Building volcanic disaster resilience community through school and education

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Abstract. School has a significant role in building community resilience since school has the responsibility to deliver knowledge and science in one hand, and has the capacity to implement disaster risk reduction education in the other hand. Having more than eighty schools located in volcanic disaster prone areas, Merapi volcano is one of the most densely populated volcanoes in the world. Therefore, it is important to understand the role of schools in implementing disaster risk reduction education through a program entitled Sister School and to analyse teachers’ and pupils’ knowledge and experience on volcanic disaster and risk reduction awareness program. In addition, this research tries to analyse their acceptance towards this disaster resilience program. This research was conducted in two schools located in a volcanic prone area, one as affected school and one as supporting school. The results showed that schools located in the highest volcanic prone area participate in the Sister School program. Most of teachers and pupils of the affected school and supporting school have good knowledge on volcanic disaster since most of them experienced the 2010 Merapi volcanic eruption and participated different volcanic risk reduction awareness programs. Teachers and pupils have positive acceptance towards sister school program.

1. Introduction
Disaster risk reduction is a long-term activity, as part of sustainable development, by using knowledge, innovation, and knowledge to build a culture of survival and resilience in all societies [1]. Disasters may disturb education and may provoke emotional shock or trauma. Under the United Nations Convention on the Rights of the Child (44/25 of 20 November 1989), children have absolute rights in all conditions – including disasters, when they are at their most vulnerable – and the right to contribute in decisions that eventually affect them [2]. It is important therefore to educate children about disaster risk and empowering them to use the knowledge, and to ensure the participation and voice of children in DRR efforts. Education can be influential in cultivating the essential knowledge, skills, and attitudes to prepare for and to cope with disasters, as well as in assisting the community to return to a normal life (resilience) [3].

2. Merapi Volcano: mainstreaming volcanic risk reduction
Volcanoes in Indonesia are part of the Pacific Ring of Fire. The Indonesian archipelago contains more than 120 active volcanoes, which is more than any other country. About 76 of them have erupted in
historical times. It contains some of the world’s most famous volcanoes like Toba, Krakatau, Tambora, and Merapi. Merapi stratovolcano (2965 m) is located in Java, Indonesia, 30 km north of the inner city of Yogyakarta [4]. Merapi volcano is one of the most active volcanoes worldwide. Approximately 1.3 million people live within a radius 20 km from the summit [5]. Administratively, Merapi volcano is located on the border of four districts or Kabupaten: Sleman in the Special Region of Yogyakarta, and Magelang, Boyolali and Klaten in the Central Java Province. Out of the 1.1 million people living on the flanks of the active Merapi volcano, more than half are at high risk in areas prone to pyroclastic flows, surges, and lahars. People accept to live at risk because of the rich volcanic soil [6]. In the long run, volcanic deposits can develop into some of the richest agricultural lands on Earth. The volcanic disaster-prone area (KRB – Kawasan Rawan Bencana in Indonesian language) of Merapi is shared into three areas, namely KRB III, KRB II and KRB I (from high to low hazard level). KRB III is an area near the source of danger, frequently affected by pyroclastic flows, lava flows, ash fall and mudflow known as the lahars (Figure 1).

Figure 1. Volcanic Disaster Prone Areas into three zone: dark pink (KRB III – most hazardous area); pink (KRB II – medium hazardous area); yellow (KRB I – least hazardous area) (source: CVGHM, 2011).

The outcomes from volcanic unrest is quite unique since every single eruption even it is coming from the same volcano may have different characteristics [7]. A volcano may have an erupting activity for several day or even several years. The threat of the Merapi volcanic eruption needs to be watched out by preparing various facilities and infrastructure for residents, especially school and other physical infrastructure. Therefore, disaster risk reduction program on volcanic prone area is needed. One of the disaster risk reduction and awareness program in the southern part of Merapi volcano is Sister School program. In the concept of sister school, affected schools (school located in the highest prone area)
become sister with buffer schools which is located in relatively safe areas. This concept is derived from another program called Sister Village which had been implemented after the 2010 Merapi eruption, notably in Magelang and Sleman Regency [8]. The Sister School relation is therefore mentioned in an agreement or in a memorandum of understanding between two schools. Thus, in the event of an emergency (when a volcanic disaster occurs) where it is not possible to carry out the teaching and learning process, to ensure the continued implementation of learning activities, all components of the school affected by the disaster will be transferred to the buffer schools.

