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INVESTIGATING THE ROLE OF GEOGRAPHY EDUCATION IN ENHANCING EARTHQUAKE PREPAREDNESS: EVIDENCE FROM ACEH, INDONESIA

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ABSTRACT: Aceh is one of the provinces in Indonesia with a high earthquake risk index. The high risk of earthquakes requires educational institutions to play an important role in increasing disaster preparedness among students. This study aims to find out the effects of disaster education that have been integrated into the geography education curriculum and the role of earthquake risk perceptions in increasing earthquake preparedness. A survey of 210 geography education students was conducted at two universities in Aceh. By using multiple linear regression analysis, the findings reveal that geographic education and earthquake risk perception have a positive effect on increasing earthquake preparedness. However, the effect of these two variables simultaneously was only 24.1%. The low influence of the role of geography education in increasing earthquake preparedness is because disaster education taught so far only shapes conceptual knowledge. This study suggests the importance of combining earthquake preparedness knowledge and practice with future disaster education programs. This is imperative because turning knowledge into action is at the core of disaster education to improve preparedness.

Keywords: Geography education, Hazard, Earthquake, Disaster, Preparedness, Risk perception.

1. INTRODUCTION

Geologically, the province of Aceh is located at the confluence of the world's active plates. This causes the Province of Aceh to have a very high earthquake hazard. In recent years, Aceh has experienced several large-scale earthquakes, including December 26, 2004 with a magnitude of 9.15 Mw and the Pidie Jaya earthquake on December 6, 2016 with a magnitude of 6.0 Mw. The December 26, 2004 earthquake was the worst earthquake recorded in history. The earthquake was followed by a tsunami that hit the mainland of Aceh. The death toll reached 165,791 people, 21,751 houses were destroyed, and 169 education facilities were severely damaged [1].

In the future, the probability of a large-scale earthquake occuring in Aceh is high. The subduction zone stretching from the western part of the Andaman Island is the most active seismic source in Indonesia [2]. Therefore, to reduce the impact of the earthquake disaster, it is very important to assess the preparedness of Acehnese students.

Greer and Murphy (2018) [3] point out students are a vulnerable group when disaster strikes. Most of them are newcomers from various regions so they do not have direct experience of disasters in the local area [4]. In addition, students often underestimate risk and are rarely involved in preparedness activities [4]. Tanner and Doberstein (2015) [5] found that the majority of students at the University of Waterloo, Canada did not have a disaster emergency preparedness kit and had barriers that limited disaster preparedness.

Therefore, assessing earthquake preparedness among students is very important [3]. Baytiyeh and Naja (2015)[6] shows earthquake preparedness among students is strongly influenced by factors as follow: risk perception (perceived hazard probability and consequences), and the role of higher education institutions. Risk perception is closely related to disaster preparedness because individuals must know the risk to be motivated to take preparedness action [7]. In addition, risk perception is very helpful in understanding and analyzing human behavior when they are faced with disasters [5]. People respond to earthquake according to their view of the hazard as perceptions and awareness of influence behavior [8].

In addition, educational institutions play a role in organizing disaster education to improve preparedness. The Hyogo Framework for Action 2005-2015 (HFA), which has now been replaced by the Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR), education is identified as the key to mitigating the impact of natural disasters [9]. HFA priority 3 emphasizes that disaster risk reduction requires the use of knowledge, innovation, and education to build a culture of safety and increase resilience [9].

Sustainable disaster education is believed to be effective in increasing preparedness. There is scientific evidence that cognitive activities during education will have a long-term effect on human neurological function [10]. This will change the way educated individuals think, reason, and solve problems [11]. Disaster education taught is believed to motivate people to take action in disaster preparedness [12].

For example, when the Indian Ocean tsunami struck in 2004, a 10-year-old student from England who was on vacation with his family on Phuket Beach, Thailand managed to save hundreds of lives of people who were vacationing on the beach. The student was able to identify the signs of a tsunami by looking at sea water that suddenly receded and foam bubbles appeared in the middle of the ocean. This knowledge was obtained from geography lessons at his school two weeks before the tsunami disaster [13].

