

In order to solve the problems regarding the students' knowledge, attitude, and behavior, an effort by the researcher through experimental teaching toward the improvement of the students' effective knowledge, attitude, and behavior in natural disasters and prevention had been already conducted in November 2012.

5.4.1. Research Framework

The framework of this research is shown in **Fig. 5.4**.

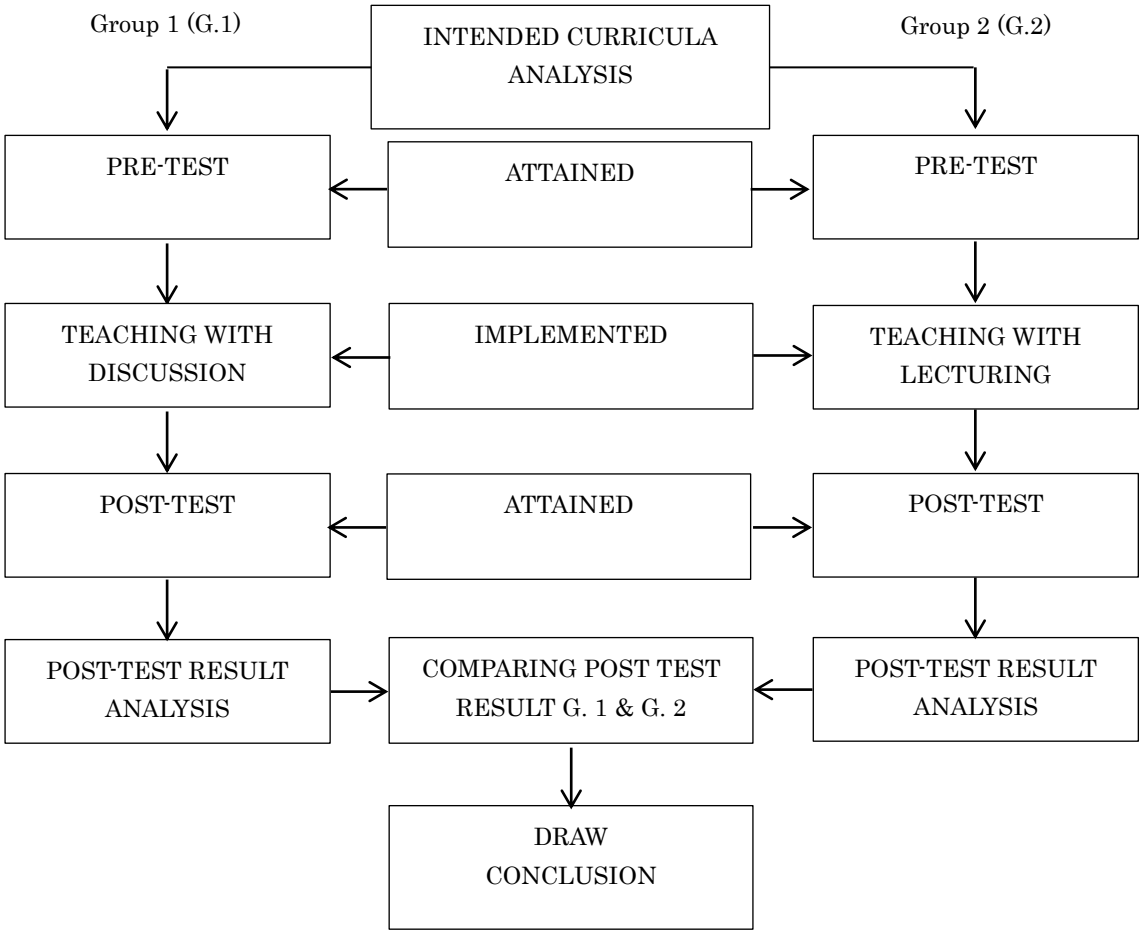


Figure 5.4 Research framework

Research was developed through experimental disaster prevention teaching in the topic of volcanic eruptions for students of the fifth grade in two purposely selected primary schools in the Cangkringan District, Sleman Regency of Yogyakarta Special Region Province. Cangkringan is one of the disaster-prone districts highly affected by Merapi eruptions. School 1 had two classes -- A.1 and A.2 -- and school 2 similarly had class B.1 and B.2. Each class consisted of 19-30 students. The total number of students participating in this research was 89.

The two schools were selected based on their relatively similar distance to the Merapi volcano (**Fig.** 5.5). School 1 is located about 10 km from the volcano and about 500 m from the Opak River. This school had 10 teachers and 122 students. During the 2010 Merapi volcano eruption, all teachers and students in this school, together with their families, were evacuated and stayed in government refugee camps.

School 2 is located about 11 km to the peak of Merapi volcano and surrounded by Kuning and Opak Rivers, which are often flooded by the lahar from the volcanic eruptions. The

school had 11 teachers and 156 students in total. Based on the interview data with the headmaster, during 2010 Merapi volcano eruption, all teachers and students in this school, together with their family members also had to evacuate and stayed in refugees' camps provided by the government. In terms of its preparedness toward the volcanic eruption disasters, school 2 was examined to lack of in service teacher training for disaster prevention.

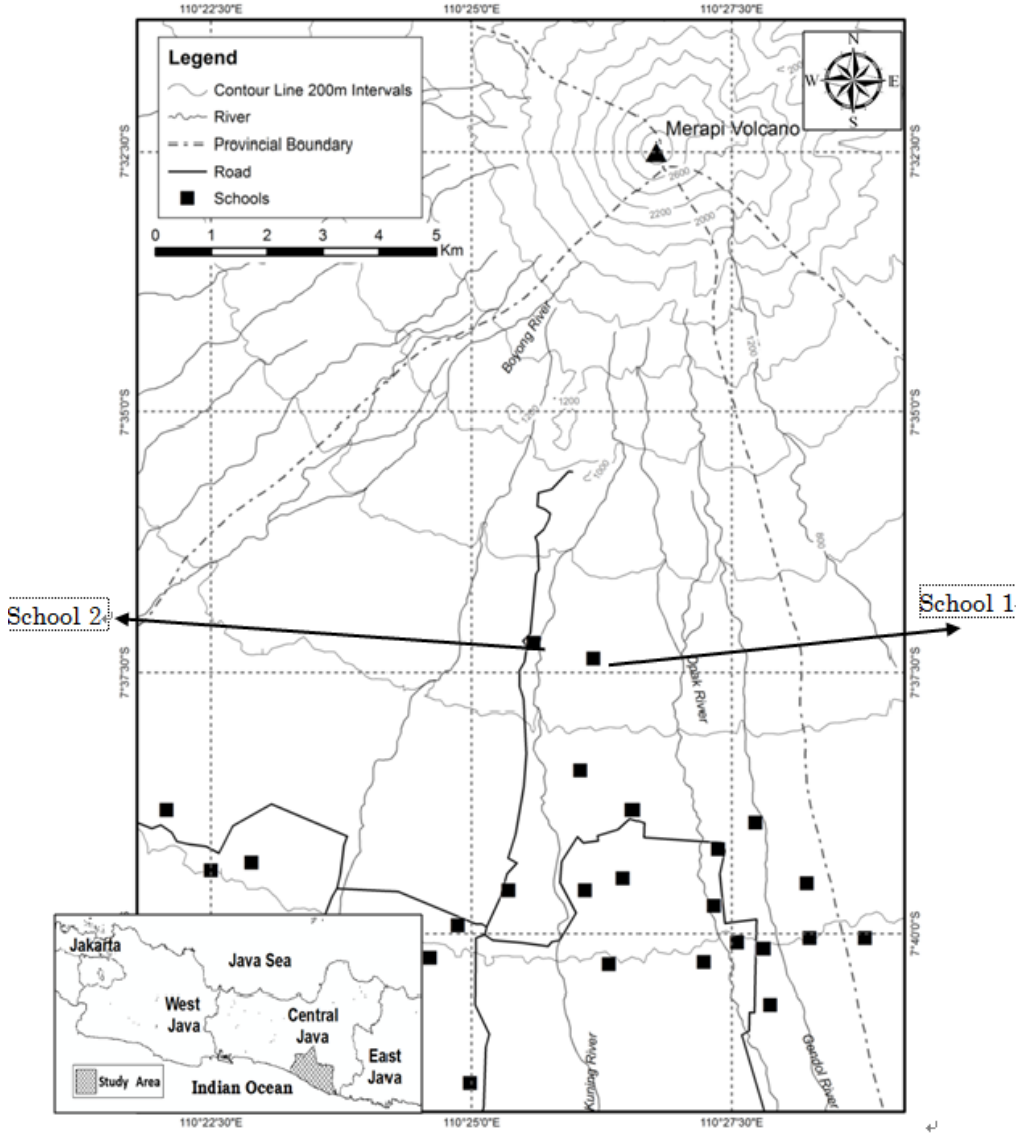


Figure 5.5 The two schools' location

Research used identical pre-test and post-tests. Pre-tests were conducted before teaching experiments to determine the current level of student knowledge, attitudes, and behavior in regard to natural disasters and for preparing experimental and control groups based on performance; while post-tests were conducted after experimental teaching for the purpose of measuring change in the performance of the two groups.

