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## Disaster Education Through Local Knowledge in Some Area of Merapi Volcano

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# Disaster Education Through Local Knowledge in Some Area of Merapi Volcano

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**Abstract.** Merapi volcano in Central Java is one of the most active volcanoes in the world. However, the area of Mount Merapi is still occupied by many inhabitants. Population growth in disaster prone areas is also quite high, even after a major eruption disaster in 2010. To reduce disaster risk, disaster education is necessary, including by utilizing local knowledge about disasters. This paper aims to (1) identify disaster education through local knowledge in the western and southern flank of Merapi Volcano, (2) reveals the influence of physical environmental conditions on disaster education that is formed. The research is done by geography approach that is environmental approach and emphasize on the theme of geography especially location, place, and human- environment interaction. The results show: (1) There are several forms of disaster education through local knowledge among others in the form of advice, philosophy of life, myths, art, and culture. The educational process is done in various activities of community life, both during pre disaster, disaster, and post disaster. village elders and community leaders are the most influential parties in the disaster education process. However, at present the role of local knowledge in disaster education is relatively poor. (2) There is an influence of the physical environmental conditions on the form of disaster education, especially geomorphological conditions. Geomorphological conditions affect the types of volcanic hazards, thus determining the characteristics of disaster education undertaken. This paper presents alternative methods in disaster education, in an effort to support disaster management that has been done by the government.

## 1. Introduction

Merapi Volcano in Central Java is one of active volcano in the world. With the continuously activity from time to time, Merapi Volcano is known as the most active volcano on holosen time too [1]. The history of Merapi Volcano has 11 big erupted since 3000 years ago. The period of eruptions from 1 – 7 years with a maximum inactivity period of 12 years [2]. A big eruption disaster occurred in 2010. This eruption is explosive and produces nue ardente or wedhus gembel (local mention) that the larger and more far reaching than the previous eruptions that accoured in 2006 [3]. BNPB [4] calculated the loss cause eruption of Merapi Volcano on 2010 is 3,56 trilion. Despite experiencing big damage and losses because eruption, the disaster prone still occupied by many residents and the population tends to increase from year to year. 8 years after the massive eruption that occurred in 2010, Merapi Volcano has an increased in volcanic activity whicht began on May, 11th 2018 [5]. Volcanic activity start from phreatic



eruption and then became a magmatic eruption [6] [7]. This condition show that Merapi Volcano as an active volcano still holds the potential for eruption hazards in the future.

The problem that then arises related to the volcanic activity of Merapi is that the population is still quite large in disaster-prone areas. The large of residents make the potential of risk are increase. For reduce the risk, needed good management disaster. On the management disaster, pre-disaster stage have a big function and greatly determine the capability to deal with disaster. Disaster education is one of part that really needs to be persued in the pre-disaster stage, that is mitigation and preparedness. Besides on formal education, education in the community by referring to local wisdom can be alternative to support disaster education and other activity that with function as disaster education media, which have been carried out by the government. Local wisdom formed by community recognition of their environment. With use the education based on lacial knowledge in community, be expected that various forms of disaster education can be delivered contextually according to local conditions so that they can be implemented properly.

Among the of all areas of Merapi Volcano, the southwestern slope to the west slope is one areas which has been affected by eruption in the past but in other hand, it is also occupied by many resident. BPS data from Magelang Regency [8]–[13] and Boyolali Regency [14], [15] showed that the disaster-prone areas of eruption on the southwestern slope of Merapi, Srumbung District on 2016 were occupied by 20.008 residents, an increase compared to 2010 with 18.843 residents. Meanwhile on the western slope covering of Duku, Sawangan, and Selo District the population in 2016 was 18670, an increase compared to 2010 with 18.001 residents. Generally, the population growth rate in Merapi disaster-prone areas reached 2,8%, higher than national population growth rate of 2,5% [16]. The southwestern slope is the most area often hit by eruption in the past [2]. Eruptions has been going on since before the civilization of society which was marked by existence of temples, in the early period of civilization, to this day. The effect of southwestern slope of Merapi can be tracked on former ancient lake in Borobudur Area [17]. Eruption track are also indicated by the presence of ancient river grooves in the southwestern of the west Merapi[18], including the Asu Temple complex at the foot of the western slope of Merapi which is burried by eruption material [19]

Disaster risks faced by residents in disaster-prone areas need to be reduced by building good disaster management. Disaster education based on local wisdom is very important to support disaster formal education. This paper aims to provide an explanation of disaster education that has developed in the community in the form of local wisdom, in several areas between the southwest slope to the west of Merapi Volcano. Education based on local wisdom in this paper is about activity in community that can be use to inform about potential and mitigation of disaster. The content can be delivered in official information from governemnt, the result of scientific studies from formal educational intitutions, and community local knowledge. Various information content delivered with local method that are easily to understood by community in disaster-prone areas. Disaster education based on local wisdom can be alternative method to support and optimize the development of disaster education, like a formal education in the school or in various extension activities about disasters carried out by the government. Next the rest of this paper is organized as follows. Section 2 describes the scope of local knowledge and hazard at Merapi Volcano, Section 3 describes the research method, section 4 explains the results and discussion, and section 5 explains the conclusion of this work.

