



RESEARCH ARTICLE

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Implementation of Town and School Watching for Disaster Education to the Communities in Sidomulyo Village, Pronojiwo, Lumajang

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Received 25 November 2022; Received in Revised Form 31 December 2022; Accepted 02 January 2023

Abstract

The eruption of Mount Semeru on December 4, 2021, caused a fairly high death toll of up to 50 people. The high number of fatalities is caused by the lack of mitigation capacity and the absence of community involvement in mitigation efforts. Increased mitigation capacity can be done by presenting disaster education to the communities. Thus, we applied the concepts of school watching and town watching in Pronojiwo District, Lumajang Regency. School watching was implemented in eight schools located at Sidomulyo Village. We also carried out town watching in Sidomulyo Village and brought out ±33 residents to the Sidomulyo village hall. The implementation of school watching and town watching in Pronojiwo District can increase community involvement in disaster mitigation efforts and public awareness of mitigation efforts.

Keywords: Town watching; school watching; hazard mitigation; community; Semeru eruption.

Introduction

Disasters are the result of natural and social processes. The natural state of an area presents a potential hazard, which can appear as a natural disaster (geo-hazard). Indonesia is a country prone to natural disasters and is even known as a natural disaster laboratory (Wibowo et al., 2013). The most frequent natural disasters in this country are earthquakes, tsunamis, volcano eruptions, floods, droughts, typhoons, and landslides. In history, the natural disasters that have claimed the most victims are earthquakes and volcanic eruptions (Sastrawan, 2022; Indonesia Expat). The most unforgettable event is the earthquake followed by the tsunami in Aceh and Nias Island on December 26, 2004 which killed 230,000 people in 14 countries and caused losses of nearly \$11.4 billion



(Indonesia Expat, 2018; The World Bank, 2019; Syugiarto, 2021; Parwanto & Oyama, 2014). The Bantul earthquake (2006), the Bengkulu earthquake (2007), the Lombok earthquake, and the Palu earthquake which was followed by the tsunami and liquefaction (2018) were also several earthquake events which resulted in the deaths of more than 1,000 people and large material losses (Syugiarto, 2021; Prasojito et al., 2021).

Apart from earthquakes, volcanic eruptions are also disasters that kill lives and even have a very significant impact on the world. The eruption of Mount Tambora on April 10, 1815 became the most catastrophic eruption in Indonesia that is said to have killed nearly 71,000 human lives in history and disrupted the world's climate, starting from abnormally cold weather in the Northeastern US, Canada, Europe, and causing crop failure in New England (Oppenheimer, 2016; Wirakusumah & Rachmat, 2017). In addition, the eruption of Mount Krakatau on August 27, 1883 is also known as the second largest eruption that caused a tsunami and killed nearly 37,000 people in the Sunda Strait and Lampung (Hidayat et al., 2020). Moreover, tsunami waves as high as 30 meters spreaded throughout the North Coast of Java and were visible to the South Coast of Java destroying 165 villages and the after-effect changed social mobility during the colonial era on a large scale (Imadudin & Erwantoro, 2021).

Indonesia is an archipelagic country covered by active volcanoes which erupt regularly at certain periods throughout the year. Mount Merapi, Galunggung, Kelud, Sinabung, Semeru, are some examples of very high-risk active volcanoes and have a long-recorded history of eruptions (Nakada et al., 2019; Hariyono & Liliyasi, 2018). The secondary eruption of Mount Semeru which occurred on December 4 2021 left a deep scar for the affected community. Based on information obtained from Mount Semeru Volcano Monitoring Post (PPGA) officers, there were two earthquakes and a pyroclastic avalanche with amplitudes of 21–25 mm which lasted 480–5160 seconds (Sofian, 2021). This stated that the event categories as a secondary eruption where the eruption occurs due to avalanche activity caused by high rainfall intensity in that month (Wardhani, 2021).