This paper is conducted under a research scheme entitled “Persaudaraan Merapi (School Sisterhood for Disaster Risk Reduction in Merapi Volcano)” where some preliminary results were published in [9]. In this paper, the authors aimed (i) to understand the role of schools in implementing disaster risk reduction education through a program entitled Sister School, (ii) to analyze teachers’ and pupils’ knowledge and experience of volcanic disaster and volcanic risk reduction awareness programs, and (iii) to study their acceptance towards this disaster resilience program.

3. Material and Methods

This paper analyses two schools, SDN Glagaharjo Public Elementary School and SDN Bronggang Public Elementary School. Both school are selected since they are located in the highest prone area (KRB III) and both are included in sister school programs created by the local government. One school acts as the affected school, namely SDN Glagaharjo Public Elementary School, and the other acts as the supporting/buffer school namely SDN Bronggang Public Elementary School. The last school however is located more than 15 kilometers from Merapi summit (Figure 2).

We conducted in-depth interviews towards the school principals, in addition, we did census questionnaires among the teachers in both schools, there were 11 teachers at affected school and 10 teachers in supporting/buffer school. In addition, we also conducted survey questionnaires towards 60 pupils, 30 pupils from the affected school and the other 30 coming from the supporting/buffer school.
The in-depth interview guideline consists of 38 questions which cover 7 themes including: knowledge; opinion; involvement; infrastructure; institutional readiness; implementation and practice of sister school. While the questionnaires towards teachers and pupils consist of 31 closed questions comprise of knowledge and experiences on volcanic disaster and volcanic disaster risk awareness programs; and their acceptance towards this sister school program. The results from in-depth interviews were analysed qualitatively, while the results from the questionnaires were analysed quantitatively.

4. Results and Discussion

4.1. Role of school in disaster risk reduction through Sister School Program
As a place for education, schools are in charge for not only giving lessons on disaster risk management, but in Merapi, during the volcanic crisis in 2006 as well as in 2010, some cases schools also serve as internally displaced persons (IDP) camps [10]. Since volcanic disaster is uncertain, there might be a possibility when a disaster occurs during school hours. In this case, the school has to consider that students are part of the elements of risk and school has to react timely to such an event [11].

In Merapi, especially in Sleman Regency, most of schools located in high hazard zone participate in the different disaster risk reduction (DRR) programs offers not only by the Local Government through a Regional Disaster Management Agency, but also by different institutions such as universities, non-governmental organizations, etc. The DRR programs conducted in schools comprise practical environmental knowledge, steps on disaster preparedness, structural and non-structural mitigation as well as disaster drills. All these activities are meant to effectively reduce future damage and loss, and to enhance school resilience to disasters.

In Sleman, different programs with regard to DRR activities were held in schools. In 2012, the local government initiated Safe School program and then continued with an advanced program called Disaster Preparedness School (Sekolah Siaga Bencana). SSB program is aimed to increase disaster awareness by educating preparedness principles, increasing community disaster resilience and reducing disaster impacts and risks [11]. In 2015, these programs were continued as Sister School program. In this program, a school located in the highest prone area has its pairing school (called as its sister school) which is located in relatively safe areas. This relation is therefore mentioned in an agreement or in a memorandum of understanding between two schools. Therefore, when Merapi Volcano erupts and it is not possible to conduct the teaching and learning process, to make sure the continuous carrying out of learning activities, all components of the school affected by the disaster will be relocated to the pairing school (sister school).

At the beginning, the Sister School program was also aimed at making emergency funds efficiently to build emergency schools in the event of a disaster. According to the 2010 Merapi volcano disaster event, many emergency schools were established with minimal resources. Learning and teaching activities are carried out only in emergency tents, without tables and chairs, with limited equipment and often exposed to dust, wind or heavy rain for more than two months. As a result of the very difficult situation, in the end of the academic year, many pupils did not succeed to have their best notes on the final exams. Until nowadays, there are more than 19 pairing schools under the Sister School Programs in Sleman Regency, one of the pairing schools who are fostered continuously are SDN Glagaharjo, located less than 10 km from Merapi’s summit and near to Gendol River, and SDN Bronggang, located approximately 15 km from Merapi’s summit. For both schools, the Sister School program is an essential to mechanism to ensure the safety of children during school and the continuity of education in the event of a volcanic eruption and volcanic crisis, especially during the evacuation period [9].

