Exploratory study for strengthening education sectors for responding to complexities due to NATECH (NAatural-Hazard triggered TECHnological disasters) disasters

Fatma Lestari¹, Yasuhito Jibiki², Dicky Pelupessy³, Fumihiko Imamura⁴, Agustino Zulys⁵, Abdul Kadir⁶, Debby Paramitasari⁶

¹ Occupational Health & Safety Department, Faculty of Public Health, Universitas Indonesia; Disaster Risk Reduction Center, Universitas Indonesia, ² Next Generation Volcano Researcher Development Program, Graduate School of Science, Tohoku University, ³ Faculty of Psychology, Universitas Indonesia; Disaster Risk Reduction Center, Universitas Indonesia, ⁴ International Research Institute of Disaster Science, Tohoku University, ⁵ Chemistry Department, Faculty of Mathematics and Natural Science, Universitas Indonesia; Disaster Risk Reduction Center, Universitas Indonesia, ⁶ Disaster Risk Reduction Center, Universitas Indonesia

Corresponding author’s e-mail address: fatma@ui.ac.id

Abstract. The city of Cilegon in Banten Province, Indonesia is selected as a site of this study. The city locates in the western edge of Java Islands and is known as one of the most famous and significant heavy industrial zones in Indonesia. Cilegon is potentially exposed both to natural and industrial hazards so that we can consider it as a suitable place for studying NATECH (NAatural-Hazard triggered TECHnological disasters) disaster situations. The Indonesian government indicates the presence of seismic gap in the Sunda Strait and the associated tsunami risk. Large-scale facilities of chemical, petrochemical, oil and gas industries stand in coastal areas in Cilegon. The industry and its surrounding communities can be affected by combination of the natural and industrial disasters. In Cilegon, we aim at strengthening capacity of the education section in the Cilegon city government and the school principals and teachers. Our preliminary implementation and survey reveal that knowledge and understanding of teachers are very limited. We will combine existing research findings from both of industrial accidents and tsunami, and develop educational materials.

1. Introduction

Indonesia is one of the countries whose regions have disaster risks from low levels to high levels. BNPB (the national disaster management agency of the Indonesian government) indicates that Cilegon City, locating in Banten Province on Java Island, is one of the high-risk cities of disasters with a Disaster Risk Index of 182.40. The Disaster Risk Index itself is the result of combining the values of the index of hazards, vulnerabilities, and capacities of each region. The potential for disasters that threaten Cilegon City are 11 types of disasters, namely floods, technological failures, droughts, extreme weather, forest and land fires, epidemics and epidemics, landslides, earthquakes, tsunamis, flash floods, and extreme and abrasion waves. Pulomerak Subdistrict has high hazard potential in floods, technological failures, extreme weather, landslides, tsunamis and flash floods. Cilegon City has a low level of regional capacity
for disasters that requires “the Implementation of Regional Preparedness Exercises Gradually, Tiered, and Continued (BNPB, 2015; Deputy for Prevention and Preparedness of BNPB, 2015).”

In the stage of disaster mitigation, the Ministry of Social Affairs of the Republic of Indonesia has a program called “Kampung Siaga Bencana (Disaster Prepared Village)” which aims to "a) provide public understanding and awareness about disaster hazards and risks; b) establish community-based disaster alert networks and strengthen the social interaction of community members; c) organize a community trained in disaster preparedness; d) guarantee the implementation of sustainable community-based disaster preparedness; and e) optimizing potential and resources for disaster management." (RI Minister of Social Affairs Regulation No. 128 of 2011 concerning Kampung Siaga Bencana, 2011a). The Kampung Siaga Bencana has the element to give people the understanding and awareness to form networks and strengthen social interaction among villagers, organize, guarantee sustainability, and optimize potential and resources (Habibullah, 2013). Lebak Gede Village in Cilegon City is one example of the Kampung Siaga Bencana implementation, which was inaugurated by the Ministry of Social Affairs of the Republic of Indonesia in 2015. Such practice, however, still needs to be strengthened because the community does not fully recognize the functions and activities of the Kampung Siaga Bencana. In addition, the program from the Cilegon office of the Indonesian Red Cross related to disaster risk reduction has been still largely focusing on handling floods and mobilizing limited community involvement.