## 2. Theoretical Framework

In the Law of the Republic of Indonesia Number 24 of 2007 concerning Disaster Management it has been explained that disasters are events or series of events that threaten and disrupt the lives and livelihoods of people caused by natural, non-natural and human factors, resulting in human casualties, environmental damage, loss of property, and psychological impact [20]. Disaster in Indonesian is referred to as a *bencana* taken from Sanskrit *vancana* which means temptation, deception, damage, or accident. The word disaster in English develops from the word *désastre* in French which previously came from the word *disastro* in Italian which means wretched, bad luck, or unfortunate [21]. Disasters can also be interpreted as an event or series of events that occur suddenly or slowly caused by nature,

humans, or both, and result in patterns of life, livelihoods, disturbances in the system of governance that are norms or damage to ecosystems so that emergency measures are needed to save people and their environment [22].

To reduce disaster risk, disaster management is carried out. This activity is a continuous cycle consisting of stages. The Law of the Republic of Indonesia Number 24 of 2007 describes Disaster management consists of disasters, rehabilitation, reconstruction, mitigating, and preparing. This whole cycle is an important part and has a different function. Disaster mitigation is one of the stages in the pre-disaster section. Republic of Indonesia Law Number 24 of 2007 and Government Regulation of the Republic of Indonesia Number 21 of 2008 concerning the implementation of disaster management was defined as a series of efforts carried out to reduce disaster risk both with physical development and awareness and capacity building in the face of disasters. The word mitigation comes from the noun in Latin *mitigationem*, which comes from the *mitigare* verb which is a combination of two root words, namely *mitis* which means softer, softer, tame, and *agare* which means doing, trying, making [21]. Pre-disaster stages of prevention and reduction and disaster relief in disaster emergency situations is an important part to emphasize. For example in handling disasters in China, the Chinese government is very concerned with prevention, reduction, and help. This is supported by the development of law and regulations in the last three decades which provide good law for this aspect [23]. In Indonesia, disaster mitigation, which is part of the pre-disaster phase, also received much attention from disaster management stakeholders as well as disaster researchers.

In the Government Regulation of the Republic of Indonesia Number 21 of 2008, it has been mandated that disaster mitigation activities consist of three activities, one of which is the implementation of education, training, and counseling, both conventional and modern. Meanwhile, in the Law of the Republic of Indonesia Number 24 of 2007, it is mandated that disaster mitigation can be carried out with physical and non-physical development. Included in the non-physical category are education, counseling, and citizen awareness [21]. Education is an important part of disaster mitigation to prepare the community for resilient disasters in the pre-disaster stage so that when a disaster occurs, the risks and losses that occur can be minimized. Regarding the importance of disaster mitigation education, Purwantara [24] has explained that in recent decades the terms and natural phenomena related to disasters are increasingly familiar to the public. That is the learning received by the community. The community becomes familiar with the natural environment and its symptoms. Various natural events related to disasters need to be increasingly understood by society rationally. For this reason, education about mitigating natural disasters is very important both through the public education channels and through formal channels in schools.

The general education pathway in the form of public education or local education that is informal also has an important role in disaster education. Through informal moments, interactions often occur within the community, in its content is conveyed about disaster knowledge and efforts to overcome it. Knowledge is very important because disaster risk reduction policies and practices require knowledge for coordinated decision making and action. Based on experience in France, it is urgently needed to increase understanding of the relationship between risk, knowledge and disaster learning. Good integration is needed from various scales, different social actors, various sources of knowledge, and various disciplines in increasing knowledge about these disasters [25]. From this information, we can know that there are many aspects that need to be understood by the community related to disasters. Such knowledge can be invested through education. Of course, there are many ways to provide education both through formal and informal channels. Improved education has proven to have a positive impact on disaster risk reduction. Adult education is one example of an important element in creating psychological resilience in the face of disasters [26]. Meanwhile, taking into account the importance of education in disaster risk reduction, experience in Indonesia shows that disaster risk reduction in education needs to be continuously improved. The results of disaster education in decades have been able to reduce disaster losses and increase resilience. Several studies have identified positive results from this disaster education [27].

### 3. Method

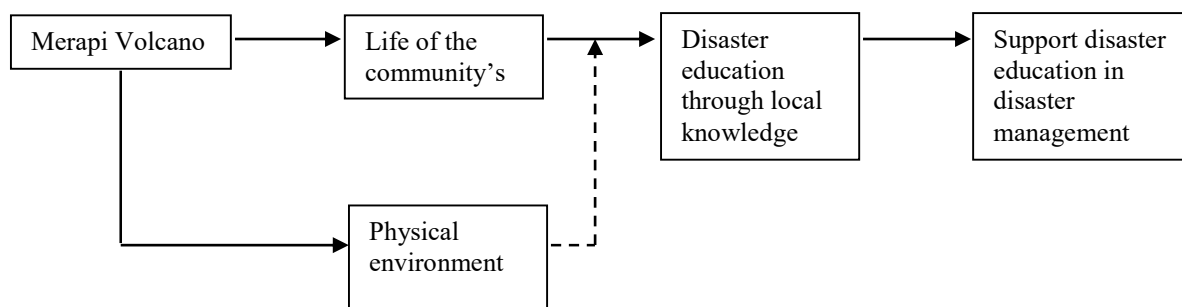
This research was carried out with a geographic approach, namely an ecological approach and emphasizing geographical themes in particular location, place, and human-environment interaction. The population in this study were people who lived in the southwestern to western flank of Merapi Volcano. To get information about how the method of disaster education based on local wisdom in the region we took informants consisting of community leaders, village officials, community elders, and members of disaster risk reduction organizations in various villages. The variable in this research are (1) disaster education in local community based on local wisdom that can be found in various aspects of life such as traditional ceremonies, community activities, behavior, and local culture, (2) physical environment characteristic that impact toward education disaster in community especially geomorphological condition.

