Are Students' Adaptive Capacity to Earthquake Disasters Correlated with Their Knowledge?

Risma Adelisna and Yunus Aris Wibowo(✉)

Geography Education Study Program, Universitas Muhammdiyah Surakarta, Surakarta, Indonesia
yaw222@ums.ac.id

Abstract. The level of knowledge and adaptive capacity needs to be analyzed because both components are an effort to improve natural disaster mitigation. This study aims to analyze the relationship between the variable level of knowledge and the adaptive capacity of students to natural earthquake disasters at SMA Negeri 1 Wedi. This type of research is quantitative research with a correlational design. The population in this study were all students of SMA Negeri 1 Wedi. Sampling was carried out with saturated samples by the census. The data collection technique used was a questionnaire distributed digitally via a google form. Analysis of the data used in this study is the Pearson Correlation Test. The results of this study indicate that 1) Students get an average value of disaster knowledge level, which is 28.59, which is included in the poor category, 2) The value of the adaptive capacity of students gets an average score of 66.81 which is included in the high category, 3) The Pearson correlation significance test value is 0.00 so that it shows a relationship between the level of knowledge and the adaptive capacity of students.

Keywords: Knowledge level · Adaptive Capacity · Natural Disasters · Earthquake

1 Introduction

Indonesia is prone to natural disasters due to the region's geographical, geological, and geomorphological conditions [1]. Geologically, Indonesia is located at the confluence of three world plates: the Eurasian Plate, the Pacific Plate, and the Indo-Australian Plate [2]. Disasters that often occur in Indonesia include earthquakes, landslides, tsunamis, volcanic eruptions, hydro climatological disasters, and floods [3]. Disaster problems cannot be avoided because disasters threaten and disrupt people's lives caused of natural, non-natural, and human factors that cause environmental damage [2, 4].

Earthquake data in Indonesia is based on the BMKG recorded from 1821 to 2018 with various levels of damage. The earthquake also caused other disasters, such as the Tsunami in 1841 in the Maluku region, with damage to several ships damaged by the tsunami waves that accompanied the earthquake in Galaga Bay and Buru Island. Meanwhile, in 2018 an earthquake occurred in the Banten area with a magnitude of 6.4

Mag with damage to houses, educational facilities, public facilities, health facilities, and other buildings [5].

The earthquake that became the most terrible recorded in Indonesia occurred in the Aceh earthquake, with a magnitude of 9.3 on the Richter scale to cause a Tsunami disaster [5]. Almost the entire area of Aceh was affected by the earthquake, and even though many buildings were damaged, all activities were stopped until the situation allowed. During the recovery due to the disaster, learning activities were carried out at the evaluation location by using improvised learning media.

Earthquake disasters that occur have various kinds of impacts. The disaster will impact the government, social, economic, health and education aspects. One way to reduce the impact of the government must further increase knowledge of earthquake disasters in the community so that they understand the conditions of the surrounding environment.

Therefore, efforts are needed to increase knowledge about the earthquake and natural disasters to analyze what actions should be taken in the event of a disaster if it strikes and efforts to prevent the risks that occur. Educational pathways are the easiest route to be accessed by all parties in introducing disasters [6]. One is earthquake disaster mitigation, where a series of strategies are efforts to reduce disaster risk through physical awareness and improvement in dealing with disasters.

Changes in public awareness about disaster knowledge can be increased through the education sector for disaster management. Schools have an important role in disaster management strategies because schools are a source of knowledge [7, 8]. School institutions can create students who can improve their knowledge and skills in dealing with disasters.

Knowledge is an important part of disaster preparedness activities to reduce the impact that will occur due to disasters [9]. Disasters that occur are experiences and learnings for individuals. Therefore, the importance of knowledge about natural disasters must be owned by each individual [10]. Individuals who live in disaster-prone areas need disaster knowledge to minimize the impact and actions that must be taken.

Disaster knowledge will increase students' adaptive capacity to disasters. Adaptive capacity or adaptive capacity is the ability to face or respond to exposure [11]. Adaptive capability is also a government effort to respond to climate change through cooperation, networks, and reactive information [12].