Almost the same thing was done also by the Ministry of Education and Culture of Republic of Indonesia to prepare for disaster on a school scale, namely the Disaster Safe Education Unit program, or commonly called the “Sekolah Siaga Bencana (Disaster Preparedness School)”. One of the programs was based on the impacts of the disasters on the education sector in Indonesia: during the past 15 years, there were 45,648 schools affected by the natural disasters. The results of the mapping of schools located in disaster-prone areas by the Ministry of Education and Culture of the Republic of Indonesia and BNPB revealed that there were 250,000 educational facilities, such as, elementary schools, junior high Schools, high schools and Islamic-religious schools in disaster-prone locations. That means almost 75% of all schools in Indonesia are located in disaster-prone areas (Amri, 2017). Thus, disaster education is needed at the level of individuals, families, schools, and communities, where it is essential to elaborate knowledge on disaster risk reduction and contribute to safety from disasters (Tuladhar, Yatabe, Dahal, & Bhandary, 2015).

Our activity uses social-ecological models (SEM), namely theories to understand the interactive effects of individuals and the environment that can influence behavior. There are five layers in the SEM hierarchy, which starts from individuals, interpersonal, community, organization, and policy. Its application to the” Health Education and Behavior Health Promotion” intervention focuses more on individual and interpersonal characteristics compared to institutions, communities or policies. More successful interventions focus on the topic of nutrition and physical activity or those carried out in certain locations such as schools (Golden & Earp, 2012).

These disaster training and simulation activities are conducted at the level of individuals, interpersonal, community and organization. As An Gie (2017) found that disaster risk management and communication must focus on the development of “human capital” and “social capital”, using a community involvement approach, and reformulating preparedness for all hazards relevant to everyday interests. The provision of these activities is supposed to achieve the objectives of this study, which is to know the description of changes in knowledge of the people of Lebak Gede Village and schools in Cilegon after being given training and disaster simulation. The results of this study are expected to contribute to strengthen the capacity of the Kampung Siaga Bencana in the Lebak Gede Village of Cilegon City and prepare schools in Cilegon to become the Sekolah Siaga Bencana.

2. Method
The design of this study is quantitative descriptive research with a community-based disaster risk reduction approach based on the concept and practicality of disaster risk reduction through systematic efforts to assess and communicate risks by the community itself so as to help more people (WHO, 2015).
The development of community capacity, namely providing community training were carried out in Cilegon in July and September 2018. With using a purposive sampling method, our research studies the members of Kampung Siaga Bencana in the Village of Lebak Gede and the principal in Cilegon.

The Kampung Siaga Bencana training and simulation activities began with licensing and dissemination of activities to be carried out to the Social Service Office of Cilegon City and Lebak Gede Village. The activity was held on Sunday, July 8, 2018 in the Hall of the Lebak Gede Village office, Pulomerak District, Cilegon City.

Meanwhile, the training and simulation of the Sekolah Siaga Bencana started with the preparation of activities in the form of 1) licensing activities to the Education Office of Cilego City; 2) identification of disaster risk of the schools assisted by the Cilegon City Education Office and Cilegon City Disaster Management Agency (locally called “BPBD”); and 3) technical preparation for the implementation of activities. The activities were took place on Saturday and Sunday of September 22 and 23, 2018 in Cilegon City. The material was provided by Cilegon City Health Office, the office of the Indonesian Red Cross, Cilegon City BPBD, Indonesian Institute of Science (a national government body known as “LIPI”), University of Indonesia, and PT Dover Chemicals (a chemical company in Cilegon).

Primary data collection was done through filling out questionnaires consisting of activity evaluation questions, pre and post test, and school preparedness in the face of disasters in training and disaster simulation activities at village and school level to find out the knowledge of respondents regarding first aid during the disaster. Before filling out the pre and post test questionnaires, the respondents received exposure to knowledge and skills regarding disaster in training. These skills include the basic first aid, lifting and moving, and victim fixation provided by the University of Indonesia's Emergency Response Team. Exposure to knowledge and skills is one way of face to face communication that is believed to be an effective approach to knowledge sharing, learning and dialogue (Twigg, 2015).