Data collection is done by interview, observation, documentation, and literatur review. Instrument used on data collection are interview guidelines, digital camera, observation sheet, GPS, geological compass, yallon, and clinometer. Relation between data collection method, instrument used, and data collected are show in table 1.

**Table 1.** the relationship between data collection methods, instruments, and the type of data collected

No	Method	Instrument	Type of Data
1	Interview	Interview guidelines, digital camera	Various form of disaster education based on local wisdom
2	Observation	Observation sheet, GPS, geological compass, yallon, and clinometer	Geomorphological condition
3	Documentation	Indonesian Topographical Map ( <i>Peta Rupabumi Indonesia</i> ), geological map	Physical environment condition
4	Literature review	Previous publication from Setyawati et al, Nurhadi et al	Local wisdom on confront the disaster

Analysis done by using analytical descriptive analysis method. To answer the problem raised in the descriptive analysis done by notice the environment approach and emphasize on location, place, and human-environment interaction aspect, that is to the existing form of disaster education can be indentified and forum to be related to the condition of the physical environment. Operationally the stages of work performed are shown in Figure 1.

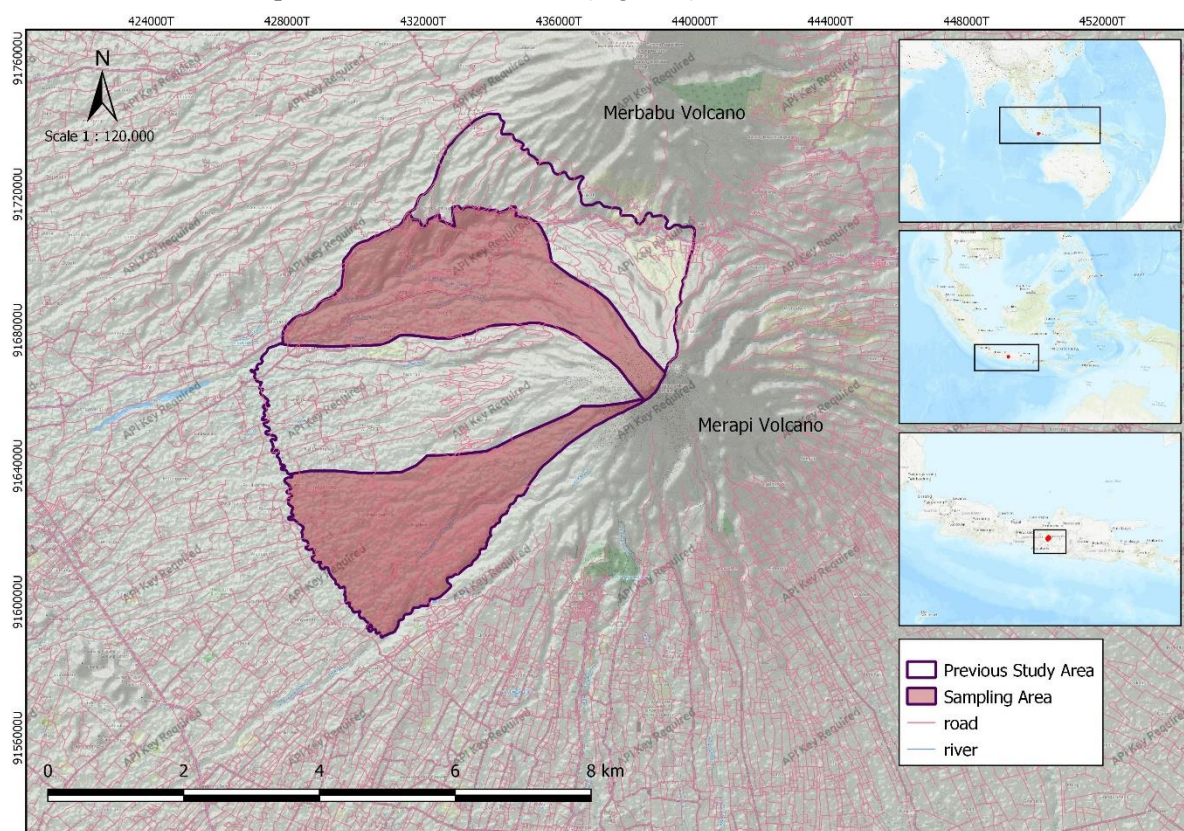


**Figure 1.** Research framework

## 4. Results

### 4.1. Research Area

This research was conducted in parts of Merapi Volcano, namely in the southwestern slope to the west. This area was chosen as the research location because it included areas that were heavily affected by eruptions in the past and were occupied by many residents on the other. The research area starts from the Krasak River valley which limits the southwest slope with the southern slope to the Pabelan River valley which limits the western slope to the northwest. Administratively, the research area belongs to the Magelang District, Central Java Province, which includes Srumbung District, Dukun District, and Sawangan District. The western slope of Mount Merapi also includes areas that are physiographically included in the valley between the Merapi-Merbabu volcano, which is around the Pabelan river valley between volcanic merapi and volcanic Merbabu (Figure 2).