4.2. Knowledge and experience on volcanic disaster and its awareness campaign
Disaster is a threatening event that can come suddenly. Therefore, a disaster risk reduction strategy needs to be carried out. Simulation and disaster reduction training in schools is one of the efforts that can be done to reduce disaster risk. Knowledge about disasters can minimize and anticipate the impacts that can be caused by these conditions.
According to the result (table 1), most of the teachers had experience in previous volcanic disaster of Merapi Eruption, 100% teachers from SDN Glagaharjo and only 90% teachers from SDN Bronggang, since the respondent started to work after the 2010 volcanic eruption. Most of the teachers from SDN Glagaharjo has experienced different Merapi volcanic disasters, such as the 1994, 2006 and the latest one in 2010. Some teachers in both schools had the experience in giving a lecture during a volcanic crisis, 81% from SDN Glagaharjo and only 50% from SDN Bronggang. Most of the teachers giving lecture during the volcanic crises at IDP camps and or at other schools located in the safer area. Most of the teachers confirmed that they did not mind to give a lecture outside their schools, the most important thing that they can still give lecture to their pupils, so they will not miss any lesson, although some lectures stated that they did not feel comfortable to give lecture outside their schools (in the IDP camps and/or other schools). According to table 2, almost all of the respondents have experienced volcanic disaster. They also experienced evacuation during the 2010 eruption, although some of pupils mentioned that they did not evacuate because some of them did not remember. Most of the pupils also did not experience learning activity during the period of evacuation.

Table 1. Teachers’ Experience in Volcanic Disaster

| Teachers’ Experience in Volcanic Disaster | SDN Glagaharjo (n=11) | SDN Bronggang (n=10) | Total (n=21) |
|------------------------------------------|-----------------------|----------------------|-------------|
| Volcanic Disaster Experience             | 100% 0%               | 90% 10%              | 95% 5%      |
| Evacuation during the 2010 Eruption      | 91% 9%                | 90% 10%              | 90% 10%     |
| Teaching Activity during the Period of Evacuation | 81% 19% | 50% 50% | 67% 33% |

Source: Analysis Result

Table 2. Pupils’ Experience in Volcanic Disaster

| Pupils’ Experience in Volcanic Disaster | SDN Glagaharjo (n=30) | SDN Bronggang (n=30) | Total (n=60) |
|----------------------------------------|-----------------------|----------------------|-------------|
| Volcanic Disaster Experience           | 100% 0%               | 97% 3%               | 99% 1%      |
| Evacuation during the 2010 Eruption    | 90% 10%               | 80% 20%              | 85% 15%     |
| Learning Activity during the Period of Evacuation | 33% 67% | 40% 60% | 37% 63% |

Source: Analysis Result

According to the results (table 3) there are 19 among 21 teachers at SDN Glagaharjo and SDN Bronggang who had already received disaster risk reduction program and awareness. There were only two teachers from SDN Bronggang who did not receive any disaster risk reduction program and awareness since both of them are new members of the school and there was no awareness program since their admission to the school. Most of the training and or awareness program were given by Sleman Regional Disaster Management Board in association with the Education Office of Sleman Regency. Other activities on volcanic DRR were disaster mitigation, first aid, trauma healing, and the preparation of contingency plans were carried out by different institutions, such as universities and/or non-governmental organization. All teachers who received disaster awareness program in both school transferred their knowledge on disaster risk reduction towards pupils at school. Teachers also experienced disaster simulation program and most of them (82% in SDN Glagaharjo and 60% in SDN Bronggang) transferred it towards their pupils. As stated by [12], lack of disaster prevention knowledge
among teachers may create difficulties the sharing of risk reduction knowledge with students, fortunately, this is not the case in Merapi where majorities of teachers have experience in disaster risk reduction and awareness program.

**Table 3. Teachers’ Experience in Disaster Risk Reduction and Awareness Program**

| Teachers’ Experience in Disaster Risk Reduction and Awareness Program | SDN Glagaharjo (n=11) | SDN Bronggang (n=10) | Total (n=21) |
|---|---|---|---|
| Disaster Awareness Program | Yes | No | Yes | No | Yes | No |
| Giving Lesson on Disaster Risk Reduction towards Pupils at School | 100% | 0% | 80% | 20% | 90% | 10% |
| Disaster Simulation Experience | 91% | 9% | 80% | 20% | 86% | 14% |
| Giving Lesson on Disaster (Evacuation) Simulation towards Pupils at School | 82% | 18% | 60% | 40% | 76% | 24% |

Source: Analysis Result

DRR program and awareness also dedicated to pupils in both schools. There were 90% of 30 pupils in SDN Glagaharjo had participated in disaster risk reduction awareness program and 83% of respondents participated in disaster simulation. While in SDN Bronggang, there were only 67% of 30 pupils who had participated in disaster risk reduction awareness program and only 53% participated in disaster simulation. In addition, a total of 83% of respondents from SDN Glagaharjo and 50% of respondents from SDN Bronggang confirmed that they received disaster material in class (table 4).