Questionnaires used in this study based on the LIPI questionnaires for schools’ principals regarding Sekolah Siaga Bencana. The questionnaire consists of components of knowledge, early warning systems, policies and guidelines, resource mobilization, and emergency response plans. Univariate data analysis was performed using SPSS and Microsoft Excel so that it can produce descriptive data, namely the mean value in the form of percentage change in knowledge after the implementation of community service activities.

3. Results and discussions

3.1. Kampung Siaga Bencana training and simulation activities
The key to the community approach is the initial involvement with vulnerable communities before a disaster occurs to build a suitable understanding of the disaster challenges to be faced; identify problems; and build capacity to improve community resilience. Governments within the community can collaborate in training communities with academics to increase their capacity (Wells, Springgate, Lizaola, Jones, & Plow, 2013).

Table 1 shows the characteristic data obtained from 12 participants in the Kampung Siaga Bencana training and disaster simulation in Lebak Gede Village. The results demonstrate that the majority of participants were male with a percentage of 67%, while female respondents were 33%. Most of the respondents were born in Lebak Gede Village, namely percentage at 83%, and only 17% of respondents who were not born in Lebak Gede Village. 34% of the participants work as the private employees, while 33% of the participants do not work. The respondents who work as the civil servants and teachers have a percentage of 8% respectively, and others with a percentage of 17%. Most of the respondents were high school graduates, with a percentage of 58% and those of graduated from junior high school and university are 25%.

Formal education can improve disaster preparedness and reduce vulnerability to natural hazards. Communities that have a proportion of women with at least secondary education increase the likelihood of being prepared for disasters (Muttarak & Pothisiri, 2013).
Table 1. Characteristics of Respondents for Disaster Training and Simulation of Kampung Siaga Bencana in Lebak Gede Village, Cilegon City 2018

| Characteristics of Respondents                  | %    |
|------------------------------------------------|------|
| Gender                                         |      |
| - Male                                         | 33%  |
| - Female                                       | 67%  |
| Birth in the Village of Lebak Gede             | 83%  |
| Occupation                                     |      |
| - Civil servants                               | 8%   |
| - Teacher                                      | 8%   |
| - Private                                      | 34%  |
| - Does not work                                | 33%  |
| - Others                                       | 17%  |
| Level of education                             |      |
| - Junior high school                           | 25%  |
| - High school                                  | 50%  |
| - University                                   | 25%  |

The correlation value between the value of the pre test and post test was 0.085. This result means that the relationship between the two variables is statistically weak (see Table 2). The p-value of 0.016 implies that there was a difference in the level of knowledge of the respondents before being given training and after being given training. Effective intervention is not only to encourage people to want to have behaviors to prepare themselves in the face of disasters, but also to exercise their abilities. The more they feel they have control in preparing disaster behavior, the more they are motivated to prepare themselves in the face of disasters (Najafi, Ardalan, Akbarisari, Noorbala, & Elmi, 2017).

The study conducted by Karanci, Aksit, & Dirik (2005) shows that disaster training participants have more disaster expectations, can estimate losses, and have more preparedness behaviors. Higher income and informal support relate to the higher resources for disaster preparedness. Kim & Zakour (2017) propose an intervention model for decision makers and community leaders in terms of providing information and advice to community members about how to adequately prepare for disasters.

Preston, Chadderton, Kitagawa, & Edmo (2016) state that the type of learning is dependent on many social factors such as stress, trauma, civil innovation, and coercion.