Increased adaptive capacity will make students faster in adapting to the environment and more concerned about the surrounding area. Students must increase their knowledge and adaptive capacity about natural disasters well to encourage an attitude of disaster preparedness in students. If students can pay more attention to the surrounding area, it will create a sense of wanting to maintain and make efforts to minimize the impact of losses due to disasters.

One of the areas in Indonesia that are prone to earthquakes is Klaten Regency, Central Java Province. The Klaten region is geographically located in three highlands; namely, in the northern part, there is a plain of the slopes of Mount Merapi, the eastern part is a low-lying plain, and the southern part is a limestone mountain plain. The topography of Klaten is located between Mount Merapi and the Thousand Mountains, with slopes of

Mount Merapi in the north, sloping areas, flat areas, and hilly in the south. The district has moderate rainfall [13].

Klaten Regency includes lowlands and mountains with varying heights and undulating land. Judging from the location of the Klaten area, there are five classifications of soil types, including litosol soil type, gray regosol, dark gray grumusol, dark gray regosol complex, and grayish brown regosol [14]. The Klaten area contains deposits from the volcanic activity of Mount Merapi and Alluvial deposits. Judging from the condition of the Klaten area, disasters often occur because of the area's position flanked by the still active Mount Merapi and the Thousand Mountains. Besides that, there are Dengkeng and Jiwo faults [15].

Wedi District is one area often affected by earthquakes and natural disasters [16]. SMA Negeri 1 Wedi is located in the first potential area with severe damage due to the natural earthquake disaster. SMA Negeri 1 Wedi has 716 students with 43 teachers, 12 educators, and 55 classroom action research teachers [17].

Many studies examine the level of students' knowledge of natural disasters. However, no research examines students' level of knowledge and adaptive capacity and the relationship between the level of knowledge and adaptive capacity of students. Therefore, this study tries to analyze the relationship between the knowledge level and students' adaptive capacity.

This study aims to determine the relationship between the level of knowledge and adaptive capacity to earthquake disasters in SMA Negeri 1 Wedi students and whether the two indicators are related. Students who already understand the importance of disaster knowledge and have a good adaptation attitude will make them more aware of the surrounding environment. This research hopes to be reconsidered in imparting knowledge and adaptive capacity to natural disasters to students, especially in earthquakes.

2   Method

This research is quantitative research with a correlational design. The variables examined in this study are students' level of knowledge and adaptive capacity to earthquake and natural disasters. This research was conducted at SMA Negeri 1 Wedi, one of the schools in an earthquake-prone area in Klaten Regency.

This study's population was all SMA Negeri 1 Wedi students from the tenth, eleventh, and twelfth grades. Respondents were determined using the census sampling technique or saturated sample, where the sample required all members of the population as respondents. Data was collected using a questionnaire containing questions and statements according to knowledge and adaptive capacity variables (Table 1).

Data collection techniques were carried out by observation and questionnaires. Observations were made in the form of validating the existence of school locations in the field based on the Disaster-Prone Area Map, seeing the surrounding locations, and conducting interviews with the school regarding earthquake disasters in schools. Meanwhile, the questionnaires were distributed digitally with the presence of researchers and accompanied by teachers so they could be minimized.

The collected results will be processed using descriptive statistics and inferential statistics. Descriptive statistics are used to process students' level of knowledge and

Table 1. Questionnaire.

Variables	Indicator	Number of question
Knowledge	1. Disaster Knowledge	6
	2. Disaster Warning	4
	3. Disaster Evacuation	5
Adaptive Capacity	1. Experience Knowledge	7
	2. Social Learning	4
	3. Individual Competence	5
	4. Access Resources	5
	5. Adaptation	4

adaptive capacity. Descriptive statistics is an analysis that summarizes, describes, and presents data so that it is easy to understand; usually, the presentation is accompanied by graphs, charts, and tables [18]. Furthermore, inferential statistics were used to analyze the relationship between the level of knowledge and adaptive capacity. Inferential statistics provide a more in-depth analysis and are used to conclude at the population level [19]. The statistical test used is the Pearson correlation test, where calculations are carried out to determine the relationship between two variables [20]. The correlation formula is as follows:

$$r_{xy} = \frac{N \sum XY - (\sum X)(\sum Y)}{\sqrt{\{N \sum X^2 - \sum X^2)\}\{N \sum Y^2 - (\sum X^2)\}}}$$

[21].

