

## THE LEVEL OF DISASTER LITERACY OF EARTHQUAKE- EXPERIENCED STUDENTS IN MATHEMATICS AND SCIENCE FACULTY OF STATE UNIVERSITY IN INDONESIA

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### Abstract

The high impact of the earthquake for communities prone to earthquake hazards is caused by low knowledge. The majority of college students of the mathematics and science faculties (FMIPA) have experience related earthquake occurrence and, therefore, have the potency to involve in disaster mitigation programs at schools and in communities. This research aims to examine the level of earthquake disaster literacy among first-year college students and discuss the influencing factors. The measurement was conducted through an online questionnaire survey involving 297 participants, which were determined purposively. The data were analysed using statistics of Pearson correlation. The result shows that the disaster literacy level, especially in an earthquake, reaches a sufficient level with the best achievement in skill dimension, and knowledge dimension is in the lowest achievement. It was found that the choice of a study program in education area influences the literacy level, while gender and the area of origin have less influence. It can be concluded that the literacy level is categorised into unaware as scientist and educated as citizen. We recommend the knowledge dimension improvement through education programs in higher institutions.

Keywords: Earthquake, Disaster-literacy, Higher education students, Preparedness.

## **1. Introduction**

The disaster literacy of earthquake-experienced college students can be described as personal knowledge, awareness, technique, and capacity, including the ability to read, understand, use information to make decisions, follow instructions and empower people to act appropriately in the context of mitigating, preparing, responding, and recovering from an earthquake [1-3] after directly suffered from an earthquake. Disaster literacy is required by a prone to disaster society, including the people of Padang city on how to prevent, manage, and reduce risks [1, 3, 4] arising from the earthquake. It is because Padang city has high risks facing future disasters, such as the major earthquake in the Sunda megathrust and Tsunami [5].

In addition to physical conditions, social isolation, and limited financial resources, Brown et al. [2] suggested that low cognitive, education and literacy are factors that negatively affect safety during and after disasters. The results of the United Nations Educational, Scientific and Cultural Organization (UNESCO) study show that the level of risk is higher because most people in disaster-prone areas have low knowledge, which is associated with low disaster preparedness [6, 7]. In addition, the level of education, knowledge, and innovation is among the priorities in the Hyogo Framework to build community resilience and safety at various levels [8]. In this case, universities have an important role because they conduct academic programs for knowledge development and scientific studies [9].

Furthermore, the United Nations International Strategy for Disaster Risk Reduction (UNISDR) states that scientific societies are responsible for reducing the risks of disasters [8]. Col reported that scientists' role during the coordination for mitigation of The Great Tangshan Earthquake had contributed to their successful mitigation [10]. University students, as part of a scientific community, must not be ignored due to their role as projected agents who will contribute to public earthquake awareness and preparedness. A number of studies have been conducted to develop disaster literacy, yet the participants are focused on nursing and psychiatric students with its purpose to the provision of health centre [9], psychological impacts [11], innovations on information, media and learning strategy in term of disaster literacy like presenting interactive disaster management hub over the internet [1]. However, there are limited studies on earthquake literacy assessment. The previous study found the low level of earthquake preparedness of Lebanese students [12], the less accurate initial conception of earthquake events on Morocco students [13], and the insufficient disaster prevention knowledge [4]. This study aims to describe the disaster literacy level and discuss the factors which influence the earthquake literacy of first-year college students who have directly experienced the disastrous earthquake of Padang Pariaman on September 30, 2009. This study is different from the previous ones because we regard prior earthquake experience as the main factor related to preparedness [14-16] as well as earthquake literacy to form the resilience community in the earthquake-prone area.

## **2. Methods**

This study was conducted at a faculty of mathematics and science at a state university in Indonesia. We applied the survey method to gather earthquake literacy information with online questionnaire. The population is the first-year college students, and the sampling was determined purposively with those students who have direct experience in large earthquake in Padang Pariaman. The instrument was

in the type of Google form and developed with reference to instruments applied by Kanbara et al. [3], Baytiyeh and Naja [12], and Chung and Yen [4].