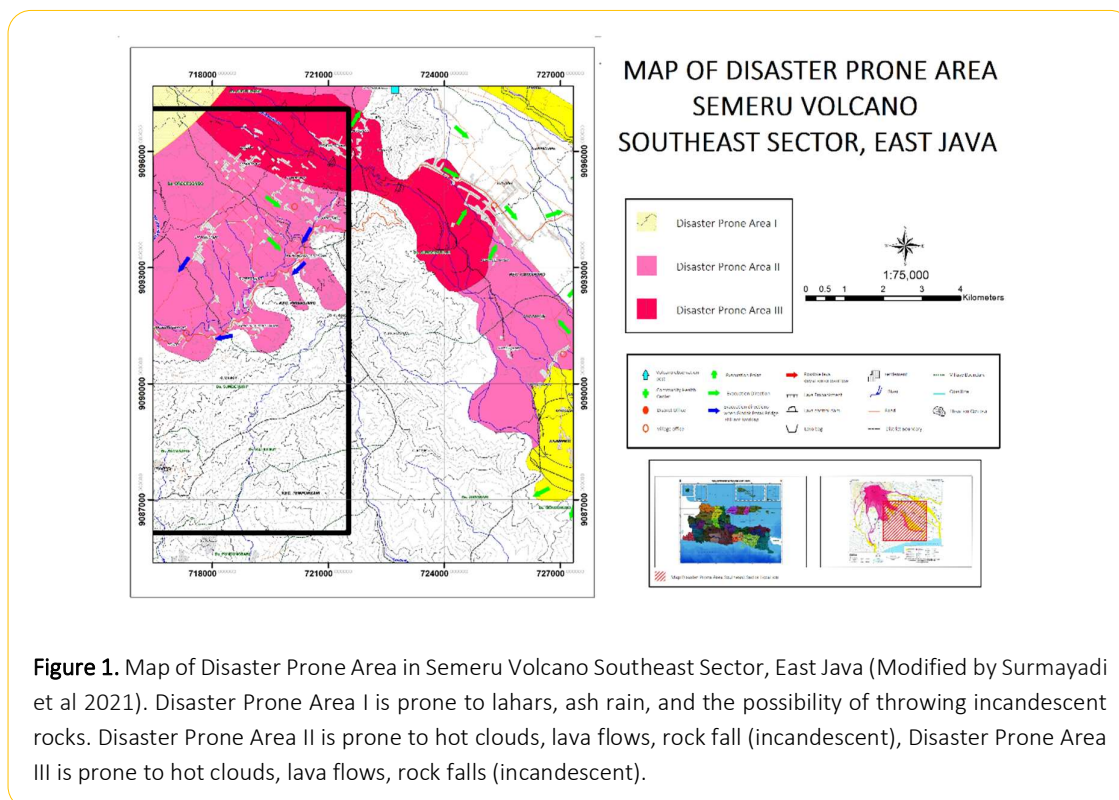
The secondary eruption of Semeru Volcano that occurred on December 4, 2021 was estimated to lose of more than 500 billion (Adit, 2021) with 56 people dead, 4 people severely injured, 12 people being hospitalized, and 7915 people displaced in 396 evacuation points. It also damaged several public facilities such as 1027 habitable houses, 2 kilometers of major roads, 1 connecting route, 19 worship facilities, 1 health facility, and 25 educational facilities (PT Baca Indonesia Kreatif, 2022) at 3 districts in Lumajang Regency (Pronojiwo, Candipuro, and Senduro; Table 1). According to Maryanto et al. (2018), mitigation that carried out in disaster-prone areas still faces numerous obstacles, thus the implementation is not optimal and does not involve community participation.

Table 1. areas affected by the eruption of Mount Semeru

District	Village	Secondary Eruption Impact
Pronojiwo	Pronojiwo	Pyroclastic fall
	Oro Oro Ombo	Pyroclastic fall
	Sumber Urip	Pyroclastic fall
	Curah Kobokan	Pyroclastic fall
Candipuro	Kamar Kajang	Pyroclastic fall
	Sumber Wuluh	Pyroclastic fall
	Sumber Mujur	Pyroclastic fall
	Penanggal	Pyroclastic fall

Senduro	Ranupane	Light intensity pyroclastic fall
	Senduro	Light intensity pyroclastic fall

Fig. 1 is a map of disaster-prone areas on Semeru Volcano focused on Pronojiwo District, Lumajang Regency (Modified by Surmayadi et al 2021). It can be seen that several villages in Pronojiwo District are included in the I, II, and III-prone areas from the Semeru volcano eruption. Several other villages, for example, Sidomulyo, are not included in the three prone areas, but also cannot be said to be safe because their location is still less than 10 kilometers from the center of the Semeru volcano eruption. Therefore, if the Semeru eruption occurs with a larger capacity in the future, this area is still potentially affected by the expansion of pyroclastic fall, heavy ash rain, and incandescent rocks. This also happened in the Pronojiwo village which actually is a safe zone, but at the time of the last eruption of Mount Semeru on December 4, 2021, it was also affected by the pyroclastic fall (Table 1; Fig. 1).



So far, the community has only relied on the early warning installed on Semeru Volcano (Kurniawan, 2021). This early warning will be delivered when the volcano experiences a primary eruption that is characterized by magma symptoms rising to the surface from the recorded instrument around the volcano. Due to the eruption on December 4 being a secondary eruption, the early warning did not detect the hazard signal, thus many residents were unable to save themselves. In addition, the public's lack of understanding about disasters, especially volcanic eruptions also make them confused when an eruption occurs suddenly without notification.

People living in areas prone to volcanic eruptions should be aware that behind the fertility of the soil and the abundant natural resources in the area, there is a danger that threatens when a volcano erupts. They must at least aware of the basics of self-rescue when an eruption occurs. In fact, they must also understand the signs seen in the area where they live before the disaster occurs so that they still have time to prepare themselves when an eruption occurs one day. Based on this, we propose a town/school watching program to provide public understanding regarding disaster education, especially volcanic eruptions. Communities living in disaster-prone areas will try to prepare, anticipate and adapt to disasters known as disaster management efforts. Disaster mitigation can increase public awareness and guide disaster management immediately or as soon as possible (Setyowati, 2019). This activity will be carried out in Sidomulyo Village, Pronojiwo District, Lumajang Regency, East Java. The selection of this location is based on the fact that this area is one of the locations that will have an impact if the eruption of Semeru Volcano happens again in the future.