Table 2. Pre Test and Post Test Results Disaster Preparedness Training and Simulation for Disaster Preparedness in Lebak Gede Village, Cilegon City 2018

| Variable      | Mean  | Correlation | p Value |
|---------------|-------|-------------|---------|
| Pre test      | 56.17 | 0.085       | 0.016   |
| Post test     | 79.08 |             |         |

3.2. Sekolah Siaga Bencana training and simulation activities

Based on Figure 1, Evaluation Results of the Activities carried out on the second day (September 23, 2018) showed that the respondents of 37 people assessed 93% of the material aspects, 94% of the informant aspects, and 93% of the implementation aspects met the respondents' expectations. This value is derived from the results of the calculation of the average rating with the range values of each is the material aspect 0.2, the resource aspect is 0.25, and the implementation aspect is 0.17. The Participant Capability Assessment Chart shows that after participating in the training activities, 36 participants had a basic Life Assistance ability of 88%, Fixation of 90%, and Lifting & Moving of 100%. This value is obtained from the results of the average assessment of participants' abilities carried out during the training. Meanwhile, based on the Value Graph of Participants Knowledge Pre and Post Training, it can be seen that there is an increase of 6% of participants' knowledge regarding Basic Life Assistance, Fixation and Lifting & Moving from before being given training to after being given knowledge. This value is obtained from the results of the average pre-test and post-test scores of 36 participants.
Effective intervention must not only encourage people to have disaster preparedness behaviors, but also give them the ability and purpose in carrying out these activities. The more they have control over disaster preparedness behavior, the more they will show their intentions. In that way, increasing feelings of having control can strengthen their motivation to behave in disaster preparedness (Najafi et al., 2017).

Based on Figure 2 (see the next page), it was found that 0% were kindergarten, 46% were elementary school, and 54% were junior high school students who participated in the Sekolah Siaga Bencana in Cilegon. As for the value of school preparedness towards disasters, it was found that junior high schools had higher preparedness compared to kindergarten and elementary school. Values are determined based on the median results of filling out questionnaires by each school attending the training activities. The median is then classified as ready and not ready for disaster. From school preparedness to disasters in Cilegon, kindergarten is known to have the highest preparedness in the aspect of Emergency Response Plans, elementary schools is known to have the highest preparedness in the knowledge aspect and the lowest in aspects of the disaster warning system, while junior high schools have preparedness in almost every aspect with a value of 44% except in aspects resource mobilization.

Schools are identified significantly as community centers that are important for the disaster response and recovery phase, including the need to increase school principals and teachers' preparedness for their role in traumatized communities after disaster (Mutch, 2015). Based on the results of Amri’s research, Bird, Ronan, Hayness, & Towers (2016), there is a mismatch of knowledge of school children towards disaster risk reduction education, this is related to, among other things, teacher awareness and access to disaster education material, teacher capacity in implementing education disaster risk reduction in schools, and collaboration between schools and policy holders. In addition, the development of risk communication based on intervention must be carried out in Islamic teaching to educate people to be better prepared to face further disasters by discussing the interpretation of the verses of the Qur'an related to natural disasters (Adiyoso & Kanegae, 2013).
Figure 2. Graphs and Results Diagram of School Disaster Preparedness Assessment in Cilegon City 2018

UNICEF and UNESCO recognize the importance of the role of education in reducing vulnerability and building resilience. Education can be an instrument in building the knowledge, abilities, and attitudes needed to prepare themselves for disasters and adapt to them (Selby & Kagawa, 2012). Disasters can make school-age children scared, confused, and insecure. In Turkey, a lot of drill is done in schools to improve the preparedness of school-age children in the face of disasters, some drills are conducted regularly every year at Disaster Week (Ersoy & Koçak, 2016).

Santa-Cruz, et al (2017) state that education facilities are a top priority in risk reduction strategies and they also find social sustainability factors such as security, safety and health of students, accessibility, income, provision of basic needs, and community organizations.

4. Conclusion
Cilegon City requires the Implementation of Regional Preparedness Exercises Gradually, Tiered, and Continues to increase regional capacity in the face of disasters. The exercise carried out in the villages of Lebak Gede and schools in Cilegon in a descriptive manner can improve the knowledge and abilities of the people of Cilegon City. Even so, in addition to organizing regional preparedness exercises, Cilegon City also needs to collaborate between formal and informal institutions to be better prepared in the face of disasters.