The questionnaire consists of 4 aspects: 1) antecedent, 2) knowledge dimension; type of knowledge (prediction, preparedness, impact, response) and technique to gain the knowledge, 3) attitude (awareness of prevention, value of prevention, responsibility of prevention), and 4) skills (preparedness action, response behaviour). The online form was distributed to 334 students from July to August 2018, and 297 of respondents gave the responses back completely. The data were analysed descriptively to perform literacy level in the form of score and percentage. In the interpretation of literacy level, we refer to disaster literacy scale developed by Col [17].

For further analysis, a statistical Pearson correlation analysis through IBM Statistic SPSS 25 was applied to find out the relationship between independent variables (gender, origin, and study program) and dependent variable (earthquake literacy level). The percentage of male and female respondents is, respectively, 14% and 86%. In addition, the sample is classified into the earthquake-vulnerable region (62%) and non-vulnerable region (38%). The study programs were distinguished into educational and non-educational programs without taking the discipline backgrounds into account due to all of respondents who were administered to follow the same course were in their first semester. There were 70% of students who chose the educational program. The others were registered in the non-educational program.

### **3. Result and Discussion**

Disaster literacy encompasses the capacity of individuals to read, understand, and use the information to make and follow decisions in the context of mitigation, preparedness, responses, and disaster recovery [2]. Literacy consists of personal knowledge, attitudes, and skills for disaster prevention [3] distinguished by the level of the school, age, years of service, personal disaster experience, and school disaster-stricken status [4]. Disaster literacy plays a role in mitigation because it can help diminish the impact of disaster risk. Besides, personal and/or communities' direct experience of suffering the disaster need to be considered as part of concern in mitigation program, especially for frequent disasters occurrence type such earthquake in West Sumatera, Indonesia, and Windstorm in Penang, Malaysia [18].

One approach to improve earthquake literacy is disaster education for disaster-prone area community. Universities facilitate research and assessment of scientific, methodical, socio-cultural, and economic aspects of disasters, including engineering, local wisdom, disaster education, and socialization. Kapucu and Khosa added that the role of universities in the community included the implementation of various researches and the establishment of a network of partnerships with surrounding communities [10].

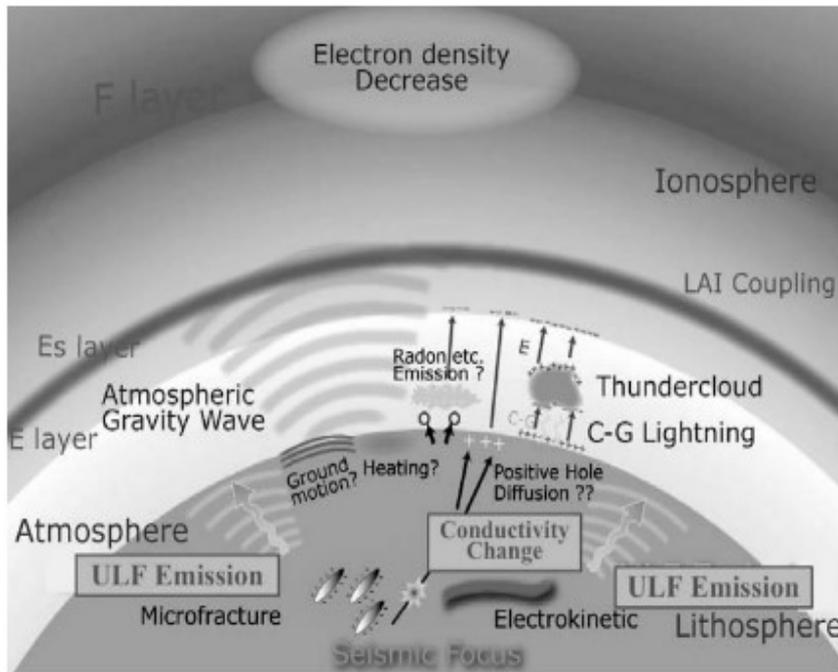
The scores of the disaster literacy of earthquake-experienced college students and each dimension are presented in Table 1. The overall scores of earthquake literacy reach 65.68, in which the skills dimension score is the highest while the knowledge dimension score is the lowest. The study result is in line with previous finding of Chung and Yen [4] that the disaster prevention skill among school administrators and teachers in Taiwan is relatively good. So, it seems that the

citizens who live in disaster-prone area have the awareness and develop certain skill to face the disaster.