**Figure 2.** Research Area

Geologically the study area is affected by volcanic activity from the young volcanic period, including the Merapi Young (Qmi) Volcanic Deposition, Avalanche Deposits from the Hot Clouds (na), the lava dome and the slope (d), and the Old Merapi Volcano Deposition (Qmo) [28]. Geomorphologically the southwest slope of Mount Merapi includes the Merapi Muda section, so the shape of the southwest slope is very complex as a feature of the active composite volcano consisting of craters, volcanic cones, volcanic slopes, volcanic feet, and volcanic foot plains. There are also results of volcanic activity in the form of lava fields and lava fields. The slopes and feet of the volcano have moderate rain potential with the average annual rainfall on the slopes is 1,734 and the volcano's foot is 1,550 mm. The type of climate according to Schmidt Ferguson in the southwest region of Mount Merapi is the type of climate C, while according to the Oldeman classification includes the type of climate B. While hydrologically, the study area has good aquifer potential [28].



The research area is greatly affected by the potential for disaster eruptions as a result of its location adjacent to the eruption center. Merapi Volcano is categorized as volcanic type A. As previously explained, Merapi Volcano is a very active volcano, known as never sleeps volcano [16] and is one of the most active volcanoes during the holocene [1]. Since 1006 Merapi Volcano has continued to erupt regularly with a span of one to seven years. Until now, Vulkan Merapi has been recorded as having erupted more than 80 times [2], [28]. Oktrina and Sugiharto [29] explained that the eruption of Merapi occurred since 1961 precisely the peak of the eruption occurred on May 8, 1961. Subsequent eruptions occurred in 1967, 1968, 1969, 1984. Eruptions occurred again in 1986, 1992, 1994, 1997, 2001 2006, and last October 2010. The eruption activity of Mount Merapi with the characteristic of issuing lava and hot clouds. The level of activity of Mount Merapi is divided into four, which are normal, alert, alert, and alert. The level of normal, alert and alert activities is the result of analyzing quantitative monitoring data. The alert status is related to the combination of interpretation of technical data and the emergence of high risks of the danger of Merapi for the population.

In the historical record of the eruption, the intensity of the eruption of Mount Merapi is relatively high, with an average occurring once in a period of 1-7 years, with a period of inactivity of at least 12 years. Merapi eruption is known to have occurred since 3000 years ago, and among them there were 11 major eruptions that occurred between 150-500 years[2], [30]. In the past, the eruption of Merapi was known to be directed west or southwest. This is understandable because the active crater of Mount Merapi is currently open to the west - southwest. So that as long as the growth of the lava dome is still inside and has not exceeded the crater wall, the eruption will lead to the west - southwest[2]. In the southwest slope area of Mount Merapi in Srumbung Subdistrict, Magelang Regency, the eruption disaster caused an impact in the form of damage to farm land pondoh and palawija. With the population in disaster-prone areas III reaching 15,722 people and the largest source of income for the population in the agricultural sector [30], damage to agricultural land due to the eruption disaster had a very large impact on the social life of the community.

#### *4.2. Interview with key informant*

The interview was conducted during 6th July - 26th August 2018. Interviews were conducted in seven villages which were geomorphologically located at the southwest slope of Merapi Volcano and one geomorphologically village located in the valley between Merapi Merabu volcanoes. The location for sampling in this interview considered from the catastrophic eruptions that often occur in the past at the southwest slope of the Merapi Volcano [2], [28], [31], [18]. Eruptions have a huge impact on people's lives, for example in the situation of the post-disaster eruption crisis in 2010 [30]. Meanwhile, on the west side of the transition to the northwest of Merapi Volcano, there are more complex geomorphological conditions of the meeting between the volcanic morphology of Merapi and Merbabu volcanic namely in the valley between the volcano Merapi-merbabu [32]. Besides being affected by the eruption disaster in the past more complex geomorphological conditions are considered as a factor that gives an impact for local wisdom-based disaster education which can be used as a comparison with samples taken in the southwestern slope.

In the southwestern slopes of the Merapi Volcano, interviews were conducted in Mraggen Village, Ngargosoka Village, Tegal Randu Village, Ngablak Village, Kemiren Village, Kaliurang Village, and Srumbung Village which were all included in the Srumbung District of Magelang District. Whereas in the western part of Mount Merapi, which is in the valley between the Merapi-Merbabu volcano, an interview was conducted in Wonolelo Village, which is included in the Sawangan District of Magelang Regency. Interviews in Wonolelo village focused on hamlets located close to the Pabelan River valley because most of the village area was based on its morphological conditions located at the foot of Merbabu Volcano. Fourteen interviews were already conducted. Key informants in this study consisted of community leaders, village officials, community elders, and members of disaster risk reduction organizations (Table 2). In this interview, the questions have been prepared covering several aspects related to disaster education (Table 3). Informants can provide answers more broadly and freely without

depending on the guiding question. Interviews were conducted in Indonesian and/or Javanese. The results of the interviews were filled in the instruments used as interview guides.

**Tabel 2.** Survey Methods at southwest slope and western slope of Merapi Volcano

Southwest Slope											Western Slope
Village	Mraggen		Ngargo soka	Tegal randu	Ngablak	Kemiren	Kaliurang		Slumbung	Wonolelo	
Date of the survey (month/year)	6 <sup>th</sup> July 2018	27 <sup>th</sup> July 2018	27 <sup>th</sup> July 2018	27 <sup>th</sup> July 2018	27 <sup>th</sup> July 2018	27 <sup>th</sup> July 2018	6 <sup>th</sup> July 2018	27 <sup>th</sup> July 2018	26 <sup>th</sup> August 2018		
Technical survey approach	Secondary data collection and semi-structured interview										
Interviewed people and their function	<i>Bapak</i> Ani (miner), <i>Kakek</i> Sukripto (farmer)	<i>Bapak</i> Budiono (head of village), <i>Bapak</i> Sarbini (farmer)	<i>Ibu</i> Dwi Lestari (village official)	<i>Bapak</i> Ahmad Ridwan (village official), <i>Bapak</i> Sudirman (OPRB official)	<i>Bapak</i> Junar (village official), <i>Bapak</i> Suhono (farmer)	<i>Bapak</i> Rifai (farmer), <i>Bapak</i> Ahmad Hasar (village official)	<i>Bapak</i> Ahmad Muslim (village official), <i>Kakek</i> Jenuri (farmer)	<i>Bapak</i> Triyanto (governm ent)			