The same thing happened during the earthquake in Japan on March 11, 2011. Sustainable disaster preparedness education regularly taught for seven years was able to save 2,900 students' lives in the coastal city of Kamaishi from the earthquake and tsunami disaster [14]. The story is known as "The Miracle of Kamaishi". Of course this is not a miracle, but the result of a long process of school-based disaster preparedness education. Disaster preparedness education has been taught to students in coastal schools with a risk of a tsunami disaster. In addition, they also regularly conduct tsunami evacuation drills [14].

However, currently there is still limited literature that assesses the role of disaster education that has been integrated into the geography education curriculum in tertiary institutions in increasing disaster preparedness among college students. During the acute phases of a disaster, college students are often defined as a vulnerable population [3,4].

Therefore, this study aims to assess the effect of risk perception and disaster education that has been integrated into the geography education curriculum in increasing earthquake preparedness among college students.

As a science that examines physical and social aspects, geography education pays great attention in disaster studies [15,16]. In Indonesia, disaster education has been integrated into the geography education curriculum in tertiary institutions since 2007. In addition, earthquake knowledge has also been taught in geology and geomorphology courses. This is in accordance with the mandate of the Lucerne Declaration on Geographical Education for Sustainable Development (2007) [17] which emphasizes the importance of the theme of disaster risk reduction and climate change integrated into the teaching of geography throughout the world [17]. Specifically, this study will test the following hypotheses:

H1: There is a positive and significant influence between the perception of earthquake risk and disaster preparedness.

H2: There is a positive and significant influence between geography education and earthquake preparedness.

2. METHOD

Data was collected from geography education students at two prominent universities in Aceh, Syiah Kuala University and Samudra University. The two universities were chosen because they are located in earthquake hazard areas. The Province of Aceh was the region of Indonesia that was most severely affected by the earthquake on December 26, 2004. All students enrolled in the geography education study program were asked to participate in this research. Researchers coordinated with the heads of departments at the two universities to distribute questionnaires to students. Students who participated were only those who had taken the disaster geography course. Researchers distributed online questionnaire links to geography education students at the two universities. A total of 210 students participated in this study.

2.1 Measurement and Instrumentation

Questionnaire to measure earthquake risk perception, the role of geography education, and earthquake preparedness consists of 15 question items (table 1). 5 question items about earthquake risk perception (1-5), 5 statement items about the role of geography education (6-10), and 5 items related to earthquake preparedness (11-15). Earthquake risk perception is measured by two variables: perceived hazard probability and consequences. The essential attributes of people's perceptions of environmental threats are generally considered to be probability and consequences [18].

Table 1 Earthquake risk perception questionnaire, the role of geography education, and earthquake preparedness.

Item	Questions	Mean	SD
Risk Perception Means = 3.53	1. Large-scale earthquakes are likely to occur in Aceh in the future.	3.56	0.49
	2. There are several active seismic faults in Aceh.	3.60	0.50

	3. Earthquakes in neighboring provinces can have an impact on Aceh.	3.63	0.49
	4. Tens of thousands of people might be injured or die if an earthquake occurs in Aceh.	3.56	0.50
	5. Buildings that are not designed to with stand earthquakes are likely to collapse when an earthquake occurs.	3.31	0.46
The role of Geography Education Mean = 2.81	6. The geography education curriculum helped me learn about the earthquakes hazard and preparedness	3.49	0.70
	7. My lecture have discussed the necessity of earthquake preparedness in classroom	3.5	0.65
	8. My lecturer has taught me how to prepare an emergency plan for earthquake preparedness	1.78	0.75
	9. Geography departments in my college usually organize seminars related to earthquake awareness and preparedness	3.42	0.63
	10. Geography departments in my college usually organize simulation drill related to earthquake preparedness	1.89	0.70
Earthquake Preparedness Mean = 2.68	11. I have prepared an emergency plan to help reduce the impact of earthquake on the family.	2.74	0.94
	12. I have attended at least one workshop related to earthquake preparedness	3.34	0.77
	13. I have practiced drills related to earthquake preparedness	1.97	0.92
	14. I know about the disaster evacuation route at my university.	3.29	0.68
	15. I have prepared an emergency kit because it is essential for earthquake survival	2.1	0.87