Town Watching itself is an activity developed in the 1970s in Japan as a participatory tool of community building or community planning (Evans, 2021 in Yoshida et al., 2009). Town Watching aims to form a community that is responsive to natural disasters. As the name suggests, town watching means observing the city. However, this activity is not limited to just observing, but also examining the surrounding environment, making some notes, and documenting it using a camera. This activity is based on the fact that the residents or community have the best understanding of their environment and is involving all the layers of the local community.

Many activities have implemented town watching as part of disaster management in disaster-prone areas (Utsu et al., 2019; Weston & Sampson, 2019; Pek, 2019; Ogawa et al., 2005). The success of town watching later be expanded by focusing the observation in a school, hence the name school watching. School watching is student-based activities including school observation, examining the school building and its environments. The aims of school watching itself is to picture a mitigation measures and evacuation route if a disaster occurs during school time.

The town and school watching activities are something new adapted for disaster education in Indonesia, because the concept of this activity is that academics go directly to the field to foster the community. Even though it is still relatively new, town/school watching activities have been successfully carried out in various areas of Indonesia that have disaster risks such as the Mount Kelud area (Maryanto, et al., 2018) and disaster risk reduction education using town watching activities in Aceh (Goto, et al., 2010). School watching has also been implemented to increase students' knowledge about earthquake disasters (Sari & Khatimah, 2015) and floods in Jakarta (Asian Disaster Preparedness Center, 2010).

This research aims to test the effectiveness of the implementations of town and school watching methods to ameliorate the community who resides in regions prone to disaster and increase awareness about mitigation measures. We hope that after these activities were completed, the residents understand their places much better that may be dangerous, facilities that are useful during a disaster, locations that can be used as evacuation areas during a disaster, and so on. It is also hoped that this activity will create groups of residents who care about disaster risks, thus later they can become community investments before, during, or after a disaster.

Methods

This research used a quantitative approach that is quasi-experimental by testing the difference in the community's understanding level before and after the implementation of town and school watching. We implemented the basic steps for town watching and modified them for school watching activities according to the community

condition at Sidomulyo Village in accordance with what was done by Ogawa et al (2005), Utsu et al (2019) and handbook from Shaw & Takeuchi (2009).

In town watching method, the subject is the representatives of local residents in Sidomulyo Village that consists of 33 people who come from several society, i.e., teachers, village officers, youth organization, and ordinary residents. The implementation of town watching took place in Sidomulyo Village and divided into three stages of activities.

1. Socialization that aim to provide early disaster information to the community and was begun by spreading questionnaires to test the depth of their knowledge about disaster and mitigation measures.
2. Mapping the environment by observing the building and their surroundings, later collected the findings about the problems and disaster risk potentials by creating a map that includes an evacuation route for the neighborhood. All participants branched into four teams, and each was given an observation route map of the Besukcukit, Sidomulyo Village, shown in Fig.2.
3. Discussion stage that aims to sharpen the critical thinking skill of the community by discussing their findings during observation and looking for best solutions to overcome the issues. During the discussion, the outcome of the implementation of town watching is shown as the community begin to actively aware about the disaster potentials surround them and be more determined about their safety.