**Tabel 3.** Questions asked during semi-structured interviews.

Variable	Question
Socio-demographic	Question about: Personal details (name, age, gender, occupation)
Potential eruption disaster in the area	How big is the danger level in this area? How is/are the impact(s) of eruptions that occurred in the past?
Hazard knowledge	How is your experience of the eruption disaster that ever happened?
Environmental knowledge	Is this village include in a disaster-prone area?
Local activity related to disaster education	Whether community behavior, oral stories, traditional ceremonies, community activities, or certain traditions have values for disaster education?
Disaster education based on local knowledge	How can disaster education inserted in various community activities?
	Who is deliver the information about worth disaster education in various activities in the community?
	What is the method of teaching local disaster-based disaster education?
	When is and where is the transfer of knowledge of worth disaster education usually occur?
Perception	How is/are the effectiveness of local wisdom-based disaster education in reduce disaster risk?

#### 4.3. Disaster Education based on community local knowledge in the Southwestern and Western flank of Merapi Volcano

In the first part of paper, disaster education is an important part of disaster risk reduction efforts. Disaster education is one of the activities carried out at the stage of disaster mitigation, which turned out to be very useful in increasing community preparedness. In its implementation, disaster education can not only be done formally but can also be delivered informally through public education and various activities that can support the delivery of transfer of knowledge regarding disaster.

The southern to the western flank of the Merapi Volcano since the past have faced many eruptions. With the number of disaster event faced by the community, it is very possible in the community to form local wisdom in the form of community recognition of the characteristics of the surrounding environment. Setyawati et al [31] explained that people in the southwestern slopes of the Merapi



Volcano who had occupied disaster-prone areas for generations and repeatedly experienced catastrophic eruptions, had traditional intelligence in the face of disasters as a result of people's recognition of their physical environment. One form of local wisdom in dealing with disasters is about how to deliver education about the disaster of eruption.

In this study, several forms of disaster education based on local knowledge in the community of the southwestern to the western flank of the Merapi Volcano have been identified. The disaster education take place through various forms of community interaction in which there is a transfer of knowledge about the disaster of eruption. Disaster education includes behaviors, traditional activities, community gathering, oral stories, and *gethok tular*. Disaster education based on local knowledge is conveyed informally, unstructured, and generally occurs incidentally in certain moments.

- Behaviour

Community behavior is one of the effective media in the transfer of knowledge regarding the disaster of the Merapi volcanic eruption. Behavior in the form of community behavior in response to symptoms of increased Merapi volcanic activity. This behavior has been going on for generations in the communities on the southwest slope to the west of Merapi volcano. Communities in this region have understood some of the symptoms of the physical environment related to the increase in Merapi volcanic activity. Setyawati et al. [31] explained that there were several environmental symptoms related to the increase in eruption potential that were understood by the community in the southwestern part of Merapi Volcano, including physical symptoms such as roaring and lightning from volcanic directions, behavior of wild animals away from volcanic areas in groups, as well as symptoms of damage or inhibition of growth of several types of community agricultural crops. If various symptoms of this physical environment arise, it will be addressed by the community with increased alertness. Among community members usually, remind each other of the possibility of an increase in volcanic activity. This behavior provides learning to the public to recognize physical signs related to the potential for eruption hazards while waiting for official information about the status of eruption activity of Merapi Volcano.

This behavior greatly helps the community in increasing alertness and preparedness in the face of disasters. Hereditary behavior can be useful as a medium of transfer of knowledge regarding the initial symptoms of increased Merapi volcanic activity. The behavior of this community is formed as a result of community interaction for a long time with the physical environment of Merapi Volcano. The community knows the symptoms that show an increase in volcanic activity which is then addressed with behavior and becomes a learning for the next generation. In the modern era such as the current behavior in addressing physical symptoms is supported by accurate information from those obtained from the government based on observations of increased volcanic activity by the scientific method.

The behavior of the people in the southwestern slopes to the west of the Merapi Volcano is formed because the habits of people in this region from time to time in the past often face the danger of eruption. Eruption records show that the southwest slope to the west of Merapi Volcano in the past is the area most affected by eruption [2]. For the next generation, this behavior has the value of learning because there is a transfer of knowledge about increasing eruption activities. Learning in the community through this behavior was not always found in people who lived in the volcanic landscape. For example in the volcanic Sumbing and Sindoro volcanic regions, the people there do not understand the existence of an eruption danger. Even the public views the Subing and Sindoro only ordinary mountain is not a volcano [33].