The pre- and post-test questionnaire had 10 statements. Students had to respond to each statement in the questionnaire by choosing agree (A), not certain (NA), or disagree (D),

followed by a brief written reason for each answer in the column provided. Statements fell into three aspects: student knowledge (number 1, 5, 6, and 10), attitude (number 3, 7, and 8), and behavior (number 2, 4, and 9), as described in **Table 5.19.**

Table 5.19 Distribution of the statements for each aspect in the questionnaire

ASPECTS AND STATEMENTS	
Knowledge	
Item no. 1	When a big earthquake occurs, running out of home is very dangerous to do.
Item no. 5	A big earthquake can cause house fire.
Item no. 6	A big earthquake is sometimes followed by volcanic eruptions.
Item no. 10	When there are many animals going down from the mountain, it is one of the characteristics that Merapi volcano may erupt.
Attitude	
Item no. 3	When there is a super natural person says that tomorrow there will be a disaster in my living area, I believe it.
Item no. 7	I am aware that my living area is prone to natural disasters.
Item no. 8	I think humans' misbehaviours can make God angry and result in disasters.
Behavior	
Item no. 2	When there is a big earthquake, indoor I hide under a strong table.
Item no. 4	I discuss with family about information on natural disaster prevention that I have got from school.
Item no. 9	I often read books about natural disasters.

In school 1 classes A.1 and A.2, students had integrated disaster prevention lessons within the main school subject of Indonesian language using discussions, with group 1 as the experimental group. In school 2 classes B.1 and B.2, students had the same lessons as students in school 1 but using lectures, with group 2 as the control group. Both groups were taught by the same teacher using the same topic and contents about the Merapi eruption, each for 2 periods totalling 70 minutes (2 lessons, each 35 minutes long). Pre-tests, experimental teaching, and post-tests in group 1 were conducted on November 28, 2012, and in Group 2 on November 29, 2012.

The disaster prevention teaching used pictures presented on PCs, while for main teaching materials, the teacher used 2 newspaper articles from the online Detik newspaper dated November 9, 2010, concerning the conditions of refugees and villagers in the Sleman Regency during the 2010 Merapi volcanic eruption. The first news article described psychological tensions experienced by local residents in refugees' shelters in the Maguwoharjo Sport Stadium in the Sleman Regency. It also described Red Cross non-government organization activities to set up special classes for child refugees to continue their schooling and to minimize their disaster-based stress. The second news article described conditions in the village nearest to the Merapi peak, i.e., Kepuhharja village, half of which was destroyed when the volcano erupted.

After being given a lecture about volcanic eruptions using pictures, students in the lecture group read news passages individually, while students in the discussion group read and discussed news passages in each group of 4-5 students. Students in both groups were then given 7 questions on the teacher's lecture and the news passages. Lecture group students answered questions individually on their notebooks, without helping each other; while discussion group students discussed questions and put answers on a report sheet.

Figure 5.6 Students' learning activities under discussion method

After answering all questions, the teacher asked individual students to write answers on the blackboard one by one; to check whether answers were correct, letting students comment on the answer. In the discussion group, the teacher acted as a moderator, letting each group in turn present answers orally in front of the class. While one group was presenting an answer, other groups were listening and commented on the answer. At the end of both lessons, the teacher summarized answers and drew conclusions.

Table 5.20 presents the comprehension questions for both groups.

Table 5.20 List of comprehension questions by the teacher in the experimental teachings

NO	QUESTIONS
1.	Beside the volcano mentioned in the text you have read, mention at least five other volcanoes in Indonesia and the province where they are located!
2.	In 2010, in what dates did Merapi volcano erupt?
3.	Volcanic eruption is very dangerous for human beings; mention at least five hazards which are caused by Merapi volcanic eruptions?
4.	Describe briefly the sufferings experienced by the local people due to Merapi volcanic eruptions!
5.	What are the names of the two rivers near Merapi volcano mentioned in the text and explain why those rivers were dangerous when Merapi volcano was erupting!
6.	Describe the condition of the refugees in the shelters during 2010 Merapi volcanic eruption!
7.	Explain what did you and your families do when Merapi volcano would erupt, while it was erupting, and after it had erupted in 2010!

Pre-test and pos-ttest results in the experimental and control groups were then analyzed statistically to draw conclusions for the research.

5.4.2. Research Findings

Table 5.21 shows the students' response frequency distribution for each statement item in the pre-test together with its p-value (all groups).

Table 5.21 The students' response frequency distribution in the pre-test for all groups

Statement number		Discussion Group (%)			Lecturing Group (%)			p value
		Disagree	NA	Agree	Disagree	NA	Agree	
KNOWLEDGE	No.1.	77.50	2.50	20.00	83.70	0.00	16.30	0.494
	No.5.	52.50	20.00	27.50	53.10	34.70	12.20	0.496
	No.6.	20.00	15.00	65.00	26.50	16.30	57.10	0.427
	No.10.	15.00	5.00	80.00	12.20	24.50	63.30	0.167
ATTITUDE	***No. 3.***	***77.50***	***20.00***	***2.50***	***57.19***	***32.70***	***10.20***	***0.036***
	No. 7.	27.50	15.00	57.50	18.40	12.20	69.40	0.235
	No. 8.	***32.50***	***15.00***	***52.50***	***6.10***	***12.20***	***81.60***	***0.001***
BEHAVIOR	No. 2.	10.00	0.00	90.00	6.10	2.00	91.80	0.739
	No. 4.	10.00	5.00	85.00	16.30	6.10	77.60	0.366
	No. 9.	7.50	2.50	90.00	6.10	6.10	87.80	0.775

Based on the statistical analysis of pre-tests for the two groups using an independent-samples Mann Whitney U test, p values showed that among 10 statements in total, statement 3 and 8 were found to be significantly different, meaning that from the beginning, the two groups already differed in attitude regarding their belief in supernatural prediction about natural disasters and the relationship between human misbehaviour and natural disasters.

Pre-test statement 3: *When a supernatural being says that tomorrow there will be a disaster in my living area, I believe it ($p= 0.036<0.05$).*
Pre-test statement 8: *I think human misbehaviour can anger God and result in disaster ($p=0.001<0.05$).*

Regarding response frequency distributions for statement 3, it was noted that the number of students in the discussion group who disagreed with the prediction of a supernatural being about natural disasters -- 77.50% -- was higher than the number of students in the lecture group who disagreed with-- 57.19%.

Regarding the response frequency distribution for statement 8, it was noted that the number of students in the lecture group who agreed with the relationship between human misbehaviour and natural disasters -- 81.60% -- was relatively higher than the number of students in the discussion group who agreed with--52.50%.

Table 5.22 shows the students' response frequency distribution for each statement item in the post-test (all groups).

Table 5.22 The students' response frequency distribution in the post-test for all groups

Statement number		Discussion Group (%)			Lecturing Group (%)			p value
		Disagree	NA	Agree	Disagree	NA	Agree	
KNOWLEDGE	No.1.	50.00	2.50	47.50	65.30	0.00	34.70	0.173
	No.5.	***50.00***	***12.50***	***37.50***	***8.20***	***10.20***	***81.60***	***0.000***
	No.6.	27.50	15.00	57.50	24.40	20.40	55.10	0.967
	No.10.	17.50	5.00	77.50	16.30	6.10	77.60	0.973
ATTITUDE	No. 3.	80.00	17.50	2.50	71.40	20.40	8.20	0.311
	No. 7.	***27.50***	***10.00***	***62.50***	***12.20***	***6.10***	***81.60***	***0.041***
	No. 8.	***32.50***	***10.00***	***57.50***	***14.30***	***4.10***	***81.60***	***0.015***
BEHAVIOR	No. 2.	5.00	2.50	92.50	2.00	0.00	98.00	0.223
	No. 4.	5.00	7.50	87.50	10.20	10.20	79.60	0.311
	No. 9.	2.50	10.00	87.50	10.20	0.00	89.80	0.851

Based on statistical analysis of post-tests for the two groups by using the independent-samples Mann Whitney U test, p values showed that there were two statements significantly different related to students' knowledge and attitude (statement 5 and 7).