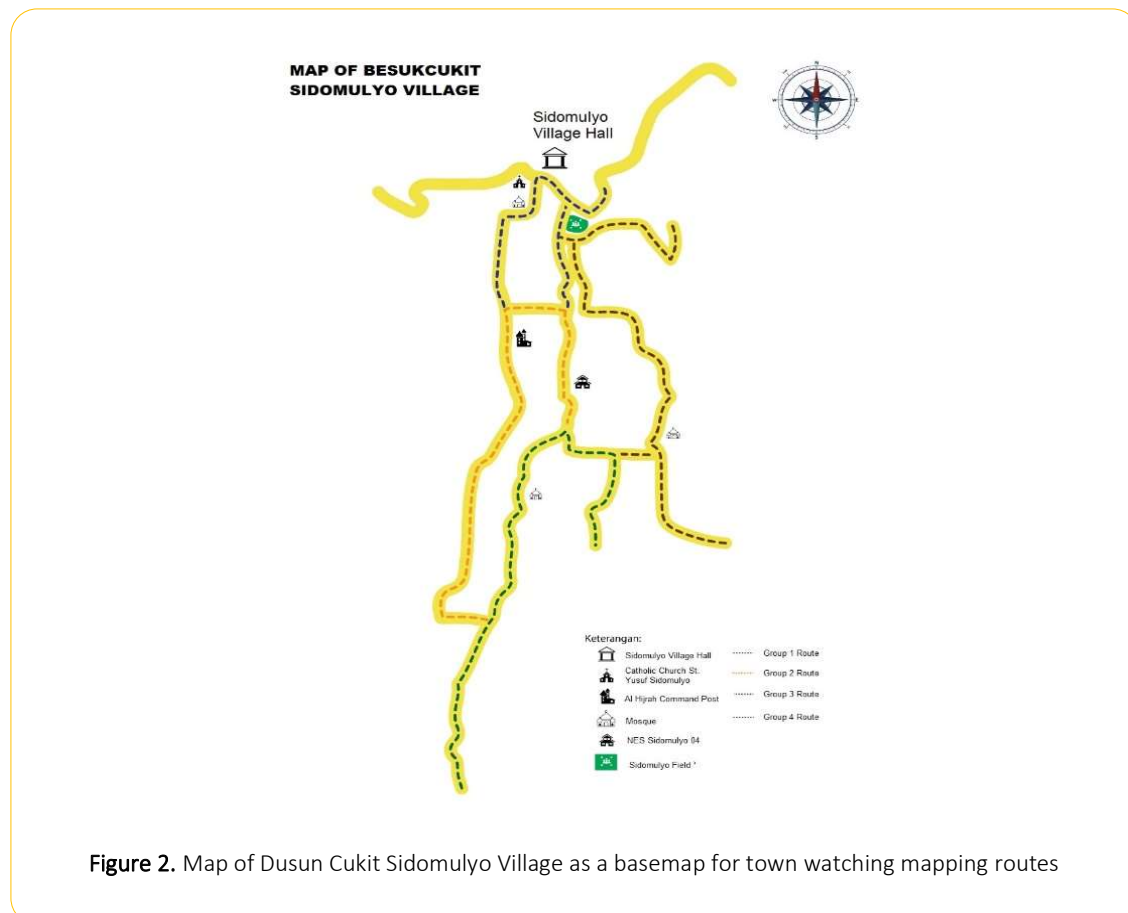


Figure 2. Map of Dusun Cukit Sidomulyo Village as a basemap for town watching mapping routes

Meanwhile, the school watching method was carried out in eight schools ranging from kindergarten, i.e., Muslimat NU Supiturang Kindergarten, elementary school, i.e., Sumberurip 02 Public School, Sidomulyo 01 Public School, Sidomulyo 02 Public School, Sidomulyo 03 Public School, Sidomulyo 04 Public School, and junior high school in Pronojiwo District, i.e., Pronojiwo 2 Junior High Public School and Nusantara Junior High School. The students involved in the stages of the implementation of school watching activities are from grade 4 and 5 in elementary school and grade 7 and 8 in junior high school.

Prior to the beginning of the activities, the students were given basic questions related to mitigation measure and school watching itself. It aims to determine their initial understanding about mitigation measure and school watching. The activities for the elementary and junior high school students comprise of three stages.

1. Socialization to deliver the material that consists of disaster and mitigation basic knowledge. In addition, the socialization was closed by a volcanic eruption experiment to demonstrate the eruption process to the students, and they acquired more understanding about the Mount Semeru as the biggest threat of their lives.
2. Observation stage is done by observing the school building to locate accident potentials and high-risk points. During the observation stage, students also create a school evacuation route map by routing a safe route and fixing the assembly point.
3. Group discussion stage to find best solution of their findings by presenting in front of others.

The activities conducted in kindergarten had several modifications to adjust the recognition and learning ability of the students who are still in early ages. The introduction of the disaster and mitigation measure were delivered by watching video animation, playing puzzle, and sing a song.

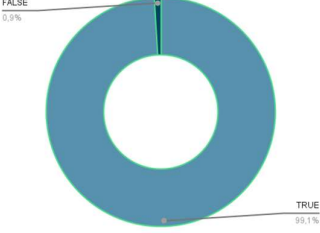
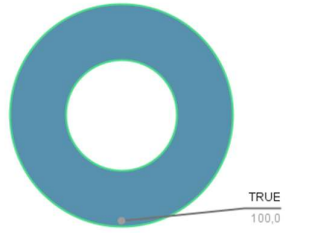
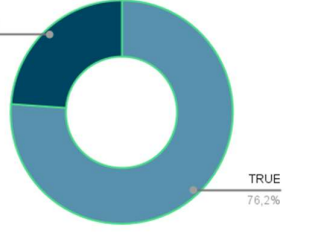
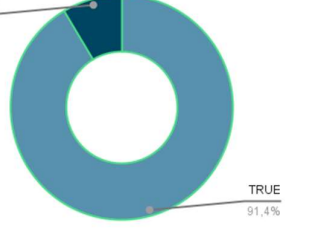
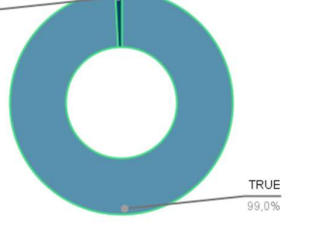
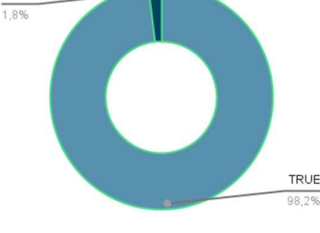
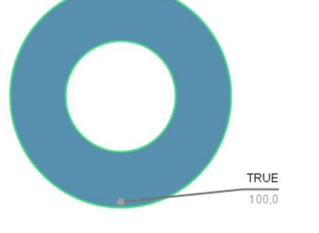
Data collection to gain first-hand resources on the outcome of the implementation of town and school watching was done by spreading questionnaires. The participants were given the same questions twice, before and after the activities were conducted. The questionnaire aims to test the depth of participants' knowledge and understanding of disaster and mitigation measures and how the implementation of town and school watching increase their knowledge and understanding regarding the topic discussed. The results of the questionnaires later be transformed into graphical data to simplify the analysis.