Information:

r_{xy}: correlation index number.

N: *number of cases.*

$\sum XY$: the sum of the multiplication results between the X score and the Y score.

$\sum X$: total score X.

$\sum Y$: total score Y.

3   Result

Research at SMA Negeri 1 Wedi obtained data using a questionnaire distributed by all students. The questionnaire results are in the form of knowledge level and adaptive capacity results, so there are two result values from the questionnaire. The result of the

score from the questionnaire is the total score obtained by the students. The number of samples in this study was 651, so the amount of data to be processed by researchers was 651 values of knowledge level and adaptive capacity. The results obtained from the level of knowledge and adaptive capacity will then be analyzed according to the variables using descriptive statistics and to determine the relationship between the two variables using the Pearson correlation test.

3.1   Analysis of Disaster Knowledge Level

Descriptive statistic was used to calculate the level of student knowledge. Table 2 shows that the average level of disaster knowledge of students is 28.59, which is the result of a total sample of 651 students. The average value of 28.59 is included in the low category. The Median at the level of knowledge is 30. The value that often appears is 36.67. Therefore, it can be concluded that the level of knowledge of SMA Negeri 1 Wedi students has a value of 36.67. Meanwhile, the standard deviation value, the data distribution in the knowledge level test sample, shows a value of 11.66.

Students' knowledge level about natural disasters can be seen in Table 3 and Figure 2. Students' level of knowledge is divided into four categories: Very High, High, Statisfactory, and Poor. The poor category has a score range of 21–40, the statisfactory category has a value range of 41–60, the high has a value range of 61–80, and the very high category has a value range of 81–100. Students of SMA Negeri 1 Wedi who have scores between 21–40 in the poor category are 578 students with a percentage of 89%. While other students have scores between 41–60 in the statisfactory category, totaling 73 students with a percentage of 11%. Based on these data, it can be concluded that the results of the questionnaires filled out by students of SMA Negeri 1 Wedi are dominated by students with low levels of disaster knowledge (Fig. 1).

Indicators in the analysis of students' knowledge level about natural earthquake disasters include knowledge, early warning, and mobility. *"The knowledge of students is*

Table 2. Statistical Analysis of the Distribution of Disaster Knowledge Levels

Distribution Statistics	
Mean	28.59
Median	30
Mode	36.67
Standard Deviation	11.66
Number of Samples	651

Table 3. Student's knowledge level

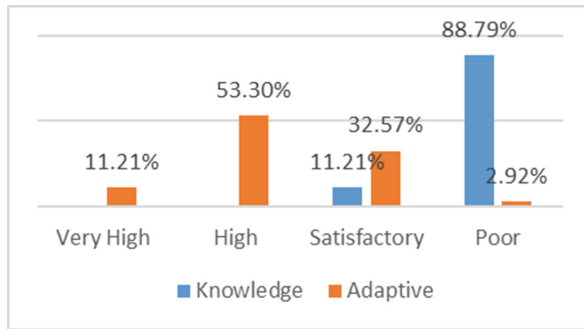| Category	Score	Total	Percentage (%)
Very High	81–100	73	11.21
High	61–80	347	53.30
Statisfactory	41–60	212	32.57
Poor	21–40	19	2.92
Total		**651**	**100**

Fig. 1. Knowledge Level and Adaptive Capacity of Students

Fig. 2. Filling out student questionna

only fleeting in general for the science class, in contrast to the social studies class that studies geography," said the geography teacher. The difference in knowledge that students have about the earthquake and natural disasters makes the level of knowledge of students different. *"We also often participate in competitions about disaster preparedness, like yesterday we took a video of a preparedness competition about earthquakes involving all class students,"* he added. The competition is one of the school's efforts to increase the knowledge of students better to prepare themselves in the event of an earthquake and to be able to share the information they get with others (Fig. 2).

3.2 Analysis of Students' Adaptive Capacity

Based on the statistical analysis of the adaptive capacity, the average value of adaptive capacity is 66.81. It shows that the average SMA Negeri 1 Wedi student belongs to the category value range between 61 and 80. The mean value of students on the adaptive capacity questionnaire is 68. The value that often appears on the adaptive capacity questionnaire is 68, thus indicating that most of the students of SMA Negeri 1 Wedi have a score of 68. The standard deviation value of SMA Negeri 1 Wedi students shows a value of 13.57 (Table 4).