The role of geography education is measured by questions about the efforts made by the geography education department in teaching earthquake preparedness to students. The instrument was developed from a previous study conducted by [6] who assessed the role of tertiary education in increasing earthquake preparedness among college students in Lebanon. Meanwhile, disaster preparedness is measured using instruments developed by American-Red-Cross (2015). The instrument consists of five variables: storing food and water, having an emergency kit, developing an emergency plan, attending at least one disaster preparedness workshop, and following at least one earthquake preparedness simulation.

Risk perception, the role of geography education, and earthquake disaster preparedness are made in the form of a likert scale on a 5 points scale (1 = strongly disagree, 5 = strongly agree). Before being used, the questionnaire was tested on 20 students. The feedback obtained from the trial respondents was changed to ensure that the words of the questionnaire could be easily understood.

2.2 Data Analysis

The research instruments were analyzed with validity and reliability tests. Validity Test aims to measure the extent to which the research instrument can be used to measure a variable. The validity of an instrument item can be determined by comparing Pearson's product moment correlation index at the 5% significance level with its table value (0.197, n = 100). If the calculated r value obtained is greater than r table of 0.197 then the item is declared valid and vice versa if lower than r table is declared invalid. Reliability is an index that shows the extent to which a measuring device can be trusted or reliable. The instrument can be said to be reliable if it has a reliability coefficient of 0.6 or more. The reliability test used was Cronbach's Alpha. The reliability measurement results show that the Cronbach Alpha coefficient value is 0.649. This indicates that the data from the variables are classified as reliable to use.

After the research instrument is valid and reliable, it is followed by multiple linear regression analysis by first testing the classical assumptions (normality test, multi-collinearity test, and heteroskedasticity test). After all classical assumptions are met, then proceed to the analysis of the influence of independent variables on the dependent variable using multiple linear regression. Regression analysis is useful to determine the effect of the independent variables: risk perception and the role of geography education on the dependent variable (earthquake preparedness). Data processing using SPSS 24 software. Testing was undertaken using one degree of freedom and a significance level of 0.05.

3. RESULT AND DISCUSSION

3.1 Normality Test

An assessment of normality is a prerequisite for the regression test. Normal data is an underlying assumption in parametric testing [19]. The regression model can be said to meet the assumption of normality if the residual (ei) obtained from the regression model is normally distributed [20]. Ghasemi and Zahediasl (2012) [19] point out the frequency distribution (histogram) and P-P plot (probability-probability plot) can be used for checking normality visually. A histogram is an estimate of the probability distribution of a continuous variable. The P-P plot (probability–probability plot or percent percent plot) is a graphical technique for assessing how closely two data sets (observed and expected) agree. Thus, this study uses the histogram chart and the Normal P-P plot as follows:

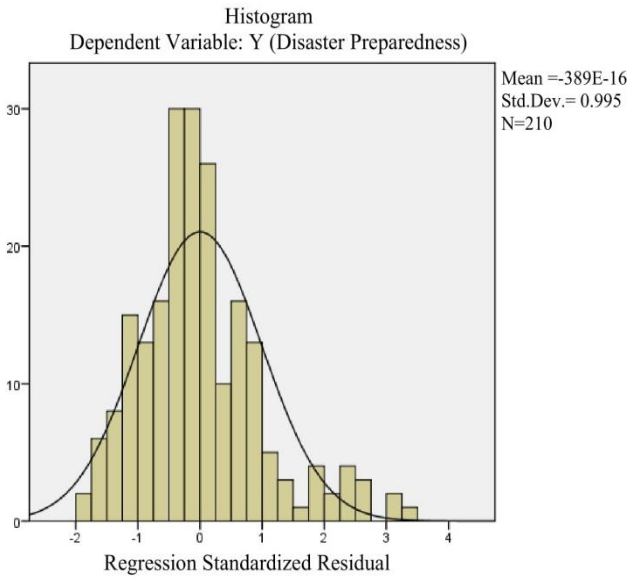

Fig.1 Histogram chart

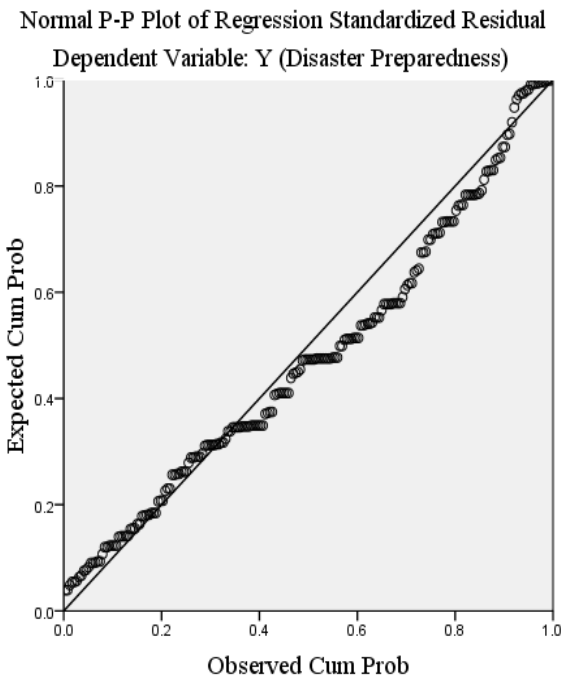

Fig.2 Normal P-P plot

Figure 1 shows that the bar chart follows the normal curve that is formed bell-shaped. If the graph is approximately bell‑shaped and symmetric about the mean, we can assume normally distributed data [20]. Meanwhile, the P-P graph the plot in figure 2 shows that the observation data is around a diagonal line. The data is normally distributed when this forms a roughly straight line in around a diagonal line [20]. Based on Figs.1 and 2, it can be concluded that the distribution of residuals is normally distributed [19].

3.2 Multicollinearity Test

Multicollinearity test aims to find out whether the regression model found a correlation between independent variables (independent variables). Regression model should not occur multicollinearity. One method used in testing the presence or absence of multicollinearity is to use Variance Inflation Factor (VIF). If the VIF value> 10 indicates the presence of multicollinearity. And if vice versa VIF <10 then multicollinearity does not occur.

Table 2 Multicollinearity test with VIF

Variabel	Tolerance	VIF
Risk Perception	0.902	1.108
The role of Geography Education	0.902	1.108

Based on Table 2 above it is found that all VIF values of each independent variable of <10 with a tolerance value of more than 0.1, which means that between independent variables there is no strong enough correlation or no multicollinearity.

3.3 Heterokedasticity Test

This test aims to see whether the regression model has the same residual variance (variance) or not. A good regression model is a model that has the same relative homogeneous variety. The way to test homoscedasticity is to look at a plot graph between the predicted value of the dependent variable (ZPRED) and the residual (SRESID). If the points form a certain pattern that is regular (wavy, widened and then narrowed), then it indicates that heteroscedasticity has occurred (assumptions are not met). Whereas, if there are no clear patterns, or points spread above and below the number 0 on the Y axis, then heteroscedasticity (assumptions are met) does not occur.