Post-test statement 5: *A big earthquake can cause a house fire ($p= 0.00 < 0.05$)*
Post-test statement 7: *I am aware that my living area is prone to natural disasters ($p= 0.041 < 0.05$).*

For statement 5, regarding students' knowledge about the consequences of a big earthquake regarding a house fire, the response frequency distribution of students in the lecture group from pre-tests to post-tests had changed more compared to students in the discussion group. It was noted that before being given experimental teaching classes, the number of students who agreed with statement 5 was only 12.20%. After lectures, the number of students who agreed with it increased to 81.60%.

For statement 7, regarding student attitudes about awareness of living in a disaster-prone area, the response frequency distribution of students in the lecture group from pre-tests to post-tests also became higher compared to students in the discussion group. Before teaching, the number of students who agreed with statement 7 was only 69.40%, but after lectures, the number of students who agreed with it increased to 81.60%.

For statement 8, although the p value (0.015) in the post-test indicated a significant difference between the two groups, the response frequency distribution of the two groups in the pre-test compared to the post-test did not change significantly.

Table 5.23 shows the result of non-parametric analysis with Wilcoxon signed-ranked test for each group.

Table 5.23 Result of non-parametric analysis for pre-post-tests with Wilcoxon signed-ranked test for each group

Statement number		p value for discussion group pre-post tests	p value for lecturing group pre-post tests
KNOWLEDGE	No.1.	***0.019***	***0.022***
	No.5.	1.000	***0.000***
	No.6.	0.302	0.815
	No.10.	1.000	0.454
ATTITUDE	No. 3.	1.000	0.143
	No. 7.	0.791	***0.039***
	No. 8.	0.774	1.000
BEHAVIOR	No. 2.	1.000	0.375
	No. 4.	1.000	1.000
	No. 9.	1.000	1.000

Based on the data in **Table 5.23**, it was found that learning in discussions and learning in lectures had significant changes or improvements regarding knowledge about appropriate actions indoors during a big earthquake (statement 1, with p values of 0.019 and 0.022). It was further found that students learning in the lectures also had significant changes in knowledge about the consequences of a big earthquake regarding a house fire (statement 5, p=0.000), and in attitude regarding awareness of living in a disaster-prone area (statement 7, p=0.039).

CHAPTER 6

DISCUSSION

This chapter discusses the research findings in the study. It consists of four parts through five phases of research: the School Preparedness to Merapi Volcanic Eruption, the Teachers' Performance in Disaster Prevention Lesson, the Students' Achievement in Learning Disaster Prevention as well as the Educational Merits of the Lecture and the Discussion Method for Improving the Students' Achievement in Learning the Disaster Prevention.

6.1. School Preparedness to Merapi Volcanic Eruption

Due to the geographical location which is close to the peak of Merapi volcano, all schools participating in the study are vulnerable to getting the negative impacts of the volcanic eruptions. Moreover, some of the schools are also near the rivers which are often flooded by the lahar from Merapi volcano and it, of course, makes them more vulnerable to being highly affected by the other related hazards of the eruption. Among the 24 schools, one school which is located in Cangkringan district was reported to be completely damaged by the 2010 Merapi volcanic eruption. A year later, with the financial assistance from Indonesia Telecommunication Company (Telkom) that damaged school was successfully renovated so that it can be used again.

Figure 6.1 Renovated school building by Telkom in Cangkringan district

Considering the vulnerability of the schools to the impacts of Merapi volcanic eruption disaster, ideally all the schools should have a good system of preparedness for anticipating such kind of natural disasters. And this condition can be accomplished when the headmaster of each school is aware of the school-risk to the eruption and he or she can effectively manage the preparedness system for anticipating the disasters.

This study revealed that not all the schools had good preparedness system to anticipate the impacts of the volcanic eruption. Using two parameters by looking at the soft and hard

components of the preparedness system based on the headmasters' perceptions, it was found out that there were only 6 schools having well-preparedness level with both good soft and hard components. These ideal schools had dominant characteristics, such as having a well-prepared special unit and evacuation plan, regular risk assessment, good coordination with local fire department and health center, sufficient support from government, and the teachers often got training related to disaster prevention education.

Thirteen schools still needed to improve the preparedness level due to either their critical soft or hard components: Eleven schools under relatively middle-risk level had shortage in soft components of preparedness and one school under this risk level had shortage in hard components; while one school under relatively lower risk level had shortage in soft component.

Five schools were categorized in the worst condition in their preparedness with both critical soft and hard components. The schools under such condition had major characteristics of having no or poor evacuation plan and no regular risk assessment, few supply emergency kits, and few or no emergency exits, little support from government, and the teachers were almost never trained about disaster prevention education.

This study implied that from the 24 schools, 18 schools should make efforts in order to improve their preparedness system to reach a good level for minimizing the impacts of volcanic eruptions and other natural disasters. Some shortages were relatively easy to be fulfilled by the schools for the improvement of the preparedness system, such as the development of an evacuation plan and regular risk assessment, as well as the addition of emergency supply kits, while some other shortages, due to the demand of big budget and professionals, could be fulfilled with the assistance from the government and private sectors, for example for conducting in-service teacher training on disaster prevention.

6.2. Teachers' Performance in Disaster Prevention Teaching

One of the most important factors in the success of disaster prevention education at schools is the teachers because they are the main actors in delivering knowledge and teaching the skills to the students to be able to cope with any disasters within their living area. Each natural disaster has its own characteristics which demand people to take certain actions in order to escape from its negative impacts. And it becomes teachers' responsibility to be aware of the occurrence of natural disasters within the students' living area and having sufficient knowledge of disaster prevention to be disseminated to the students.

The role of teaching media is important in the success of disaster prevention education; therefore, it is mandatory for teachers for being creative in making various kinds of appropriate teaching media to be effectively used for teaching. This study revealed that in teaching natural disaster prevention, the teachers mainly depended on the usage of text-books and modules; although some teaching media were also used by the teachers, such as pictures and maps. The cross table of the frequency distribution of the using text-book and teaching media showed that during the teaching process, most of the teachers used text-book and picture media.

There is a continuum of options for how to integrate disaster prevention education into school curricula. At one end are stand-alone courses devoted to the subject-matter and at the other hand is the infusion of lessons, activities, and problems into a broad range of course materials at every grade level. In Indonesia itself, because the schools curricula have already put many subject matters, it is recommended the disaster prevention education to be integrated within the main teaching school subjects and not to be considered as the separated subject matter.

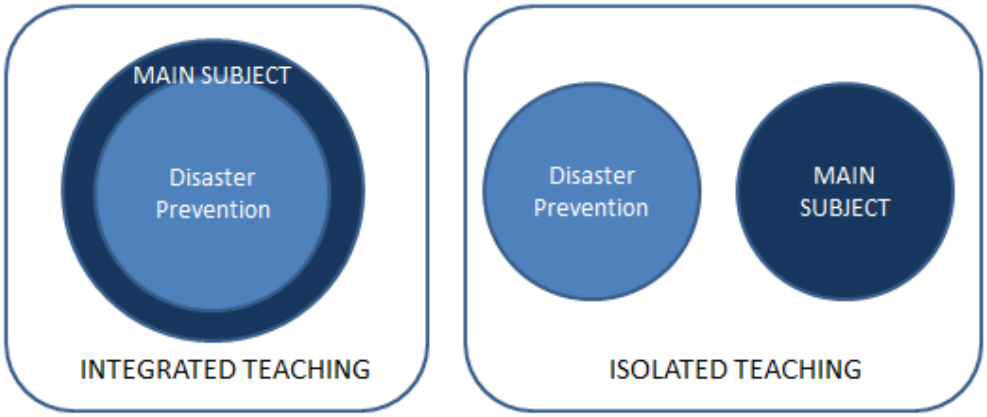


Figure 6.2 Integrated vs. isolated teachings

This study found out that among 174 teacher respondents who gave the answer, there were only 39 teachers who were consistent in using integrated teaching method. This finding pointed out the importance of in-service teacher training on integrated teaching of disaster prevention for teachers in Merapi volcano area.

In related to teaching topics, it was found out that most of the teachers had already introduced to the students the topics of earthquake, volcanic eruption, flood, and landslide. These topics were very urgent to be learnt by the students in Merapi volcano area because the area where they were living in was risky to have those kinds of natural disasters.