**Table 1. Student scores in earthquake literacy and its dimensions.**

	Knowledge	Attitude	Skill	Earthquake Literacy
<b>Mean</b>	57.55	67.53	71.95	65.68
<b>Mode</b>	61.11	75.00	85.71	60.85
<b>Std. Deviation</b>	17.16148	19.87543	22.80867	16.62518
<b>Variance</b>	294.517	395.033	520.236	276.397

Among the four types of knowledge, the students perform best in earthquake effect. Suffering from the earthquake personally in their past time has left awareness and preparedness to cope with earthquake hazard. Being involved in the true earthquake condition has cultivated social-emotional and awareness toward hazardous changes in the surrounding environment. Furthermore, experience can be a strong motivator of preparedness and raising awareness and knowledge [19]. However, the students do not really understand about knowledge of potential factors to predict earthquake events, such as the changes in natural phenomena as described in Fig. 1 and biological changes before an earthquake [14].



**Fig. 1. Physics processes preceding shocks in an earthquake occurrence.**

Based on Fig.1, several physics and chemistry processes appear synergically before the shake itself, termed as precursors [20]. Radon gas emanation primarily occurs in the fault area which undergoes accumulative tectonic stresses. Consequently, it produces abundance of positive ions releases to atmosphere,

changes ionosphere composition, thermal anomaly, electricity and electromagnetic waves. The associated mechanism is supposed to influence organism. Hata et al. [21] found a rapid impact of the Japanese Sanriku earthquake which was followed by a tsunami against the decline of *Plecoglossus altivelis* population as one of the specific fishes of the region. In addition, it has also been observed that there is a relationship between the spatial distributions of redwood ant nests, Fucacinae family, in fault areas in West Eifel, Germany [22]. The unusual behaviour of animals has the possibility of associating with electromagnetic effects [23] because it causes physiological effects on a number of organisms. Furthermore, Grant and Conlan [24] reviewed the reduction of cow milk production before the 2011 Tohoku earthquake and explained the presence of ULF radiation factors. They found an effect of increasing the electric field on the appearance of earthworms before the earthquake and the effect of increasing H<sub>2</sub>O<sub>2</sub> concentrations on zooplankton [25]. However, not all anomalies that have ever been observed and reported by certain groups of people can be accepted as earthquake bioindicators.

Related to behaviour, Shapira et al. [26] explained the anticipated behavioural response patterns to an earthquake. There are three components of attitude, namely responsibility to prevent, the value of prevention, and awareness of prevention. Disaster prevention includes prevention and evacuation. The study generates two findings. First, very few students assess themselves as having the ability to inform others about their knowledge of disaster preparation, and, second, very few students feel that they are able to compile the needed knowledge of tectonic earthquake disaster preparedness that they already have to be presented to others. Disaster preparedness is preparation for potential disasters and includes disaster risk analysis, the establishment of disaster early warning systems, emergency rescue professional training, and training of local residents.

In addition, there are 2 aspects of skills, namely action preparedness and response behaviour. Skills in the aspect of readiness include: 1) identifying the location of emergency exits and first aid kits available in public buildings; 2) helping to teach how to read safety maps (e.g. evacuation routes) to others, 3) getting involved in planning a tectonic earthquake disaster prevention exercise that is routinely held by the campus to help others understand the routes and procedures for escaping; and 4) providing support for the role of campus/school involved in disaster management. Furthermore, for the skill element in the behavioural aspect, the responses are indicated by the following: 1) there is a response to cooperating cooperatively if disaster prevention exercises are held, 2) there is a response to invite other people to take part in activities to avoid disaster impacts/hazards, and 3) there is a response to help rescue teams if an earthquake occurs in a neighbouring country.