- Traditional activity

A traditional activity is a form of local wisdom in which there are often values of disaster education. There are many traditional activities in the study area like *Saparan*, *Ruwahan*, and *Nyadran*. *Saparan* is an activity carried out on the Sapar month, the second month in the Javanese calendar system or the same as the prayer month in the Islamic calendar. In the sapar month, activities are usually carried out by the village or the village, namely a joint prayer asking for salvation and gratitude for fortune, especially in the form of agricultural crops that have been obtained in a year. The saparan activities are

generally filled with wayang kulit performances such as those carried out by the Kemiren Village and Kaliurang Village in October 2018. Other forms of *Saparan* activities are earth alms ceremonies, namely the ceremony to parade the *tumpeng* (cone rice) and various other foods which are then eaten together by the village community and visitors from outside the village. This earth charity ceremony is carried out in the village of Kemiren as an expression of gratitude for the harvest. In the activities of *Saparan* both through wayang kulit performances and earth charity ceremonies are usually inserted messages containing the value of disaster education. For example, people were reminded that they lived in the Merapi Volcano area. This region has provided abundant resources to the community so it must be grateful, however, the community is also reminded to always ask God for salvation because they are in a potentially disastrous area. Messages about this disaster remind the community to always have preparedness in the face of disasters. Usually, community leaders or village elders in giving remarks often remind about the events of disasters that have occurred in the past as learning for the future.

Other traditional activities such as *Nyadran* and *Ruwahan* also have the meaning to thank God for the blessings that have been given and pray to be protected from danger. *Nyadran* and *Ruwahan* activities are basically prayer activities with all the village people for their ancestors. People gather and pray together in this *nyadran* activity. In this activity information that is valuable to disaster education can also be delivered even though it is rarely discussed compared to the activities of *Saparan*. In *ruwahan* activities, common prayers are generally accompanied by festivity with cone rice (*tumpeng*) and various other types of food. The rice cone (*tumpeng*) which resembles a cone turns out to mean that the condition of the village community has a strong harmony, runs straight with the same rhythm, so it does not cause disputes and deviations to the villagers. *Jadah Bakar* means that people do not burn land in the mountains so that natural conditions remain sustainable. The ornaments on the rice cone (*tumpeng*) mean that security in the mountain area can be maintained. In the Wonolelo Village area, there are also various types of offerings prepared in pairs that have the meaning of male and female gender. This is because the residents analogize Mount Merapi as a man and Mount Merbabu as a woman. The values of shared prayer and semiotics in food used in *ruwahan* activities are meaningful to always remind humans to thank God for the blessings that have been given and pray to be protected from danger. In the activity also included stories of the eruption of the past of Mount Merapi along with identifiable signs.

- Community association

One of the characteristics of the life of the village community is the culture of togetherness between members of the community as indicated by various activities of community associations. In the activities of this association, there is interaction and intensive direct communication between community members. Citizens' associations can be in the form of incidental activities such as *jagongan* or *tahlilan*, as well as routinely scheduled activities such as *mujahadahan* and *ronda*. Interaction and direct communication between community members make it possible to exchange information relating to the danger of Merapi volcanic eruptions. In meetings that are incidental, such as *jagongan*, for example, there is not always talk from the community regarding Merapi volcanoes, but it is not uncommon for people to communicate about Merapi volcanic activity, especially when there is an increase in activity and official information about the increase in activity.

*Mujahadahan* is a routine prayer activity which is held regularly every Friday night (Thursday night) or Night *Selasa kliwon*, which is a market day that occurs every 35 days. *Selasa kliwon* is a combination of *selasa* and *kliwon*, *selasa* is one day in seven days (*Selasa* = Tuesday), *kliwon* is one of the five market days in Java (*pon*, *wage*, *kliwon*, *legi*, and *pahing*). This *mujahadahan* activity is a prayer ritual that is carried out in people's homes in turns or in certain places such as mosques or village retreats. *Mujahadahan* is carried out by the method of Islamic religion which is the majority religion of the community but does not rule out the possibility of community members who embrace other religions also taking part in this activity and praying with the procedures of their religion. *Mujahadahan* develops not only as a joint prayer activity but also routine community meeting activities which are usually carried out in the neighborhood unit (*RT*) or in certain moments some *RT* in one hamlet join in one forum.

Because this religious activity is a routine meeting of community members, this activity is a very effective means of conveying various information to the community. One of them is information about the volcanic activity of Merapi. In addition to non-formal information exchange that develops through citizen conversations, at certain times, for example, when there is official information about increasing volcanic activity in Merapi, *RT* heads and village staff and OPRB members usually submit information formally. Of course, the discussion about Merapi volcanoes did not always occur in this activity but at certain times when there was an increase in Merapi volcanic activity. Village elders in Kemiren Village once said that philosophically this *Mujahadahan* began with a joint prayer in a post-eruption crisis situation around the 1960s. Village elders occasionally reminded of the dangers of eruptions faced by society, historical eruptions of the past, and areas that have been hit by eruptions in the past.

*Ronda* is an activity carried out daily by the community in an effort to maintain security in the environment where they live. In the southwestern part of the Merapi Volcano *ronda* is not only carried out to maintain the security of criminal acts but also as a form of preparedness to face disasters when there is an increase in the activity of Merapi Volcano. Through this *ronda* activity, there is interaction and communication between citizens and there is usually an exchange of information regarding the increase in eruption hazards that are officially conveyed by the government and the handling that will be carried out in the event of a disaster. Through *ronda* various information about the status of increasing Merapi volcanic activity, updating the results of monitoring activities, zoning disaster-prone areas and handling them, information about the characteristics of Merapi activities is usually conveyed non-formally through this activity.