Acknowledgments
We appreciate the financial support for the implementation of our Kampung Siaga Bencana and Sekolah Siaga Bencana training and simulation activities, which was provided by Science and Technology Program for Communities “Kampung Siaga Bencana” of University of Indonesia. We are also grateful for the financial support to the second author’s traveling provided by Japan-ASEAN Science, Technology and Innovation Platform (JASTIP). Additionally, the financial support provided by International Research Collaboration Grant Number NKB-1943/UN2.R3.1/HKP.05.00/2019 of Universitas Indonesia enables us to complete the manuscript development.
References

[1] Adiyoso, W., & Kanegae, H. (2013). The Preliminary Study of the Role of Islamic Teaching in the Disaster Risk Reduction (A Qualitative Case Study of Banda Aceh, Indonesia). Procedia Environmental Sciences, 17, 918–927. https://doi.org/10.1016/j.proenv.2013.02.110

[2] Amri, A. (2017). Pendidikan Tangguh Bencana. Jakarta, DKI Jakarta, Indonesia: Kemendikbud RI.

[3] Amri, A., Bird, D. K., Ronan, K., Hayness, K., & Towers, B. (2016). Disaster risk reduction education in Indonesia: Challenges and recommendations for scaling up. Natural Hazard and Earth System Sciences, 344.

[4] An Gie, Y. (2017). A Social-Ecological Approach to Understanding Natural Disaster Preparedness and Risk Perception amongst Immigrants: A Multi-Method Inquiry. Dipetik 11 26, 2018, dari uOttawa Research: https://ruor.uottawa.ca/handle/10393/37007

[5] BNPB. (2015). Indeks Risiko Bencana Kota Cilegon . Dipetik 10 24, 2018, dari inaRISK: http://inarisk.bnpb.go.id/irbi/kabupaten

[6] Deputi Bidang Pencegahan dan Kesiapsiagaan BNPB. (2015). Kajian Risiko Bencana Kota Cilegon Banten 2016-2020. Jakarta: BNPB.

[7] Habibullah. (2013). Kebijakan Penanggulangan Bencana Berbasis Komunitas: Kampung Siaga Bencana dan Desa/Kelurahan Tangguh Bencana. Informasi, 18(02), 133-150.

[8] Kim, H., & Zakour, M. (2017). Disaster Preparedness among Older Adults: Social Support, Community Participation, and Demographic Characteristics. Journal of Social Service Research, 498-509.

[9] Mutch, C. (2015). The role of schools in disaster settings: learning from the 2010-2011 New Zealand earthquakes. International Journal of Educational Development, 283-291.

[10] Najafi, M., Ardalan, A., Akbarisari, A., Noorbala, A. A., & Elmi, H. (2017). The theory of planned behavior and disaster preparedness. PLOS Currents Disaster.

[11] Najafi, M., Ardalan, A., Akbarisari, A., Noorbala, A. A., & Elmi, H. (2017). The theory of planned behavior and disaster preparedness. PLOS, 1-17.

[12] Preston, J., Chadderton, C., Kitagawa, K., & Edmo, C. (2016). Community response in disasters: an ecological learning framework. International Journal of Lifelong Education, 727-753.

[13] RI, K. S. (2011a). Peraturan Menteri Sosial RI No. 128 Tahun 2011 tentang Kampung Siaga Bencana. Jakarta.

[14] Santa-Cruz, S., de Cordova, G. F., Rivera-Holguin, M., Vilela, M., Arana, V., & Palomino, J. (2017). Social sustainability dimensions in the seismic risk reduction of public schools: a case study of Lima, Peru. Sustainability: Science, Practice, and Policy, 34-46.

[15] Tuladhar, G., Yatabe, R., Dahal, R. K., & Bhandary, N. P. (2015). Knowledge of disaster risk reduction among school students in Nepal. Geomatics, Natural Hazards and Risk, 190-207.

[16] Twigg, J. (2015). Disaster Risk Reduction. London: Humanitarian Policy Group.

[17] Wells, K. B., Springgate, B. F., Lizaola, E., Jones, F., & Plough, A. (2013). Community engagement in disaster preparedness and recovery: A tale of two cities - Los Angeles and New Orleans. Psychiatr Clin North Am, 451-466.

[18] WHO. (2015). Managing disaster risks in communities. Nasr, Cairo, Egypt.