Overall, the training and drill improved the knowledge and ability of disaster preparedness for both undergraduate and diploma students [27]. In addition, Kronmüller et al. found that media exposure had a positive effect on emergency preparedness behaviour and risk perception [28]. The media could provide a brief theoretical and technical information [29]. To raise the actual and perceived preparedness level, formal and informal sources can be instigated [30].

In this study, there are 3 suspected factors assumed to influence the earthquake literacy level; they are gender, region, and study program as independent variables. Table 2 displays the correlation coefficient (*R*) between dependent and independent variables as well as their dimensions.

**Table 2. R-value for correlation between gender, region, study program to earthquake literacy.**

		dependent var.			
		Earthquake literacy	Knowledge	Attitude	Skills
<b>independent var.</b>	Gender	0.015	0.008	0.054	0.010
	Region	0.000	0.024	0.026	0.041
	Study Program	0.312	0.076	0.334	0.376
	Gender, Region, Study Program	0.362	0.252	0.349	0.448

Referring to information of Table 2, it can be explained that separately, earthquake literacy is mostly influenced by the study program compared to gender and region. This finding is different from the previous research stating that gender is the attribute of different action [19, 20, 31, 32]. The educational program strongly correlates to students' literacy levels, especially attitude and skill dimensions of earthquake-experienced college students. The students who choose educational program or pre-service teacher program seem to express more concern to attitude and skill.

Özbey et al. [33] suggested that there is a positive and meaningful relation between their resilience skill and life satisfaction to be registered at the educational program [33]. Life satisfaction creates self-efficacy, in which both self-efficacy and disaster impact has direct effects on preparedness behaviour, and self-efficacy further moderates the effect of disaster impact. Region of originality does not correlate to the earthquake literacy level. Vulnerable region of the original area seems not to contribute to literacy level although they experienced in earthquake directly. Consistently, Johnson and Nakayachi [32] proposed the demographic factors which associate to other factors that have small contribution to earthquake preparedness. Shapira et al. [26] found that the low status of socioeconomic causes a more vulnerable status. However, Al-Najar et al. found how a region of family origins contribute to high unemployment records of graduated students in the Gaza Strip should be considered due to illiterate factor [34].

Generally, the level of literacy of the students about the Padang earthquake disaster can be presented in two categories. Referring to literacy developed by Col [17], it can be explained that firstly, the level of tectonic earthquake disaster literacy that students have as an academic community or scientists includes the lowest level or being unaware. This is indicated by the low knowledge of FMIPA students. Improvement in higher students educations is needed, especially earthquake disaster knowledge integrated learning program. The minimum learning process skill for responding earthquake is analytical thinking due to learning analytics plays a vital role to improve the students learning activities, in which engineering software learning is one of alternative learning choice [35]. Secondly, the level of disaster literacy of students as members of the community is at the educated level because they have the awareness, preparedness and sufficient skills to respond the sudden occurrence of the earthquake.

#### 4. Conclusion

It can be concluded the students of FMIPA have enough level of earthquake literacy which is mainly influenced by attitude and skill dimensions. This finding implies that knowledge dimension is still below the developing process while the knowledge has significant contribution to building attitude and skill. The prediction knowledge is less mastered. However, the source of surrounding information is available to be integrated into building earthquake literacy level. The interesting finding here is that the gender factor does not influence the literacy level while most studies found that gender would have significant role to distinguish this ability between female and male. This finding would be specific knowledge for the Padang earthquake literacy that needs further investigation in relation to cultural and ethnic background. Deeper research is needed to find the psychological factor related to passion of working. Another interesting finding is that the choice of being a teacher candidate has influence of the literacy level. This finding implies that the pre-service teacher has potency to be involved in earthquake preparedness or mitigation program. Therefore, the disaster topic, especially the earthquake, should be integrated into learning process. For the above findings, we recommend the need for improvement efforts to increase disaster literacy in educational program in higher education institutions.

#### Acknowledgement

The authors would like to thank the Dean of Mathematics and Science Faculty (FMIPA) of Padang State University (UNP) for his permission to collect the data and the first-year students of FMIPA for wisely participating in responding the questionnaire distributed.

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