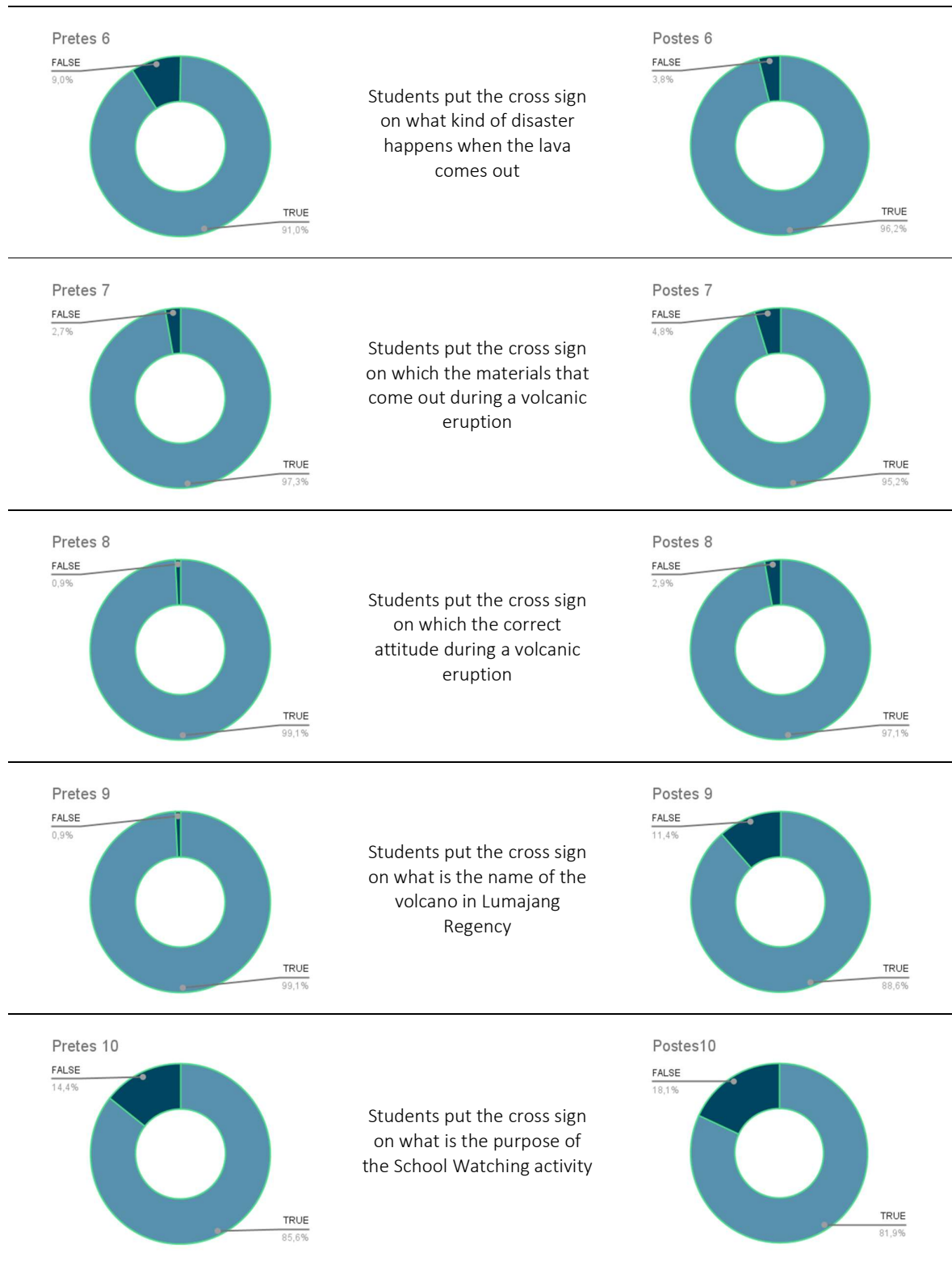
Results and Discussion

School Watching

We expect to enlighten representative students from every education level possible and later they can share their knowledge and experiences with the others. Hence, we collected 111 representative students from grade 4 and 5 from elementary students, grade 7 and 8 of junior high students, and kindergarten students as participants to reconstructed the school watching steps. To find out the level of students' understanding of the volcanic eruptions basic, we distributed questionnaires in the form of pretest questions which were conducted before the socialization and posttest afterward (Table 2).