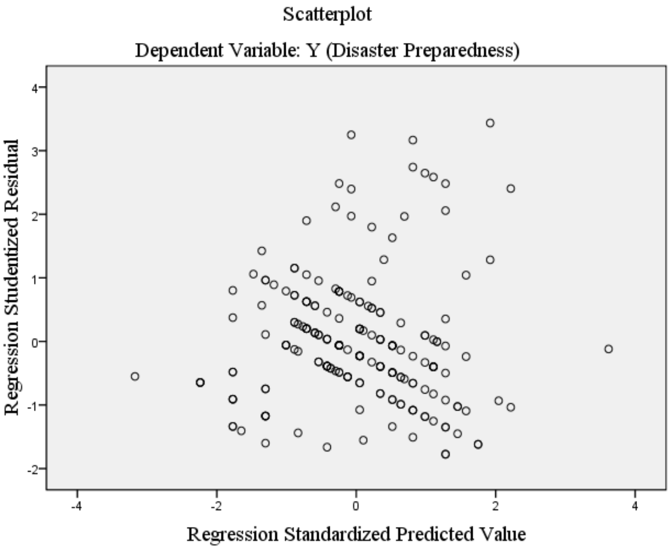

Fig.3 Heteroscedasticity Test with Scatterplot

From the results of the scatterplot in Fig.3 above, the points are randomly scattered (patterned) both above and below the number 0 on the Y axis, which means that the assumption of heteroscedasticity is fulfilled (homogeneous residual variations). After all classical assumptions have been met, then proceed to the analysis of the influence of independent variables on the dependent variable using multiple linear regression.

3.4 Results of Multiple Regression Analysis

Table 3 is the result of multiple regression analysis. Hypothesis test results indicate that the earthquake risk perception variable has a positive and significant effect on the earthquake preparedness (P = .001 < 0.05). The results of this test are in accordance with hypothesis 1. A positive coefficient indicates that an increase in risk perception can significantly increase disaster preparedness variables. Hypothesis 2 testing shows that geography education has a positive and significant impact on disaster preparedness variables (P = .000 <0.05).

Table 3 Multiple Regression Analysis

Variable	*B*	T_{count}	*P-value*	Significane
Constant	-2.176			
Risk Perception	0.391	3.450	0.001	Significant
The role of Geography Education	0.620	5.887	0.000	Significant
A			= 0.050	
Coefficient of Determination (R^2)			= 0.241	
F-count			= 32.836	
P-value F			= 0.000	

Meanwhile, simultaneous testing showed that earthquake risk perception and the role of geography education had a significant effect on disaster preparedness (P <0.05). The magnitude of the contribution of the influence of the independent variables simultaneously on the dependent variable has a coefficient of determination (R Square) of 0.241 or 24.1%. While the other 75.6% is influenced by other factors not measured in this study.

In general, the findings of this study reveal that earthquake risk perceptions among students are high (μ = 3.53 on a scale of 5). The high risk perception is suspected because the province of Aceh has experienced an earthquake in 2016 with a power of 6.5 MW. In addition, a large earthquake with a magnitude of 6.4 MW also occurred in Lombok in 2018. In the same year, an earthquake with a magnitude of 7.4 MW also occurred on Sulawesi Island [21]. The big earthquake that occurred in the last three years is thought to have influenced the high perception of earthquake risk among college students. The risk perceptions usually increase dramatically shortly after a disaster event, but soon fade with time [22]. The high perception of earthquake risk has a positive and significant impact on earthquake preparedness.

Meanwhile, the results of statistical tests show that disaster education that has been integrated into the geography education curriculum has a positive and significant effect on disaster preparedness (P = .000 <0.05). This finding corroborates the results of a previous study conducted by [23] that the integration of disaster education into the geography education curriculum had a positive impact on disaster preparedness among high school students in the city of Banda Aceh. This finding also supports previous research conducted by [24] who found that various disaster education programs that have been integrated into the education curriculum in primary schools in Aceh Province have proven to be effective in increasing risk perceptions, awareness and disaster preparedness.

However, simultaneously (R Square) the level of significance of the influence of the perception of earthquake risk and the role of geography education in increasing earthquake preparedness is low of 0.241 or 24.1% (Table 3). These conditions make earthquake preparedness tend to be low. The average value of earthquake preparedness is only (μ = 2.68 on a scale of 5) Table 1. The low role of earthquake risk perception in increasing earthquake preparedness among students because students tend to underestimate earthquake hazards. This finding corroborates previous research conducted by [5] at the University of Waterloo, Canada. The results of the study revealed that the majority of students on the campus did not have a full preparedness kit. Most students experience obstacles that limit disaster preparedness.