Table 4. Statistical Analysis of Adaptive Capacity Value Distribution

Distribution Statistics	
Mean	66.81
Median	68
Mode	68
Standard Deviation	13.57
Number of Samples	651

Table 5 and Figure 4 show that the adaptive capacity to earthquake disasters is divided into four categories: Very High, High, Statisfactory, and Poor. The poor category has a score range of 21–40, the statisfictory category has a value range of 41–60, the high category has a value range of 61–80, and the very high category has a value range of 81–100. The adaptive capacity of SMA Negeri 1 Wedi students is in a high category, with 337 students out of the total. These results indicate that most SMA Negeri 1 Wedi students have a good adaptive capacity with a percentage of 553.30%. In the very high category, there are 73 students with a percentage of 11.21% in obtaining the value of the questionnaire about adaptive capacity. In the statisfictory category, there are 212 students with a percentage of 32.57% in obtaining the value of the questionnaire about adaptive capacity. In the poor category, there are 19 students with a percentage of 2.92% in obtaining the value of the questionnaire about adaptive capacity (Fig. 3).

In Fig. 4, students fill out a questionnaire for approximately 30 minutes. Indicators in the adaptive capacity of students to natural earthquake disasters include experiential knowledge, social learning, individual competence, resource access, and adaptation. *"Yesterday, when taking a video of the competition on earthquake preparedness, the place for evaluation was in the field because it was far from buildings,"* said one of the 11th graders. Experiences that happened directly made students more able to adapt directly to disasters, so students will reflect on the actions they have to take to reduce the impact that occurs due to disasters. *"We went to the evaluation site and followed the signs at the school; the signs helped us when making competition videos"* he continued. Students make the experience of competition as knowledge of their experience so that they understand the meaning of disaster signs so that they will not experience confusion in reading and understanding disaster signs their residential location.

Table 5. Student Adaptif Capacity Level

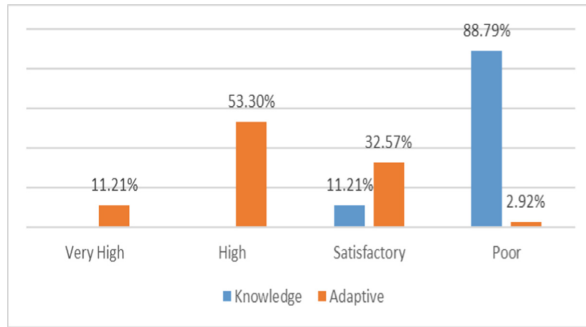| Category	Score	Total	Percentage (%)
Very High	81–100	73	11.21
High	61–80	347	53.30
Statisfactory	41–60	212	32.57
Poor	21–40	19	2.92
Total		**651**	**100**

Fig. 3. Knowledge Level and Adaptive Capacity of Students

Fig. 4. Filling out student questionna

3.3 Relationship between Knowledge and Adaptive Capacity

Normality Test

A normality test is conducted to determine the normal or abnormal distribution. If the significance value is >0.05, it can be said to be normal, whereas if the significance value is <0.05, it is said to be abnormal. The normality test results for the two variables in the study had abnormal results. The normality test of knowledge level and adaptive capacity used the Shapiro-Wilk method, where the significance level was 5%. The normality results in Table 6 show that the level of knowledge has a significant value of 0.00, which means that the data is abnormally distributed. Likewise, the significance value for adaptive capacity has an abnormal distribution because the significance value is less than 0.05.

Table 6. Tests of Normality

Tests of Normality			
	Shapiro-Wilk		
	Statistic	df	Sig.
Knowledge	.956	651	.000
Adaptive	.988	651	.000

Homogeneity Test

The results of the homogeneity test of the level of knowledge and adaptive capacity can be seen in Table 7. The data can be said to be homogeneous if the significance level is more than 0.05 and is said to be not homogeneous if the significance level is less than 0.05. The homogeneity test results of the knowledge and adaptive capacity level are 0.026. The value of 0.026 < 0.05 means that the knowledge and adaptive capacity level is not homogeneous.