Table 2. Questionnaire results of school watching

PRETEST	QUESTION	POSTEST
Pretes 1  FALSE 0,9% TRUE 99,1%	Students put a cross sign on a volcanic eruption picture	Postes 1  TRUE 100,0
Pretes 2  TRUE 45,0% FALSE 55,0%	Students put the cross sign on which the activities around the school to observe objects and places that are dangerous when a disaster occurs	Postes 2  FALSE 23,8% TRUE 76,2%
Pretes 3  FALSE 17,1% TRUE 82,9%	Students put the cross sign on which is the cause of an earthquake	Postes 3  FALSE 8,6% TRUE 91,4%
Pretes 4  FALSE 3,6% TRUE 96,4%	Students put the cross sign on which is the correct attitude during an earthquake	Postes 4  FALSE 1,0% TRUE 99,0%
Pretes 5  FALSE 1,8% TRUE 98,2%	Students put the cross sign on which is a dangerous place or object when a natural disaster occurs	Postes 5  TRUE 100,0



The socialization was done by introducing about volcanic eruption disaster to the students. Moreover, the familiarization of what students must do before, during, and after the disaster also be presented by asking the student to be active in class by playing games, watching videos, and doing the simple experiments (Fig. 3).



Figure 3. The socialization in school watching was done by playing games, watching videos, and doing the simple experiments (Photo by MBKM Semeru Team).

Looking at the recapitulation of the questionnaires at Table 2, the percentage of students' understanding of disaster mitigation and school watching was 89.37% by referring the correct answers for each question given before the activities. The results show an increase of 4.19% on the level of correct answers to 93.56% after the activities that show the students are more educated. The understanding of school watching escalates compared to other topics in the questions. Before the implementation of school watching, the level of students' understanding about school watching was at 45%, and found an increase in the understanding level of 31.2% after the activities were carried out that reach 76.2%.

For the mapping activity, students observed their school environment and finding that various objects need to be avoided when a disaster occurs. We take one example from the observation in Sidomulyo 04 Public School (Fig. 4). The results of observations around the Sidomulyo 04 Public School are shown in Table 3. From the findings of these observations there were several school buildings that were cracked, brittle, and broken which at any time could fall on anything underneath which could injure school members or other losses. In addition, electrical cables that are not arranged properly will be an obstacle for the school residents who pass through them.

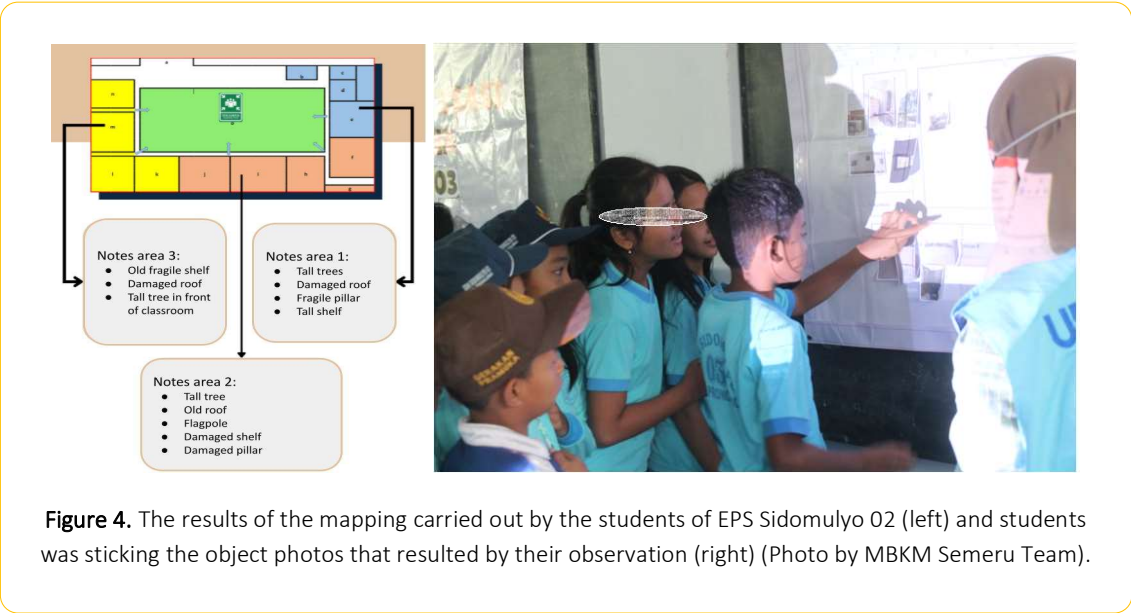


Table 3. Observation notes in Sidomulyo 04 Public School.

Problem Findings and Drawings	Problem Impact	Security Level Description
Fragile roofs and ceilings 	The roof can collapse at any time and affect the people underneath.	It's dangerous around n, m, l, k buildings.
Cracked wall 	Walls that are left cracked and there is no repair being done the cracks will be wider. Can be dangerous during teaching and learning activities.	It's dangerous in some parts of the school building.