- Oral Story

Storytelling verbally, especially by the elderly members of the community is also an effective means of communication for the community to recognize the danger of the eruption of Merapi Volcano, especially the history of past eruptions. The narrative of oral stories usually occurs in the family, but it does not rule out the possibility of occurring in community associations. Information conveyed in oral stories includes the history of past eruptions, handling disaster emergency eruptions by the community in the past, toponym places associated with eruption disasters, and myths. Myths are quite widespread in the volcanic region of Merapi, including on the southwest slope and west of the Merapi Volcano. People at this time generally do not trust myths in relation to eruption activities and potentially erupted areas. However, it turns out that this myth also has philosophical and educational values in the face of disasters that can be applied well as supporters of handling official disasters from the government. Setyawati et al. [31] explained that in the southwest slope of Merapi Volcano there are many myths related to the eruption disaster. For example, there is a myth that when an eruption occurs, there is a magical connection between Merapi Volcano and the South Sea, then there will be a *arak-arakan* (procession) from Merapi to the South Sea where people are advised not to be in an area near the river to avoid the danger of the *arak-arakan* (procession). Through the analysis of geomorphological hermeneutics, the *arak-arak* (procession) was post-eruption rain lava which indeed led to the southern sea (Indian ocean) through river valleys which empty into the Indian Ocean. Regarding this myth Lavigne et al. [33] explains that the link between the Javanese people and their volcanic environment is very strong. In general, in Indonesia, almost all Indonesian volcanoes have their own legends, which usually involve gods, prince and princess, and mortals. In the Javanese cosmology, the Indian Ocean is home of the queen of the south, the princess of the south, who is renowned for influencing the Merapi activity.

In addition to myths through oral stories also conveyed signs of other physical environments which in the past became the guideline of the community in identifying the initial symptoms of an eruption disaster. Setyawati et al. [31] explained that there is local wisdom in the form of the ability to read the signs of the initial symptoms of an eruption disaster which are physical semiotics, faunal semiotics, and vegetal semiotics. Physical semiotics are physical signs such as roar from the mountain and the air temperature is hotter than normal. The ability to read physical signs is also found on the southern side of the Merapi volcano [34]. Faunal semiotics are signs of animals, namely wild animals on the slopes of the Merapi volcano leave their habitat in groups. There are also types of yellow butterflies clustered

away from the known Merapi Volcano as a sign of a catastrophic eruption. Vegetal semiotics is a condition of vegetation, especially agricultural crops that are not normal if an eruption will occur. Suggestions regarding the process of evacuating disasters are also widely conveyed through oral stories. In Wonolelo village, there are still early warning systems using kentongan which has been understood by the people for generations. Besides that, in the evacuation process, it is also taught from generation to generation to always be calm and not say negative words. The community believes that if an area is not calm and says negative words during the eruption of Merapi Volcano, the area will be affected by more eruptions than other regions where the community is calm and says positive things. Oral history is a traditional warning which is actually quite effective in preventing greater losses due to eruption disasters [34].

Oral history in the area of Merapi Volcano about volcanic disasters is still found and taught. However, because there are many myths in the oral history, the young population is not too familiar and doesn't follow too much. Oral history still exists from time to time because many people experience repeated eruption events that develop recognition of their environment. Casman [35] explained that the knowledge of the volcanic process provides unique input to the interpretation of oral tradition. Communities in the Merapi Volcano region since 1961 have experienced more than 10 eruption disasters, namely in 1961, 1967, 1968, 1969, 1984, 1986, 1992, 1994, 1997, 2001 2006, and finally in October 2010 [29]. This phenomenon that is experienced repeatedly in Javanese society will produce a treasury of knowledge. Sunarto [36] explains that from the phenomenon that occurs repeatedly, people will remember the incident and saved (bahasa: *disimpan*) in their memories as '*simpanan*'. In the Javanese language, it is often called *pasimpenan* or *parimbuan*. The word *parimbuan* then developed into *primbon*. *Primbon* is a deposit of the results of people's reminders of the events and experiences of good and bad that override them and are told intergenerationally. The oral history of the people in Merapi Volcano shows that education based on local wisdom through oral history is inseparable from the background of people who often experience disasters of an eruption. Different conditions are found in the Samoan Islands as explained by Németh [37]. The region also has the potential for volcanic disasters, but the oral history that teaches about volcanic hazards does not develop because young volcanic age is not active and has an impact on people's lives. While the eruption had happened but it was very long, namely 2 million years ago so that it did not allow interaction between the community and volcanic disasters. The oral history related to the developing myth is the origin of the population of Samoans including Christian teaching, war, and violations committed by the tribe.

- Getok tular

Education carried out by the community, especially in Wonolelo Village in teaching local wisdom related to disasters is usually carried out by Getok Tular means to inform one person to another, word of mouth. Besides that education is also done by giving examples to the younger generation, especially children regarding local wisdom that is routinely carried out. Getok Tular as a media for disaster education in Wonolelo Village, Sawangan Subdistrict, according to the informants, is the best media. Evidence from the statement is the community unity in Wonolelo Village is very thick. The impact of this tradition of Getok Tular is that people are increasingly united and understand in recognizing the signs of disasters. This tradition is not only done for the indigenous people of Wonolelo Village but also applies to all Wonelelo people including migrants. The holder of the control of Getok Tular is the family which is the place for the child's first education.