In relation to the professional capacity in teaching disaster prevention, unfortunately, the teachers admitted that they still lacked knowledge regarding how to teach disaster prevention effectively due to lacking of in-service teacher training. This issue was problematic because for the teachers in Merapi volcano area primary schools, teaching natural disaster-related learning content within the main teaching subject was relatively a new policy so that it may be difficult for the teachers. Therefore, sufficient guidance through regular in-service teacher training is needed to make the implementation of the disaster education effective.

In spite the fact that the teachers still lacked of knowledge, the data showed that the students were motivated to learn about natural disaster and prevention; as stated by the teacher respondents that 33 of them confessed their students' motivation was very strong and 83 of them admitted that their students' motivation was strong. This finding was a good clue that if the students were strongly motivated in learning, they would be much easier to master the competency standard or the basic competence stated in the lesson plan.

6.3. Students' Knowledge, Attitude, and Behavior in Natural Disaster Prevention

Students in Merapi volcano area primary schools confessed to being vulnerable to get negative impacts of at least four kinds of natural disasters, namely Merapi volcanic eruption itself, earthquake, mud flood, and landslide. Many students reported that their homes were partly and seriously damaged by the volcanic eruption. Fortunately, the students had already learnt about natural disasters and prevention relatively for a long time before the implementation of the recent disaster prevention education curricula in the academic year of 2011-2012. The students admitted to learning about natural disaster topics since when they were in kindergarten as well as in grade one to five of primary schools under integrated learning of disaster prevention within the main subject matters such as Natural and Social Sciences. This information was in line with what the teacher respondents reported that they had already introduced about natural disasters and prevention to their students either under integrated or isolated teaching practice.

It is really true that in disaster-prone area, children from the early ages should be introduced about natural disasters that commonly occur within their living area together with the appropriate knowledge and skills for the disaster prevention. Children should be made aware that they live in a dynamic earth which has both merits and demerits, and for being able to live safely and peacefully, they need to learn how to respond any natural hazards with appropriate actions to prevent the hazards to be disasters.

The natural disaster topics learnt by the students in Merapi volcano area were flood, cyclone, earthquake, volcanic eruption, and tsunami. In the researched schools, it was found out that only flood and typhoon were learnt by the students at all grades (one-five), while earthquake was not learnt at grade two; volcanic eruption was not learnt at grade one and two either; and tsunami was learnt only at grade five. Ideally, because children in the research schools were vulnerable to getting impacts of both the volcanic eruption and earthquake disasters, they should have learnt about these two issues at all grades continuously. Therefore, it becomes the responsibility of the teachers in Merapi volcano area primary schools to ensure that in each grade, the volcanic eruption and earthquake topics should be taught to the students in an integrated manner within the teaching subjects which they deal with.

Beside from formal learning at schools, the students also got information about natural disasters and prevention from mass media mainly television and radio. In relation to the roles of electronic mass media in educating the community for volcanic disaster prevention, it is very important for teachers to socialize the existence of **Jalin Merapi** (Information Network around Merapi) to the students as well as to use it as one of good sources for knowing the update situation and condition of Merapi volcano. By relying on internet-based-interactive media, Jalin Merapi utilized its instruments for public information, such as website (http://merapi.combine.or.id), twitter social network accounts (@jalinmerapi and @jalinmerapi_en) and Facebook groups (Jalin Merapi), short message service gateway, community radio, telephone, and field information posts.

By getting disaster prevention education both from school and outside of school, it is expected that children in Merapi volcano area have sufficient knowledge regarding a

volcanic eruption and its related hazards. However, in spite the fact the students had already learnt, it was noted that there were still confusions or problems regarding their effective knowledge, attitude, and behavior related to natural disaster prevention measures.

The first problem was the students' poor knowledge regarding the consequences of a big earthquake: 44% of the students did not know that running out of home while a big earthquake was going on was dangerous to do; that a big earthquake could cause house fire disaster (51%); that a big earthquake was sometimes followed by volcanic eruptions (29%); and that the phenomenon of many animals going down from the forests to people's settlement was one of the characteristics that a volcano might erupt (22%). In the event of an earthquake, it often happens that people tend to be panic when they are indoor. They would prefer to hurriedly go out from the building without realizing that they could be hit by the falling objects. To make the students accustom to properly act for self-protection during the earthquake, one of the effective ways that can be done by the teachers at school is conducting earthquake drill regularly both inside and outside of the classroom. In addition, the usage of video during the disaster prevention lesson, showing the relation between a big earthquake and fire disaster, can enhance the students' understanding that for some cases house fire can happen due to a big earthquake.

The second problem was the students' poor attitude: 30% of the students did not feel their living area was prone to natural disasters; 35% of them still believed about the myth of supernatural person's prediction about natural disasters, and 38% of them did not realize that humans' misbehaviour could anger God and result in disasters. In relation to the belief to the myth regarding the volcanic disaster, the students could be influenced by local people's belief to the *Juru Kunci* (the key holder of the Merapi volcano) whom was trusted to be able to communicate with the spirits who look after the mountain. The students possibly followed their parents' belief about the myth.

The third problem was related to the students' behavior: 20% of the students did not discuss or share with their family members the information about natural disasters which they gained from schools and 22% of the students did not often read books related to natural disasters and prevention. This finding suggests that the students should be well-informed about the importance of information sharing within their family members at homes. Once, they get important message or information regarding disasters from the school, they need to import it to their father, mother, and siblings. The students should share with their family members, not only information, but also the skills they obtain from disaster drill activities at school. Therefore, families are highly recommended to build the habit of information sharing within their members. In a moment of having together dinner at home, for example, a father or mother can open discussion with children about what they have got at school. When this information sharing activity becomes one of family lifestyles, the flow of effective disaster prevention education from schools to the community will be smoothly done and, as a result, community as a whole will be more aware of how to take appropriate actions in the event of natural disasters as shown in **(Fig. 6.3).**

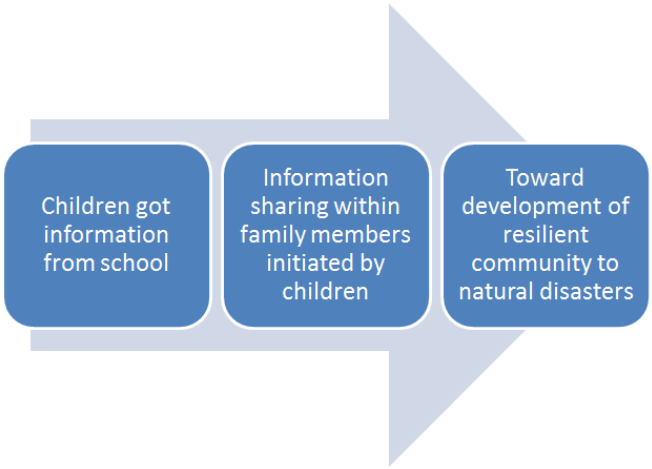


Figure 6.3 The ideal flow of effective disaster prevention education to community

6.4. Toward Improvement of the Students' Knowledge, Attitude, and Behavior

Education can be a vital tool for cultivating the students' knowledge, attitude, and behavior for having a safe life. One of the characteristics of a safe life is free from the negative impacts of disasters within the living area. Therefore, disaster prevention education is really important for making sure that the students have sufficient capacity for preventing themselves, their families and properties from the bad impacts of natural disasters.

Educational effort through experimental disaster prevention teaching using lecturing and discussion teaching methods for improving the students' knowledge, attitude, and behavior has been done through this study. Initially, students in this research had significant differences in attitude on beliefs in supernatural beings predicting natural disasters and the relationship between human misbehaviour and natural disasters. The percentage of students who did not believe in supernatural beings at school 1 (discussion group) was higher than at school 2 (lecture group). In both groups, fewer than 80.00% of students believed in supernatural beings' predictions about natural disasters. Unfortunately or otherwise, after experimental teaching, the percentage of students who did not believe in supernatural beings did not increase significantly. Percentage of students who believed the statement that there was a relationship between human misbehaviour and natural disaster in school 2 -- 81.60% -- was relatively higher than in school 1 -- 52.50%. After teaching, no significant improvement was seen in either group.

Children living in the Merapi volcano area may be influenced by traditional beliefs of their parents and society. Many people living on the slope of the volcano still strongly believe in supernatural beings that are trusted as spiritual guardians of the Merapi volcano -- for example, the late Mbah Maridjan or Maridjan Grandfather, who was killed in the 2010 Merapi volcano eruption because he remained in his damaged village. His relatively long existence became a source of local wisdom regarding Merapi volcano eruptions, so it was difficult to change belief regarding toward the scientific mechanism of natural within the area. These findings suggest that student belief in supernatural beings is also difficult through change by school education in a relatively short time. This will thus need good,

sustainable collaboration among families, communities, and school education for developing scientific thinking skills in the general public with regard to natural disasters.