Meanwhile, the low influence of geography education on disaster preparedness is due to disaster education taught in geography education study programs has not been effective in motivating students to take preparedness action. This can be seen from students' responses to questions in the questionnaire stating that geography education lecturers did not teach students how to prepare contingency plans for disaster preparedness ($\mu = 1.78$ on scale 5) Table 1. These findings confirm previous research conducted by [6] which shows that professors rarely discuss in classrooms about earthquake preparedness so that higher education institutions in Lebanon do not play a major role in increasing earthquake preparedness among students

In addition, another reason for the low role of geography education in increasing disaster preparedness is because geography education study programs rarely carry out earthquake simulation programs. This is evidenced from the answers given by students to the question "geography departments in my college usually organize drill simulation related to earthquake preparedness" has a low average value ($\mu = 1.89$ on a 5 points scale) Table 1. Disaster education taught in geography education follows a traditional education methodology, which is focused on theoretical and conceptual knowledge.

Tsai, Wen, Chang and Kang (2015) [25] show that disaster education which only focuses on conceptual knowledge is not effective in increasing student motivation to take preparedness action. Without simulation and training, people only know the hazard of earthquake, but do not know how to preparedness. This has been proven by research conducted by [26], using a questionnaire survey of 1,065 secondary students in Japan during the 2002-2003 period, the study found that a traditional education methodology, which is focused on theoretical and conceptual knowledge, did not play an effective role in raising disaster awareness and preparedness.

Based on these findings, this study suggests redesigning the disaster education model in the future geography education program. This is important to do, because geography education students are prospective teachers who are very instrumental in sharing knowledge and motivating students to make disaster preparedness in the future. The teacher has been recognized as playing an important role in shaping and transferring knowledge to students [27,28].

Disaster education in the future geography education curriculum must emphasize the importance of combining conceptual knowledge and earthquake preparedness practices. Turning knowledge into action is at the core of disaster education to increase preparedness [29,30]. Previous research has proven that learning by doing is effective in increasing disaster preparedness. For example, research conducted by [29] in 12 schools from various regions in Japan found that students in Maiko showed higher risk reduction measures than students in other regions. This is because schools in Maiko focus on mitigation and disaster preparedness. The learning process has proven effective in reducing disparities between intentions and actions [29].

In addition, referring to experiential learning theory focusing on Dewey, experiential learning can help motivate people to act. One example of the application of experiential learning to improve disaster preparedness was carried out at a secondary school in Redbridge, London [31]. In geography class, the teacher gives homework to students to make their own "emergency kit" which contains important things needed for evacuation when a disaster occurs [31]. After that, students are asked to explain the reasons for choosing to put these objects in an emergency bag. Learning by doing that students practice on their own can motivate them to take disaster preparedness actions.

What is more, referring to the disaster education guidelines for students developed by the Directorate of Learning and Student Affairs of the Ministry of Technology and Higher Education Republic of Indonesia (2019) [32] that disaster education must emphasize three important components including: knowing, skills, doing (application in society) . Knowing is the initial stage of disaster learning. Knowing aims to form basic knowledge (basic knowledge) of students about the concept of disaster risk reduction. Basic knowledge taught to students includes: (1) Conception of disasters (risks, hazards, vulnerabilities, and capacities), (2) Relation of development to disasters, (3) policies on disaster risk reduction at national and local levels. Learning skills and practices (doing) in education are taught in the form of mapping disaster-prone areas, simulations and evacuations. Meanwhile, the component of doing (application in society) is carried out in the form of thematic field study (internship)**.**

4. CONCLUSIONS

The findings of this study show that geography education and earthquake risk perception have a positive and significant effect in increasing earthquake preparedness among college students. However, simultaneous statistical test results showed that the two variables only contributed 24.1% in increasing preparedness. The low influence of the role of geography education in increasing earthquake preparedness that disaster learning taught so far has only focused on forming conceptual knowledge of students. This condition is not relevant to the purpose of disaster education. The most important aspect of disaster education is the transformation of knowledge from know-what into know-how so that students do not only know the concept of disaster risk reduction (know-what). However, it can play a role in reducing disaster risk and disseminating this knowledge to others and taking preparedness actions. This research suggests the importance of redesigning the disaster education model in the geography education study program. This is done by developing disaster geography teaching materials that integrate important components including: knowing, skills, doing. Learning by doing has been recognized as effective in motivating people to take actions for disaster preparedness.

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