**Table 4. Pupil’s experience in Disaster Risk Reduction and Awareness Program**

| Pupil’s experience in Disaster Risk Reduction and Awareness Program | SDN Glagaharjo (n=30) | SDN Bronggang (n=30) | Total (n=60) |
|---|---|---|---|
| Experience on Disaster Risk Reduction Awareness Program | Yes | No | Yes | No | Yes | No |
| Experience on Disaster Simulation | 90% | 10% | 67% | 33% | 78% | 22% |
| Experience of Getting Disaster Related Material in Class | 83% | 17% | 53% | 47% | 68% | 32% |

Source: Analysis Results (2018)

**4.3. Teachers and pupils’ acceptance towards Sister School Program**

Volcanic crisis may last for only several hours in some cases, but it may also last until several months or even years due to the uncertainty of the volcanic crisis and its evacuation [13]. Therefore, it may have consequences on teaching and learning activities (education activities). However, since education is essential in order to cultivate the essential knowledge, skills, and attitudes to prepare for and to cope with disasters, as well as to the community to return to a normal life (resilience) [3], for that reason it is important to support the continuation of teaching and learning activities for children/pupils. This is also one of the reasons why the sister school program is needed to be conducted.

In addition, a total of 11 teachers at Glagaharjo and 7 teachers at Bronggang are ready to carry out teaching and learning activities during the evacuation in the future when disaster strikes (table 5). All respondents from SDN Glagaharjo stated their willingness to teach in another school or IDPs camp as well as sharing their class with another teacher coming from pairing school. While the result from SDN Bronggang shows a variation where not all the teachers have the willingness to teach during volcanic
crises, some of them are not yet ready to teach in another school and share their class with teachers from another school. This may because the respondent is not yet familiar with the Sister School program and had not experienced on the previous volcanic crisis in 2010 (table 5).

**Table 5. Teacher’s Acceptance towards Teaching and Learning Activities during Evacuation Period (Volcanic Crisis)**

|                              | SDN Glagaharjo (n=11) | SDN Bronggang (n=10) | Total (n=21) |
|------------------------------|------------------------|----------------------|--------------|
|                              | Yes | No | Do not know yet | Yes | No | Do not know yet | Yes | No | Do not know yet |
| Willingness to Teach during Volcanic Crisis/Evacuation | 100% | 0% | 0% | 70% | 20% | 10% | 86% | 10% | 4% |
| Willingness to Teach in other schools/IDP camps | 100% | 0% | 0% | 80% | 0% | 20% | 90% | 5% | 5% |
| Willingness to Teach in the same class together with teachers from other schools | 100% | 0% | 0% | 80% | 10% | 10% | 90% | 5% | 5% |

Source: Analysis Results (2018)

Meanwhile, a total of 25 (83%) pupils from SDN Glagaharjo and 21 (70%) pupils from SDN Bronggang were happy to continue learning activity during volcanic crisis/evacuation so that their learning activities were not left behind (table 6).

**Table 6. Pupils’ Acceptance of Learning and Teaching Activities to be conducted during Evacuation Period (Volcanic Crisis)**

|                              | SDN Glagaharjo (n=30) | SDN Bronggang (n=30) | Total (n=60) |
|------------------------------|------------------------|----------------------|--------------|
|                              | Yes | No | Do not know yet | Yes | No | Do not know yet | Yes | No | Do not know yet |
| Willingness to Learn during Volcanic Crisis/Evacuation | 83% | 17% | 0% | 70% | 23% | 7% | 77 % | 30% | 3% |

Source: Analysis Results (2018)

Some 20 out of 25 pupils from SDN Glagaharjo chose to study at other schools, while the other 5 chose to study in the IDP camps during the evacuation. While 23 pupils from SDN Bronggang wanted to stay in school when the evacuation chose to study at school. Unlike that, a number of 5 pupils from SDN Glagaharjo and 7 other SDN Bronggang pupils did not like to go to school during an evacuation because they were afraid of the threat of a sudden disaster (table 7).