In general, student knowledge regarding the consequences of a big earthquake and house fires changed significantly after teaching. The change in student knowledge in the lecture group was greater than the change in student knowledge in the discussion group.

Knowledge about the relationship between a big earthquake and house fires is very important for understanding by students. This is because fire is the most common hazard, following that of earthquakes. By learning about the mechanism of how fire can happen based on what occurs in a big earthquake, students will become aware of the appropriate actions in their homes needed to prevent house fires.

Student awareness of living in a disaster-prone area also significantly changed after teaching. The change in the lecture group was bigger than that in student attitudes in the discussion group.

Students must determine the conditions of their surroundings and get used to observing nature within their living area. In doing so, they may become more aware of the vulnerability of their living area to natural hazards and disasters.

After teaching, student knowledge regarding appropriate actions indoors during a big earthquake in both groups was significantly different. Student knowledge about the consequences of a big earthquake regarding house fires was significantly different in the lecture group only. Student attitudes regarding awareness of living in a disaster-prone area was significantly different also but only for the lecture group.

Logical reasoning by students in agreeing or not agreeing with statements in questionnaires was very important in analysis. Logical reasons represent deep knowledge by students as the output of effective teaching.

Table 6.1 shows written logical reasons given by students for agreement with statement 1 posttest.

Statement item number 1: ***When a big earthquake occurs, running out of home is very dangerous to do.***

Table 6.1 Students' agreement- reasons to statement item number 1

Reasons to agree	Frequency (N= 89)
1. When we are running to go out, we can be hit by the falling objects inside the room.	37 (41.57%)
2. Outside of home, we can be hit by the fallen trees and other objects; it is better to stay inside the room under the strong table.	21 (23.59%)
Total	58 (65.17%)

Source: Field survey, 2012

Among the 89 students, there were also 6 students who wrote their logical disagreement Among the 89 were 6 students who gave logical disagreement with statement 1 by stating the following:

"If we do not get out of the house when it is destroyed by an earthquake, we will be injured."

Table 6.2 shows logical reasons given by students for their agreement with statement 5 post-test.

Statement number 5: ***A big earthquake can cause house fire.***

Table 6.2 Students' agreement- reasons to statement item number 5

Reasons to agree	Frequency (N=89)
1. Due to a big earthquake, electrical wiring can damage, many cables cut off and lead to fire.	28 (31.46%)
2. People get panic and forget to turn off fire and or electricity.	17 (19.10%)
Total	45 (50.56%)

Source: Field survey, 2012

Among students who agreed with statement 5, two also wrote additional comments, saying that during an earthquake, it was better to shut off electricity at home. One student disagreed with statement 5 saying, based on experience:

"So far, no homes in my village burned down due to an earthquake."

The findings show that it is quite difficult to compare the effectiveness of discussion and lecture in disaster prevention lessons. One of the reasons is based on the very limited time of experimental teaching -- only two periods totalling 70 minutes. In fact, to achieve big changes in student knowledge, attitudes, and behavior, it will require a long process of teaching and learning. In addition to being affected by teaching and learning at school, student knowledge, attitudes, and behavior are also influenced by factors such as family background, local culture of surrounding people, and mass media impact.

Regarding the process of experimental teaching and learning using the two methods, it is clear that the students learning through discussion were more active and had more personal contact with others. In discussions, group members reciprocally influenced each other so individual students could get thoughts and ideas from others about volcanic disasters and related hazards. Students also got an opportunity to share tasks because by the end of the lesson, each group would present answers given by the teacher in front of the class.

CHAPTER 7

CONCLUSION AND RECOMMENDATION

This chapter briefly concludes the research findings and proposes recommendation to the schools and government for the improvement of school disaster management and prevention education in Merapi volcano area.

The study has successfully analyzed the implementation of disaster management and prevention education for volcanic eruption at the 24 selected primary schools in Merapi volcano area of Sleman Regency, Yogyakarta Special Region province in Indonesia by looking at two dimensions: the schools' role and capacity in disaster prevention through assessment of the schools' preparedness system to the volcanic eruptions based on two basic components: soft and hard components, and disaster prevention integration into formal school curricula though assessment of the intended, the implemented, and the attained disaster prevention curricula focusing on the fifth grade students.

Conclusion and recommendation which can be drawn from the study are stated as the following:

7.1. The preparedness level in facing the volcanic eruptions among the researched schools needed to be improved due to the main shortage in soft components such as teacher-training, regular risk assessment toward disasters, evacuation plan, and special unit/persons responsible for emergency preparedness and response. For the improvement of school preparedness in hard components, for example in building construction quality, it is recommended for the headmasters to report their schools' shortage to either the local or central government in order to get immediate appropriate assistance; while for the improvement of soft components, each school should set up educational activities, such as dissemination of schools resilience program toward volcanic eruption and in-service teacher-training program for designing and implementing effective lessons on volcanic eruption disaster prevention.

7.2. The 24 primary schools in Merapi volcano area have already implemented the disaster prevention education curriculum as required by the government. The students formally learn about natural disasters and prevention at schools almost at all grades either through integrated or isolated teaching method that mainly use textbooks and pictures as teaching media. Besides having learnt at schools, the students also utilize mass media like television and radio for learning natural disasters and prevention. Due to the fact that there are still problems regarding the students' effective knowledge, attitude and behavior on natural disasters that are caused by some factors including the ineffective teaching practice; it is highly recommended for the local government and schools to make strategic efforts in order to improve the teachers' performance including in developing their skills of making and using appropriate diverse teaching media for disaster prevention education through in-service teacher training. In addition, information sharing within families' members about disaster

prevention is another important point to be developed through children education at schools.

7.3. In relation to the educational effort of improving the students' knowledge, attitude and behavior through experimental teachings using two methods, the study has indicated that the lecturing method could improve two viewpoints of students' knowledge, one regarding the appropriate actions while indoors during a big earthquake, and the other regarding the consequences of a big earthquake in relation to a house fire disaster. Students' attitude viewpoint regarding their awareness of living in a disaster-prone area was also found improved by the use of lecturing method. The discussion method was found helpful in improving only one viewpoint of students' knowledge about the appropriate actions while indoors during a big earthquake. This finding is correspondent with Walker (2003) that lecture method is very useful for transmitting information, creating interest, and promoting the students' understanding. It is suggested that efforts should be taken to develop effective volcanic disaster prevention education at school focusing not only on the changes in the students' knowledge and attitude, but also their behavior. In addition, due to the fact that both teaching methods have their own merits and demerits; in teaching disaster prevention, teachers are recommended to carefully use either discussion or lecturing method, or even the combination of the two by firstly considering the teaching objectives, the teaching materials and media, as well as the available time.

7.4. Based on the text-book content analysis result and the comprehensive collected information about the history of the Merapi volcanic eruption in the literature review, it can be proposed the teaching and learning materials for the volcanic eruption. The common text-book learning contents should include the learning materials about volcano eruption process/mechanism, the volcanic hazards, types of volcanoes and their types of eruptions. The local text-book learning content should include the learning materials about the Merapi eruption process and history, the phenomena of the earthquake-Merapi eruption as paired-disasters, the Merapi early warning system, and the Merapi evacuation system which area adapted to each school's situation and condition. Some of the students' activities for deep understanding toward the learning content can be direct observation and interview the local community. The students can be given a home assignment by the teacher to observe the falling bomb and block, and sand in the river near the school. Bringing to the school some examples of the Merapi volcano's small stones and sand can be a good activity for students. In the classroom they can keep those objects for the purpose of discussion activity during the lesson of the disaster prevention. The students' activity to interview local people can make the students understand the local knowledge on how the people anticipate the impacts of the Merapi eruptions. By getting various data and information from different sources through observation, interview, and discussion, it is hopefully that the students will be able to think rationally and determine their own behavior in the event of the volcanic disaster (before, during, and after the eruption).

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Appendix 1

KUESIONER UNTUK KEPALA SEKOLAH

Kuesioner ini bertujuan untuk mengevaluasi implementasi manajemen bencana di Sekolah Dasar di daerah Gunung Merapi. Bacalah setiap pertanyaan dengan teliti dan jawablah berdasarkan petunjuk pada setiap bagian.

Part I Informasi Dasar

Jawablah setiap pertanyaan di bawah ini pada kolom yang tersedia disertai penjelasan secukupnya.