Broken glass 	Broken glass can injure students doing activities around it.	It's dangerous around the area of buildings n, m, l, j, k, l, h, and f.
Wooden debris 	Wooden debris in the room.	It's dangerous around the building m.
Detached door hinge 	Detached door hinges result in the door not standing upright and can collapse on students during teaching and learning activities.	It's dangerous around j, i, and h buildings.
The power cord is not placed properly	Electrical wires that are not placed properly can cause a short circuit and can be dangerous if students play around it.	It's dangerous around j, i, and h buildings.
Fragile support pillar	The support pillar can collapse at any time because the bottom part is brittle.	It's dangerous in the h and c part of the building

(Photo by MBKM Semeru Team)

In addition to checking the effectiveness of the delivery methods of the socialization and observation techniques, the students were given an evaluation form to decide whether or not the implementation of school watching was successful (Table 4). As seen in the Table 4, the activities are increasing the level of understanding of most students and is proven by the 91.7% students which stated that the activities add more to their knowledge related to disaster. The percentage number can be reached due to the effectiveness of the material delivery and that it was comprehensive with 91.7% students claimed. The mapping activity which is making school evacuation routes is also a concern where 85.4% of students can memorize evacuation routes in their schools as a result of carrying out observations and making evacuation routes. Lastly, 73.6% of students stated that they could implement the correct evacuation process when a natural disaster occurs.

Table 4. Recapitulation of participant satisfaction evaluation questionnaires in the implementation of school watching in pilot project schools.

Do you already know what disaster mitigation is?	Have there been any disaster mitigation activities at school before?	Was the material presented easy to understand?	Do you understand what a natural disaster is?	Do you currently know the evacuation routes at school?
Pertanyaan 1 	Pertanyaan 2 (SD 01) 	Pertanyaan 3 	Pertanyaan 4 	Pertanyaan 5 
Does this activity add new knowledge related to disaster?	Were you able to properly apply the evacuation process when a natural disaster happened?	Is this activity interesting?	Do activities like this need to be done again?	If there was an activity like this again, would you take part in it?
Pertanyaan 6 	Pertanyaan 7 	Pertanyaan 8 	Pertanyaan 9 	Pertanyaan 10 

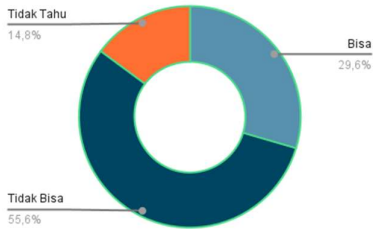
Town Watching

The implementation of town watching activities were carried out by making productive age residents the focus of providing the content for socialization. Before town watching activities, research was carried out to find out residents' understanding of disaster mitigation and town watching. As many as 55.6% of residents stated that they did not know about town watching, 22.2% stated that they had heard of it and 22.2% stated that they knew about town watching. It is also known that 70.4% of residents have never participated in socialization events regarding disaster mitigation. After the town watching activities were carried out, 75.9% of residents stated that the material presented in the town watching socialization was relevant to disaster problems in the community. In addition, according to 89.7% of residents, Town watching activities can make a good contribution to anticipating disasters that may occur. Responses from these activities are presented in the Table 5 and the mapping activity can be seen on Fig. 5.

Table 5. Questionnaire Results for town watching activity.

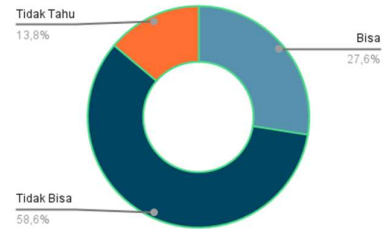
PRETEST	QUESTION	POSTEST																										
Pretes 1 (TW) <table><tr><th>Disaster Type</th><th>Percentage</th></tr><tr><td>Angin</td><td>2.9%</td></tr><tr><td>Longsor</td><td>23.2%</td></tr><tr><td>Banjir</td><td>8.7%</td></tr><tr><td>Erupsi</td><td>24.6%</td></tr><tr><td>Gempa</td><td>37.7%</td></tr></table>	Disaster Type	Percentage	Angin	2.9%	Longsor	23.2%	Banjir	8.7%	Erupsi	24.6%	Gempa	37.7%	What natural disasters often occur in your neighbourhood?	Postes 1 (TW) <table><tr><th>Disaster Type</th><th>Percentage</th></tr><tr><td>Angin</td><td>7.5%</td></tr><tr><td>Kebakaran</td><td>4.5%</td></tr><tr><td>Tanah</td><td>16.4%</td></tr><tr><td>Banjir</td><td>7.5%</td></tr><tr><td>Gunung</td><td>23.9%</td></tr><tr><td>Gempa</td><td>40.3%</td></tr></table>	Disaster Type	Percentage	Angin	7.5%	Kebakaran	4.5%	Tanah	16.4%	Banjir	7.5%	Gunung	23.9%	Gempa	40.3%
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Pretes 3 (TW) <table><tr><th>Response</th><th>Percentage</th></tr><tr><td>Tidak Tahu</td><td>25.9%</td></tr><tr><td>Tidak</td><td>3.7%</td></tr><tr><td>Bahaya</td><td>70.4%</td></tr></table>	Response	Percentage	Tidak Tahu	25.9%	Tidak	3.7%	Bahaya	70.4%	Will the natural disaster be more dangerous/less dangerous for the surrounding community?	Postes 3 (TW) <table><tr><th>Response</th><th>Percentage</th></tr><tr><td>Tidak Tahu</td><td>31.0%</td></tr><tr><td>Tidak</td><td>3.4%</td></tr><tr><td>Bahaya</td><td>65.5%</td></tr></table>	Response	Percentage	Tidak Tahu	31.0%	Tidak	3.4%	Bahaya	65.5%										
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Pretes 4 (TW)



In your opinion, can the community prevent this natural disaster?