**Table 7. Expected location as a new learning place during Evacuation Period (Volcanic Crisis)**

|                              | SDN Glagaharjo (n=30) | SDN Bronggang (n=30) | Total (n=60) |
|------------------------------|------------------------|----------------------|--------------|
|                              | Schools/Other Schools | IDP Camps | Do not want to study | Schools/Other Schools | IDP Camps | Do not want to study | Schools/Other Schools | IDP Camps | Do not want to study |
| Expected location as a new learning place during Volcanic Crisis/Evacuation | 67% | 17% | 17% | 77% | 0% | 23% | 72% | 8% | 20% |

Source: Analysis Results (2018)
Most of the respondents stated that they are happy to share learning activity with pupils from other schools (50% from SDN Glagaharjo and 90% from SDN Bronggang). They also show their willingness to share their learning activity by being in the same classroom with pupils from other schools (70% from SDN Glagaharjo and 83% from SDN Bronggang) (table 8). This positive acceptance from pupils towards sharing the learning activity and sharing classroom with other pupils coming from hazardous area and vice versa may lead to a good response towards the Sister School program. In this program, pairing schools must share their learning activity including resources that they have during the volcanic disaster crisis or evacuation period.

Table 8. Pupils’ Acceptance for Sharing Learning during Evacuation Period (Volcanic Crisis)

|                                        | SDN Glagaharjo (n=30) | SDN Bronggang (n=30) | Total (n=60) |
|----------------------------------------|------------------------|----------------------|--------------|
|                                        | Happy | Indifferent | Unhappy | Happy | Indifferent | Unhappy | Happy | Indifferent | Unhappy |
| Pupil’s Acceptance for Sharing Learning Activity with Pupils from Other Schools | 50%   | 40%        | 10%     | 90%   | 0%          | 10%     | 68%   | 23%          | 8%      |
| Pupil’s Acceptance for Learning in One Class with Pupils from Other Schools | 70%   | 20%        | 10%     | 83%   | 10%         | 7%      | 77%   | 15%          | 8%      |

Source: Analysis Results (2018)

The minimum essentials for implementing DRR-based program at school, as stated by [14] are an annual school plan that involves an annual evacuation drill and a school budget for conducting disaster preparedness activities. In addition, regulation from local government, such as Education Agency Circular Letter towards all school headmasters to include these mechanisms in the schools’ annual plans is therefore required [14]. Furthermore, schools may help students and staff in order to provide emotional or psychological supports that they need to assist them to move on [15].

5. Conclusion
This ongoing study tries to understand the role of schools in implementing disaster risk reduction education through a program entitled Sister School. The result shows that in the two selected schools, teachers’ and pupils’ knowledge and experience of volcanic disaster and volcanic risk reduction awareness programs are high. Both schools experienced the latest Merapi volcanic disaster in 2010 and both participated in different awareness programs offered by local government and other organizations/institutions. Most of teachers and pupils in both schools are aware of Sister School Program and show their acceptance to the program. Most teachers are ready to carry out teaching and learning activities during the evacuation in the future when disaster strikes. All teachers from SDN Glagaharjo stated their willingness to teach in another school or IDP camp as well as sharing their class with another teacher coming from pairing school, while some teachers from SDN Bronggang did not yet mention their acceptance towards this program. From the pupils’ point of view, unfortunately there are still some respondents who were not able to accept the idea of continuing to carry out teaching and learning activities during the crisis period. In this case, some awareness program of DRR in school is therefore still needed in order to enlighten the pupils the importance of education, not only to ensure that the learning activity continues despite disasters, but also to cultivate the essential knowledge, skills, and attitudes to prepare for and to cope with disasters, as well as in assisting the community to return to a normal life as mentioned by Selby and Kagawa (2012).

Acknowledgements
Authors would like to show gratitude to the Directorate of Research and Community Service of the Ministry of Research, Technology and Higher Education (Kemenristekdikti) of the Republic of Indonesia and Universitas Gadjah Mada for their generous funding and support under the research scheme “Penelitian Dasar Unggulan Perguruan Tinggi 2018-2019”. Authors also thanks Regional
Disaster Management Agency of Sleman Regency, Education Office of Sleman Regency, Headmasters and lecturers of SDN Bronggang and SDN Glagaharjo, as well as our research assistants.

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