NO	PERTANYAAN	JAWABAN DAN PENJELASAN
1.	Nama sekolah	
2.	Tanggal berdirinya sekolah	
3.	Jumlah fasilitas sekolah	Ruang kelas: ……. Perpustakaan: …… WC: …… Lainnya: ……
4.	Usia dan latar belakang pendidikan kepala sekolah	
5.	Lamanya pengalaman kerja kepala sekolah	
6.	Jumlah total guru dan siswa di sekolah	
7.	Jarak sekolah dengan puncak Gunung Merapi	
8.	Jarak sekolah dengan sungai-sungai (mohon namai sungai yang dekat sekolah)	
9.	Apakah sekolah memiliki sirine tanda bahaya?	
10.	Berapa kali dalam satu tahun warga sekolah mengikuti pelatihan pencegahan bencana?	
11.	Berapa kali dalam setahun kepala sekolah mengikuti pelatihan manajemen pencegahan bencana?	
12.	Pernahkah sekolah Anda mengundang orang tua/wali murid untuk menghadiri seminar atau	

	workshop mengenai pencegahan bencana? Jika pernah, berapa kali?	
13.	Organisasi apakah yang pernah mengadakan kampanye atau sosialisasi pencegahan bencana di sekolah Anda?	
14.	Ketika erupsi gunung Merapi 2010, adakah guru, murid, atau keluarga mereka yang menjadi korban? Misalnya meninggal dunia, terluka parah atau rumahnya hancur? Jelaskan kondisinya!	
15.	Ada berapa kotak P3K yang dimiliki oleh sekolah? Jenis-jenis obatan apakah yang ada di dalamnya?	

Bagian 2 Kesiagaan Sekolah Terhadap Bencana Letusan Gunung Merapi

Bacalah setiap pernyataan di bawah ini dan berilah tanggapan Anda dengan cara melingkari salah satu jawaban yang disediakan di kolom disertai alasan secukupnya.

PERNYATAAN	RESPON	PENJELASAN
1. Status sekolah terhadap bencana alam	Sangat riskan Riskan Aman	
2. Tim siaga bencana di sekolah	Terprogram baik Terprogram apa adanya Tidak terpogram	
3. Rencana evakuasi di sekolah	Tersiapkan baik Tersiapkan apa adanya Tidak ada persiapani	
4. Evaluasi resiko terhadap bencana alam di sekolah	Harian Mingguan Bulanan Tahunan Tidak ada	
5. Persediaan P3K di sekolah	Cukup Beberapa saja Sedikit Tidak ada	
6. Pintu keluar darurat di sekolah	Banyak Beberapa saja Sedikit Tidak ada	

7. Koordinasi sekolah dengan pihak dinas kebakaran dan dinas kesehatan	Baik Sedang Jelek	
8. Kualitas gedung-gedung di sekolah berdasarkan standar nasional	Baik Sedang Jelek	
9. Bentuk dukungan dari pemerintah bagi pencegahan bencana bagi sekolah	Cukup Beberapa saja Sedikit Tidak ada	
10. Tingkat keseringan guru mengikuti training kebencanaan setiap tahun.	Sering Jarang Hampir tak pernah Tidak pernah 4-5 2-3 0-1 0	

Appendix 2

QUESTIONNAIRE FOR HEADMASTERS

This questionnaire intends to assess the implementation of disaster management among the primary schools in Merapi volcano area. Read each question carefully and answer based on the instruction of each part!

Part I Basic Information

Answer each question in the provided column and write the explanation for your answer as well.

NO	QUESTIONS	RESPONSES AND EXPLANATION
1.	Name of School	
2.	Date of school establishment	
3.	Number of school facilities	Classrooms: ……. Library: …… Toilet: …… Others: ……..
4.	Age and educational background of the headmaster	
5.	Length of the headmaster working experience	
6.	Number of teachers and students in total	
7.	Distance from school to the peak of Merapi volcano (km)	
8.	Distance of school to rivers (mention the name of the rivers)	
9.	Does your school have sirine for early warning?	
10.	How many times in a year the teachers, students, and school community practice disaster drill?	
11.	How many times in a year the headmaster join training for disaster prevention or disaster management?	

12.	Has your school ever invited the students' parents for attending seminar or workshop for disaster prevention? If yes, how many times?	
13.	What organizations have ever conducted campaign or disaster prevention socialization in your school?	
14.	In 2010 Merapi volcanic eruption event, were there any teachers, students, or their family members becoming the victims of the disaster? Explain briefly their condition!	
15.	How many boxes of first aid-kits does your school have? What kinds of medicine are there in the box?	

Part II School Preparedness System for Merapi Volcanic Eruptions

Read each statement carefully and give your response by choosing one of the options and state your reason in the provided column!

STATEMENTS	RESPONSE	REASONS
1. School risk to Merapi volcanic eruption	Relatively higher Relatively middle Relatively lower	
2. Special unit/persons responsible for emergency preparedness and response	Well-prepared Prepared Not prepared	
3. Evacuation Plan	Well-prepared Prepared Not prepared	
4. Regular risk assessment toward disasters	Daily Weekly Monthly Annually No risk assessment	
5. Emergency supply kits	Sufficient Only some Few Nothing	
6. Emergency exits	Many Only some Few Nothing	

7. Coordination with local fire department and medical center	Good Fair Bad	
8. Quality of school building construction	Good Fair Bad	
9. Supports from government	Sufficient Only some Few No support	
10. Teacher-training	Often Seldom Almost never Never 4-5x 2-3x 0-1x 0x	

Appendix 3

KUESIONER UNTUK GURU

Kuesioner ini dipergunakan untuk mengetahui implementasi pendidikan kebencanaan di sekolah dasar di daerah Gunung Merapi. Bacalah setiap pertanyaan dengan hati-hati dan jawablah sesuai dengan petunjuk pada masing-masing bagian.

Bagian I Data Diri:

Jawablah setiap pertanyaan dengan sebenarnya. Untuk pertanyaan pilihan ganda berilah tanda (x) pada pilihan Anda

1. Jenis kelamin

A. Pria B. Wanita

2. Usia

A. Kurang dari 31 tahun B. 31-40 tahun C. 41-50 tahun D. 51-65 tahun

3. Latar belakang pendidikan

A. Diploma B. Sarjana (S.1) C. Master (S.2) D. Doctoral (S.3) E. Lainnya: .....
Saya lulusan dari: Universitas: …… Jurusan: ……
Saya guru di: Sekolah : ……..…….. Mata Pelajaran Pokok: ……Kelas: .....

4. Pengalaman kerja sebagai guru

A. kurang dari 4 tahun B. 4-10 tahun C. 11-20 tahun D. Lebih dari 20 tahun

5. Tempat tinggal

Desa: …… Kecamatan: …… Kab/Kota: ……...

Bagian II Pengalaman Guru Mengajarkan Muatan Kebencanaan

Bacalah setiap pernyataan dan berilah respon Anda dengan memberi tanda (x) pada pilihan Anda: sangat tidak setuju (STS), tidak setuju (TS), setuju (S), atau sangat setuju (SS) disertai alasan pada kolom yang tersedia!

PERNYATAAN	RESPON				ALASAN
	STS	TS	S	SS	
1. Saya menggunakan buku teks dan modul untuk pembelajaran kebencanaan.					
2. Saya lebih suka mengajarkan muatan kebencanaan tersendiri daripada mengintegrasikannya ke dalam mata pelajaran pokok.					
3. Saya pernah mengajarkan mengenai gempa bumi dan gunung berapi meletus kepada siswa.					
4. Saya belum pernah mengajarkan mengenai banjir dan tanah longsor kepada siswa.					
5. Saya hanya menggunakan metode ceramah dalam pembelajaran kebencanaan.					
6. Pengetahuan saya mengenai pencegahan bencana masih kurang.					
7. Saya mampu secara efektif mengintegrasikan muatan pembelajaran kebencanaan pada mata pelajaran pokok.					
8. Saya menggunakan media untuk pembelajaran kebencanaan. Gambar/foto YA TIDAK Peta YA TIDAK Boneka/Wayang YA TIDAK Film/Video YA TIDAK Lainnya (di luar buku teks) ……...					

9. Saya mengevaluasi tingkat pemahaman siswa terhadap materi kebencanaan					
10. Para siswa yang saya ajar memiliki motivasi mempelajari materi kebencanaan Tingkat motivasi: (pilih satu) a. Sangat tinggi b. Tinggi c. Agak tinggi d. Rendah					

Appendix 4

QUESTIONNAIRE FOR TEACHERS

This questionnaire intends to assess the implementation of disaster prevention education in Merapi volcano area primary school. Read each question carefully and answer based on the instruction in each part!