Postes 4 (TW)

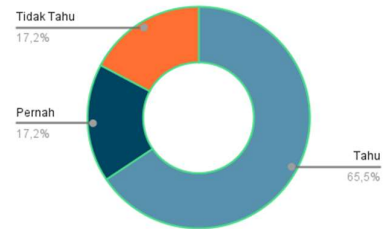


Pretes 7 (TW)

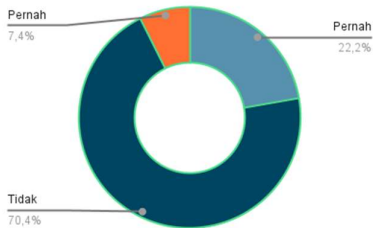


Do you know about Town Watching?

Postes 7 (TW)

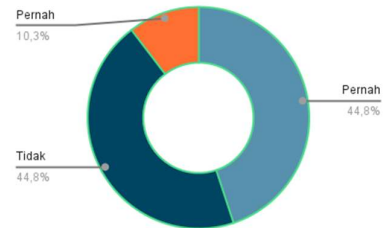


Pretes 8 (TW)

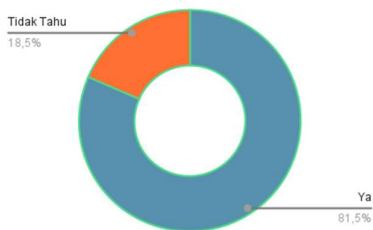


Have you ever participated in a similar socialization event?

Postes 8 (TW)

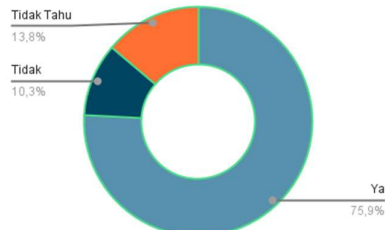


Pretes 9 (TW)

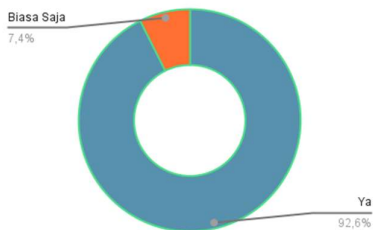


Is the town watching material relevant to the problems when a disaster occurs in the community?

Postes 9 (TW)

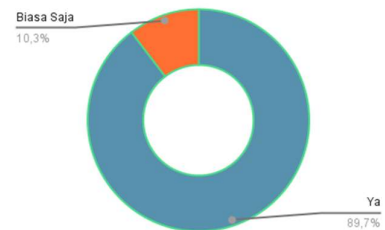


Pretes 10 (TW)



Is town watching material useful for the community?

Postes 10 (TW)





According to the observation stage, the residents could construct a map that shows areas that prone to disaster and accidents. For instance, there is an area where the cables are exposed to the ground which can be dangerous if something trigger short circuit and later cause fire. This finding leads the residents to try to clean the mess and avoid future disaster. Moreover, the Mount Semeru that stand near the neighbourhood as the biggest finding that threaten their lives might be inevitable, yet the residents now aware of the mitigation measures.



Figure 4. Residents was doing the observation at their village (above) and presented them during town watching discussion in Sidomulyo Village Hall. (Photo by MBKM Semeru Team and SEG Student Chapter UB).

Based on the assessment carried out, there was an increase in the participants' understanding of disaster mitigation. Observing school watching is a tool that helps the school community, including teachers, education staff, and students, to understand the environment around the school and the objects in it that have hazard potential. In addition, it can also be used as evaluation material for schools to repair places or objects in the school that are already damaged, fragile, and dangerous for the school community. We took an example from Sidomulyo

02 Public School. The building can be categorized to buildings that still look decent. However, it cannot be concluded immediately that the building is not dangerous for the school community, especially if a disaster occurs. Objects such as ceilings/roofs, mirrors, supporting pillars, and so on which are found in the table above remain dangerous objects and must be avoided. In addition, whilst observing the school that was conducted by students, objects or buildings such as the Sidomulyo 02 Public School monument, Pancasila monument, trees, and water tanks are also findings that must be avoided by school residents if a disaster occurs at any time.

Town and School watching both can be continuous activities in the future. This is done thus civilization and students are able to recognize more about their own environment and the potential hazards that can be happens. These activities could become a new culture, especially if they are developed within the school environment, to continuously improve knowledge and preparedness in dealing with disasters.

Conclusions

Based on the assessment carried out, there was an increase in the participants' understanding of disaster mitigation, School Watching, and Town Watching. Thus, it can be concluded that the implementation of Town Watching and School Watching activities can increase community awareness and understanding of disasters through advanced and independent disaster education that starts at an early age.

Acknowledgments

This research was partially funded by the Institute for Research and Community Service Universitas Brawijaya in the Serving Doctoral Grant Program based on contract number 973.61/UN10.C10/PM/2022. The authors thank Bumdes Sidomulyo and SEG Student Chapter University of Brawijaya for facilitating this activity as well as MBKM Semeru participants who were involved in every School/Town Watching activity.

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