Pearson Correlation Test

The Pearson correlation test has requirements in the form of a normality test and a homogeneous test. The normality test results will show that the data is not abnormally distributed. The homogeneity test shows that the data is homogeneous so the test will be used in parametric statistics. Using Pearson correlation, parametric statistics determine the relationship between knowledge level and adaptive capacity.

The relationship between the knowledge level and the participants' adaptive capacity can be seen in Table 8. Based on the parametric statistical test results using Pearson correlation, a significance value of 0.00 was obtained, meaning the value is less than 0.05. Based on the correlation results, it can be concluded that Ho (no relationship) and Ha (there is a relationship), this study shows a relationship between the level of knowledge and adaptive capacity because the significance value of 0.00 is smaller than 0.05. At the

Table 7. Tests of Homogeneity

Test of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
Knowledge and adaptive results	Based on Mean	4.965	1	1300	.026
	Based on Median	2.731	1	1300	.099
	Based on Median and with adjusted df	2.731	1	1299.083	.099
	Based on trimmed mean	4.441	1	1300	.035

Table 8. Knowledge Level Correlation Test Results and Adaptive Capacity

		Knowledge	Adaptive
Knowledge	Pearson Correlation	1	.514
	Sig. (2-tailed)		0.000
	N	651	651
Adaptive	Pearson Correlation	.514	1
	Sig. (2-tailed)	0.000	
	N	651	651

Table 9. Degree of Pearson Correlation

Category	Score range
No Correlation	0,00–0,20
Weak Correlation	0,21–0,40
Medium Correlation	0,41–0,60
Strong Correlation	0,40–0,80
Perfact Correlation	0,81–1,00

same time, the degree of relationship between knowledge and adaptive capacity can be seen in Table 9. The degree of relationship between the level of knowledge and adaptive capacity has a value of 0.514 which means that it is between 0.42 to 0.60, which is included in the category of medium correlation relationship.

4   Discussion

An important aspect in carrying out disaster mitigation efforts is the level of disaster knowledge, where knowledge about disasters must be provided early on [22, 23]. Disaster knowledge is *one* of the variables in analyzing disaster understanding where students adjust to disasters. This research focuses on the knowledge and adaptive capacity of SMA Negeri 1 Wedi students in an earthquake-prone area, Klaten Regency. The results show that SMA Negeri 1 Wedi has a low level of knowledge, while students at SMA Negeri 1 Wedi have good adaptive capacity.

The level of knowledge and adaptive capacity of students in the surrounding environment is very useful in dealing with disasters [23]. In this study, the attitude and knowledge aspects of SMA Negeri 1 Wedi students were not balanced because students in the knowledge aspect only gained general knowledge. In contrast, in the attitude aspect, students relatively often received training on earthquake disasters in the school environment. It shows that disaster risk reduction is crucial in increasing knowledge and adaptive capacity [24]. Increased knowledge and adaptive capacity through educational institutions play an important role in areas with high natural disaster risk. Knowing disasters will develop disaster prevention and reduce their impact so that adaptive capacity can be formed.

In this study, the level of knowledge and adaptive capacity of students was analyzed for both, and the relationship between the two, to obtain the fact that students of SMA Negeri 1 Wedi were superior in adaptive capacity to the level of knowledge, while the two variables had a moderate correlation. Compared to Khoirunisa's research, 2016 which examined students' knowledge of disaster for disaster preparedness, it only examined the level of disaster knowledge and understood the preparedness of students in dealing with earthquakes, thus obtaining the fact that students' knowledge was in the medium category and for preparedness students to face disasters were almost ready.

5   Conclusion

Based on the study's results, it can be concluded that students' disaster knowledge level is included in the low category, with an average number of 28.59. In contrast, the adaptive capacity of students is included in the good category, with an average number of 66.81. The results of the Pearson correlation test between the level of knowledge and adaptive capacity of students obtained a significance value of 0.00. The value of 0.00 is smaller than 0.05, indicating a relationship between the level of knowledge and adaptive capacity. The degree of Pearson correlation has a value of 0.514 which means that the correlation between the level of knowledge and adaptive capacity is included in the moderate correlation. In filling out the questionnaire, respondents must be accompanied because many still do not understand the statements or questions in the questionnaire. In addition, the ability to fill out digital questionnaires is highly dependent on the internet network. For researchers who want to conduct similar research, the results in this study can be used as research reference material so that further research is better.