Part I Personal Information:

Answer each question carefully. For multiple choice questions, write (x) on the option you choose

1. Sex

A. Male B. Female

2. Age

A. Less than 31 B. 31-40 C. 41-50 D. 51-65

3. Educational background

A. Diploma B. Bachelor C. Master D. Doctoral E. Others: .....
University: …… Majoring: ……..
I am a teacher at: School : ……...…….. Main teaching subject: ……Grade: .....

4. Working experience as a teacher

A. Less than 4 years B. 4-10 years C. 11-20 years D. More than 20 years

5. Residence

Village: …… District: …… Regency: ……...

Part II Teachers' Performance in Teaching Disaster Prevention

Read each statement and give your response by writing (x) in the column of strongly disagree (SD), disagree (D), agree (A), or strongly agree (SA) and state your reasons in the provided column!

STATEMENT	RESPONSE				REASON
	SD	D	A	SA	
1. I use textbooks or modules to teach children about natural disasters and prevention.					
2. I would rather teach about natural disasters alone than integrate it to the main subject such as natural science and social science.					
3. I have ever taught about earthquake and volcanic eruption to my students.					
4. I never teach about flood and landslides to my students.					
5. I only use chalk and talk when teaching about natural disasters.					
6. I still lack of knowledge about natural disaster prevention.					
7. I can effectively integrate the natural disaster-related content to my teaching subjects.					
8. I use media for teaching students about natural disasters prevention. Types of media: Pictures/photos YES NO Map YES NO					

Toys YES NO Film/Video YES NO Others …….					
9. I check the students' learning understanding on disasters prevention lesson.					
10. My students have motivation to learn disaster prevention. Level of the students' motivation (choose one) a. Very high b. High c. Fair d. Low					

Appendix 5

KUESIONER UNTUK SISWA

Kuesioner ini dipergunakan untuk mengentahui pengetahuan, sikap, dan tindakan siswa seputar bencana alam. Jawablah setiap pertanyaan sesuai dengan keadaan kalian sendiri dan tidak boleh melihat jawaban teman. Terima kasih!

Bagian I

1. Data Diri

Jenis Kelamin:..... Kelas:..... Umur:.....
Sekolah: .....
Nama Desa: ..... Kecamatan: .....
Kab: .....

2. Berapa kali kamu pernah mengalami bencana alam berikut ini? Tulislah angka jawabanmu di kolom yang tersedia

NAMA BENCANA ALAM	BERAPA KALI
Gunung Merapi meletus	
Gempa bumi	
Tsunami	
Banjir	
Tanah longsor	
Angin puting beliung	

3. Bagaimanakah kondisi sekolahmu saat terjadi bencana alam berikut ini di daerahmu? (Berilah tanda A, B, atau C pada kolom yang tersedia)

A. Rusak
B. Agak rusak
C. Tidak apa-apa

NAMA BENCANA ALAM	KONDISI SEKOLAH AKIBAT BENCANA
Gunung Merapi Meletus, 25 Oktober 2010	

4. Bagaimanakah kondisi rumahmu saat terjadi bencana alam berikut ini di daerahmu? (Berilah tanda A, B, atau C pada kolom yang tersedia)

A. Rusak
B. Agak rusak
C. Tidak apa-apa

NAMA BENCANA ALAM	KONDISI RUMAH AKIBAT BENCANA
Gunung Merapi Meletus, 25 Oktober 2010	

5. Jenis-jenis bencana alam apakah yang pernah kamu pelajari di sekolah?
(Berilah tanda X pada satu atau lebih pilihanmu sesuai dengan kenyataan dan tulislah kelas pada saat kamu mempelajarinya)

A. Gunung Meletus pada waktu kelas .....
B. Gempa bumi pada waktu kelas .....
C. Tsunami pada waktu kelas .....
D. Banjir pada waktu kelas .....
E. Tanah longsor pada waktu kelas .....
F. Angin puting beliung pada waktu kelas .....

6. Dalam mata pelajaran apakah kamu belajar mengenai bencana alam dengan gurumu di sekolah?
(Berilah tanda X pada satu atau lebih pilihanmu sesuai dengan kenyataan)

A. IPA
B. IPS
C. Olahraga dan Kesehatan
D. Agama dan PPKn
E. Mata Pelajaran lain: .....(tulis)

7. Selain dari sekolah, dari manakah kamu mengetahui informasi tentang bencana alam? (Berilah tanda X pada pilihanmu; satu atau lebih sesuai dengan kenyataan)

A. TV
B. Radio
C. Surat Kabar dan majalah
D. Internet
E. Keluarga
F. Tetangga

Bagian II

1. Bacalah setiap pernyataan di setiap nomor dengan teliti.
2. Berilah respon kalian dengan memberi tanda silang (x) kolom **SETUJU, RAGU** atau **TIDAK SETUJU** sesuai dengan pilihanmu pada setiap pernyataan dan tulislah alasan pilihanmu pada setiap pernyataan di dalam kolom setiap nomor yang tersedia.

PERNYATAAN		RESPON			ALASAN
		SETUJU	RAGU	TIDAK SETUJU	
1	Jika gempa besar sedang mengguncang, berlari keluar rumah itu sangat berbahaya.				
2	Abu panas letusan gunung berapi itu tidak berbahaya bagi kesehatan.				
3	Gempa bumi besar dapat menyebabkan kebakaran di rumah-rumah.				
4	Gempa bumi kadang-kadang diikuti oleh gunung berapi meletus.				
5	Hujan lebat yang turun setiap hari bisa menyebabkan banjir dan tanah longsor.				
6	Jika banyak hewan turun dari gunung, itu pertanda gunung berapi akan meletus.				
7	Menonton acara prakiraan cuaca di TV itu sia-sia.				
8	Saya pikir mengikuti kegiatan pelatihan kebencanaan itu tidak berguna.				
9	Jika orang yang dianggap sakti berkata bahwa besok akan ada bencana alam di daerah tempat tinggalku,saya mempercayainya.				
10	Kita perlu menanam pepohonan di bukit-bukit gundul.				

11	Saya menyadari bahwa daerah tempat tinggal saya rawan bencana alam.				
12	Akhlak jelek manusia membuat Tuhan marah dan mendatangkan bencana alam.				
13	Mengumpulkan/Mengkliping foto atau gambar mengenai bencana alam itu berguna.				
14	Jika ada peringatan gunung Merapi akan meletus dan keluargaku disuruh mengungsi, keluargaku tetap tinggal di rumah.				
15	Jika terjadi gempa bumi, di ruangan, saya bersembunyi di bawah meja yang kuat.				
16	Saya kadang-kadang membuang sampah ke dalam sungai.				
17	Saya berdiskusi dengan keluargaku mengenai informasi bencana alam yang diperoleh dari sekolah.				
18	Saya memakai masker saat gunung Merapi meletus.				
19	Aku dan keluargaku menyimpan dokumen-dokumen penting di dalam kotak yang aman.				
20	Saya sering membaca buku tentang bencana alam.				

Appendix 6

QUESTIONNAIRE FOR STUDENTS

This questionnaire is used to know the students' knowledge, attitude, and behavior on natural disaster. Answer each question carefully based on your own condition and please try not to watch other students' answer. Thank you.

Part I

1. **Personal Information**

   Sex: ..... Grade: .....Age: .....
   School: .....
   Village: ..... District: .....Regency: .....

2. **How many times have you experienced the following natural disasters? Write down your answer in the provided column!**

Natural Disasters	Frequency
Merapi volcanic eruption	
Earthquake	
Tsunami	
Flood	
Landslide	
Cyclone	

3. **How was the condition of your school when the following natural disaster occurred? (Write A, B, or C in the provided column!)**
   A. Damaged
   B. Partly-damaged
   C. Safe

NATURAL DISASTER	SCHOOL CONDITION
Merapi volcanic eruption on 25th October 2010	

4. **How was the condition of your house when the following natural disaster occurred? (Write A, B, or C in the provided column!)**
   A. Damaged
   B. Partly-damaged
   C. Safe

NATURAL DISASTER	HOUSE CONDITION
Merapi volcanic eruption on 25th October 2010	

5. What kinds of natural disasters have you learnt at school?
(You can choose more than one answer by writing (x) on A, B, C, D, E, and F and please identify in what grade when you learn it).

A. Volcanic eruption when I was at grade .....
B. Earthquake when I was at grade .....
C. Tsunami when I was at grade .....
D. Flood when I was at grade .....
E. Landslide when I was at grade .....
F. Cyclone when I was at grade .....