There are many forms of community activity that can be used as a medium of transfer of knowledge regarding the dangers of Merapi volcanic eruptions and their handling. In the current era of information technology advances where access to information can be done quickly and easily, disaster education informally in the community does not only play a role in delivering content that is also local wisdom but content that is official and scientific information from the government. Informal disaster education can be an alternative to support formal disaster education. The big question that then arises is how much influence does informal education have in this society? Lavigne et al. [33] explained that people on the southern slopes of the Merapi volcano, which are around the Boyong River, did not feel the threat of an

eruption in the future, even after the pyroclastic flow which resulted in 69 fatalities in the Turgo Hamlet in the 1994 eruption. the gendol river after the 2006 eruption. Lack of hazard knowledge in both cases is caused by people not knowing pyroclastic flow due to time lapse since the last pyroclastic flow occurrence at the beginning of the 20th century. This condition shows that disaster education in the future needs to be more functioned to equip the public with information about the characteristics of the Merapi eruption, the history of the Merapi eruption, the threat of future disasters, and mitigation actions that can be taken. As an alternative to supporting formal education, education in an informal society can also be empowered.

#### 4.4. *The influence of the physical environment on the development of local wisdom-based disaster education*

Local wisdom in the area of the Merapi Volcano was formed as a result of people's recognition of their physical environment [31]. The geographical physical environment is one of the factors that determine the formation of local wisdom in a region [38]. In their lives, people try to adapt for a long time with environmental conditions so that local wisdom is formed which upholds environmental ethics and local knowledge [36]. Lavigne et al. In their research in several volcanic landscape areas on Java Island, showed that behavior in facing disasters was influenced by perceptions of disaster threats. This, of course, is inseparable from the community's introduction to the landscape where they live including the danger. This various information indicates that the formation of local wisdom in the form of disaster education in some areas of Merapi Volcano, of course also can not be separated from the influence of the physical environment in the region. The physical environment, in this case, is Merapi volcano with its activities.

Merapi Volcano as an active volcano in addition to causing disaster for the lives of people in disaster-prone areas also produces various natural resources that are beneficial in supporting life. Sutikno et al [39] explained that Merapi Volcano has the potential of water resources, land resources, mineral resources, and biological resources. A large number of potential resources is very useful in fulfilling the daily needs of the community. On the basis of these conditions, the community was inspired to celebrate thanksgiving for the various adequacy given by God through Merapi Volcano so that the traditional ceremonies such as *saparan*. On the other hand, because Merapi Volcano also harbors potential hazards, the community is also constantly vigilant and begs for protection so that activities such as *mujahadahan*, *ruwahan*, and various oral stories that aim to remind the community to always be aware of the potential of Merapi volcano disaster.

Merapi Volcano in its activities produces various types of eruption products including lava, pyroclastic, and lava [39], [40]. At certain times when the volcanic eruption of Merapi is explosive, there is a rumble accompanied by lightning around the center of the eruption. Various types of material produced from eruptions and visual symptoms that can be observed when an eruption also inspires the community so that physical semiotics develop in the form of the introduction of natural signs. Even the myth of the *arak-arakan* (procession) from Merapi Volcano to the South Sea arises because of people's perceptions when they see rain-triggered lahar. Rain-triggered lahar are in the form of debris flowing across river valleys like a group that creates a rumble. Regarding the myths of the *arak-arakan* (procession) that arose to provide education about the Rain-triggered lahar, it was confirmed by the elders of the community in Kemiren Village. A toponym somewhere is also formed because people observe certain events due to eruptions in a place in the past. For example on the banks of the Bebeng river on the southwest slope of Merapi Volcano, there is a toponym place called Nglaharan. Viewed from the origin, he said, *nglaharan* comes from the word *lahar*, what is meant here is pyroclastic flow (*nuees ardentes*). Local people in the volcanic region of Merapi are used to refer to pyroclastic flows with the term *lahar*. Lavigne et al [33] explained that in the event of the 1994 eruption the community warned by shouting "lahar ... lahar ..." when they saw pyroclastic flow entering the Boyong River valley.

Another toponym is Kaligesik Village derived from the word *kali* = *sungai* = river and *gesik* = *pasir* = sand, related to river valleys filled with lava flow. Kaligesik Village is currently administratively included in the Kemiren Village area. If seen on the sheet geological map of Yogyakarta in 1995 [41]

there are lava deposits in southern slopes of Merapi Volcano and *lahar* deposits which develop as lava terrain landform and *lahar* terrain [39]. Murwanto et al [42] explained that on the southwest slope there were eruptions resulting from the eruption in 1961, namely on the slopes of the volcano and sediment from the eruption of 1969 at the foot of the volcano. This 1969 eruption deposit confirmed by the elders of Kemiren Village who explained that the eruption of 'lahar' in 1969 flowed through the batang river until reach the west of the Kemiren village. Meanwhile, on the western slopes, there are older material deposits, namely 1822 eruption pyroclastic and before.

## 5. Conclusion

Education is an important part of disaster risk reduction. On disaster management cycle, education is part of disaster management with the aim of increasing awareness and understanding of disasters. In addition to being formally implemented, disaster education can be done with informal such as local wisdom in community. In the southwestern slope to the west slope have many community activity that can be use to transfer of knowledge about Merapi Volcano eruptions and mitigation. Some of disaster education delivered by informal method and unstructured like behavior, traditional activity, community gathering, oral history, and *getok tular*. Behavior and oral history are the most effective media on transfer of knowledge about Merapi Volcano eruptions. Traditional activity, community gathering, and *getok tular* which have little role as disaster education media of disaster education, but sometimes also plays as role in the process of transfer knowledge about disaster. In this study the interview process was still limited to several villages on the southwest slope of the volcano Merapi and a comparison of the valley between the volcano Merapi-Merabu which was located on the west side of the Merapi Volcano. In further research can be still follow up by gathering information in other parts of the Merapi volcano. The area of the western slope of the Merapi volcano has also not been explor in detail in this study and needs to be deepened through subsequent research.

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