6. In what subjects do you learn about natural disasters with your teacher at school?
(You can choose more than one answer by writing (x) on A, B, C, D, and E).

A. Natural Science
B. Social Science
C. Physical education
D. Religion and Moral
E. Other subjects: .....(please write)

7. Beside from school, from what other sources do you learn about natural disasters?
(You can choose more than one answer by writing (x) on A, B, C, D, E, and F).

A. TV
B. Radio
C. Newspaper and magazine
D. Internet
E. Family
F. Neighbors

Part II (item number 1-20)

1. Read each statement carefully
2. Give your response for each statement by writing (x) on the Agree, No Idea, or Disagree column and express your reasons to the response you have made in the provided column.

STATEMENTS	RESPONSE			REASONS
	Agree	No Idea	Disagree	
1. When a big earthquake occurs, running out of home is very dangerous.				
2. Hot ashes from Merapi volcano are not dangerous for health.				
3. Big earthquake can cause house fire.				
4. A big earthquake sometimes is followed by volcanic eruption.				
5. Frequent raining can cause flood and landslide.				
6. When there are many animals going down from the mountain, it is one of the signs that Merapi volcano will erupt.				
7. I think watching weather forecast is useless.				
8. I think joining disaster training is useful.				
9. When there is a super natural person says that tomorrow there will be a disaster in my living area, I believe it.				
10. I think we need to plant trees in bare hills.				
11. I am aware that my living area is prone to natural disasters.				
12. I think humans' misbehaviors can make God angry and result in disasters.				
13. I think colleting photos, pictures on natural disaster is useful for learning.				

14. When there is a warning from authorities that Merapi Volcano will erupt and my family is advised to evacuate, my family and I just stay at home.				
15. When there is a big earthquake, indoor I hide under a strong table.				
16. I dispose garbage to rivers.				
17. I discuss with family about information on natural disaster prevention that I have got from school.				
18. I wear masker when Merapi volcano is erupting.				
19. My family and I keep important documents in a safe box.				
20. I often read books about natural disasters.				

Appendix 7

List of questions for interview

Questions for Headmasters

In 2010 Merapi volcanic eruption event, were there any teachers, students, or their family members becoming the victims of the disaster? Explain briefly their condition!

Questions for Teachers

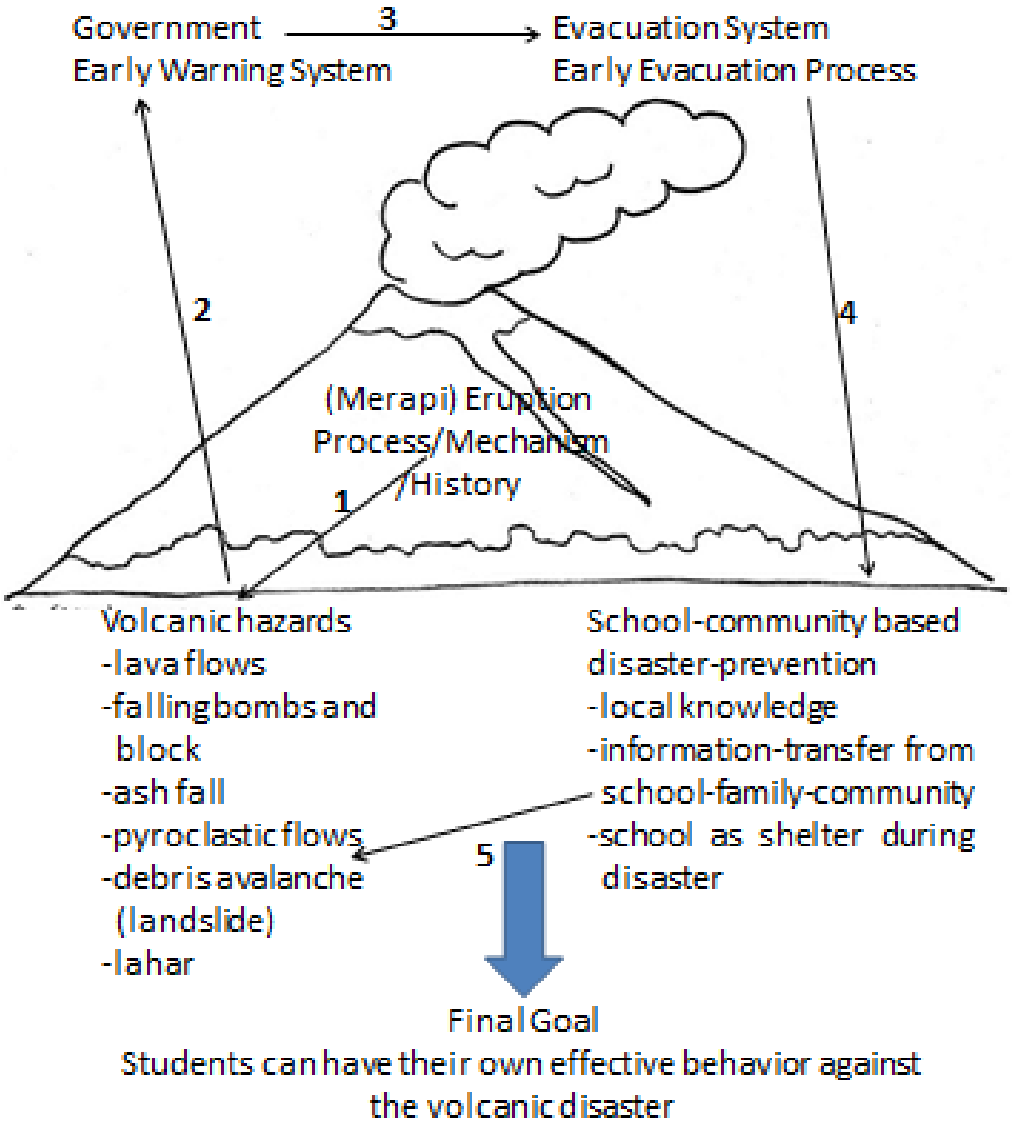
When delivering information regarding disaster prevention including Merapi volcanic eruption to the students, do you use specified time or you do it while teaching the main subject?

Questions for Students

Please, kindly describe your experience during 2010 Merapi volcanic eruption!

Appendix 8

Teaching and Learning Material Structure on the Volcanic Disaster Prevention



Note: the volcano image is taken from http://gambarmewarnai.com/gambar-mewarnai-gunung/

The teaching and learning materials in each number can be common and local materials; therefore, it is the responsibility for the teachers in each school for making the lesson plans which are specifically related to their local condition and needs.

Appendix 9

Example of a Lesson Plan of the Integrated Volcanic Disaster Prevention within the Indonesian Language Subject Class

Purpose
Students are able to gather data and information from the field by interview
Students are able to think rationally and determine their own behavior for anticipating the Merapi volcanic eruption disaster through integration of various kinds of information mentioned above.

Time
35 minutes x 2 (70 minutes)

Teaching and learning processes
1. In the previous meeting, the students have already done the home assignment by interviewing the local people about how they take actions during the last big Merapi eruption
2. Students in each group prepare their interview report
3. Teacher explains the procedure of the today discussion activities
4. Teacher asks each group to orally present the interview report and asks other groups to listen and make a note
5. After all the groups' presentation, the teacher with the help of the students makes the summary of the interview reports from all groups
6. Each group share their ideas and opinion with other groups about their own behavior before, during, and after the Merapi eruption for future anticipation.
7. Finally, the teacher asks each student as the home assignment to briefly write his/her own ideas and opinion in a short essay illustrated with his/her own picture of the Merapi volcano about his/her behavior for preparing the future eruption.

Evaluation
1. Students' active participation during the discussion
2. Student's short essay based on the field research

Appendix 10

Example of the Interview-sheet for the Students (grade V)

Instruction 1
In a group of 3-4 students, try to collect the data and information from the local people (2-5 people, for example adults and old persons) living surrounding you by interviewing them. Make the copy of the interview sheet based on the number of people you will interview!

1. What happens to you in the last big Merapi eruption? Can you remember the total number of suffered people in your village due to Merapi eruption?

2. Do you think it is good for you to follow the government command for evacuation when there is Merapi eruption? Why?

3. What do your family do or prepare for anticipating the future Merapi eruption?

Instruction 2
Based on the data and information you have got from the interview; discuss the following questions with other groups in the classroom!

What will you and your family members do if the Merapi volcano has big eruption again in the future!

Before the eruption

During the eruption

After the eruption