Authors' Contributions. Risma Adelisn.   A: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft. **Yunus Aris Wibowo**: Conceptualization, Funding acquisition, Project administration, Supervision, Writing – review & editing.

References

1. T. H. Basri and S. Raisa, "Knowledge level of earthquake and tsunami disaster at disaster preparedness school and non-disaster preparedness school in Kuta Raja sub-district of Banda Aceh," in IOP Conference Series: Earth and Environmental Science, 2019, vol. 273, no. 1, p. 12029.
2. S. Husein, "Bencana Gempa Bumi," Univ. Gadjah Mada Yogyakarta, 2016.
3. R. Djalante and M. Garschagen, "A review of disaster trend and disaster risk governance in Indonesia: 1900–2015," Disaster risk Reduct. Indones., pp. 21–56, 2017.

4. M. S. S. Ali, M. Arsyad, A. Kamaluddin, N. Busthanul, and A. Dirpan, "Community based disaster management: Indonesian experience," in IOP Conference Series: Earth and Environmental Science, 2019, vol. 235, no. 1, p. 12012.

5. BMKG, Katalog Gempabumi Signifikasn dan Merusak. 2019.

6. R. A. Berk, "An introduction to sample selection bias in sociological data," Am. Sociol. Rev., pp. 386–398, 1983.

7. E. W. Safriani, Y. A. Wibowo, and S. H. N. Hafida, "The Influence of Preparedness on the Adaptive Capacity of Junior High School Students in Dealing With a Landslide Disaster, Banjarnegara, Indonesia," in International Conference of Learning on Advance Education (ICOLAE 2021), 2022, pp. 1107–1115.

8. S. H. N. Hafida, "Urgensi pendidikan kebencanaan bagi siswa sebagai upaya mewujudkan generasi tangguh bencana," J. Pendidik. Ilmu Sos., vol. 28, no. 2, pp. 1–10, 2019.

9. A. Arviansyah, R. D. Kusumastuti, N. Nurmala, and S. S. Wibowo, "Data on knowledge management and natural disaster preparedness: A field survey in East Lombok, Indonesia," Data Br., vol. 36, p. 107156, 2021.

10. D. Alexander, Natural Disasters (1st ed.). 1993.

11. B. Smit and O. Pilifosova, "From adaptation to adaptive capacity and vulnerability reduction," in Climate change, adaptive capacity and development, World Scientific, 2003, pp. 9–28.

12. M. H. Clarvis and A. Allan, "Adaptive capacity in a Chilean context: a questionable model for Latin America," Environ. Sci. Policy, vol. 43, pp. 78–90, 2014.

13. P. Klaten, "Klaten." https://klatenkab.go.id/geografi-dan-topografi-kabupaten-klaten/.

14. B. P. S. Klaten, "Geografis dan Letak Geografi Klaten," 07 Maret, 2018. https://klatenkab.bps.go.id/statictable/2014/12/17/6/geografis-dan-letak-geografi.html.

15. S. Suryanto and A. Rahman, "Application of livelihood vulnerability index to assess risks for farmers in the Sukoharjo Regency and Klaten Regency, Indonesia," Jàmbá J. Disaster Risk Stud., vol. 11, no. 1, pp. 1–9, 2019.

16. D. P. Sari and F. Suciana, "Pengaruh edukasi audio visual dan role play terhadap perilaku siaga bencana pada anak sekolah dasar," J. Holist. Nurs. Sci., vol. 6, no. 2, pp. 44–51, 2019.

17. kemendikbud, "Profil Pendidikan SMAN 1 TELUKJAMBE (27–02–2020 19_31_29)." .

18. B. B. Conner and E. Johnson, "ant11-Research-101–1017a," vol. 12, no. 11, 2017.

19. A. Azzalini, Statistical inference: based on the likelihood. Routledge, 2017.

20. C. B. Begg and M. Mazumdar, "Operating characteristics of a rank correlation test for publication bias," Biometrics, pp. 1088–1101, 1994.

21. S. Sugiyono, "Metode penelitian pendidikan:(pendekatan kuantitatif, kualitatif dan R & D). Bandung: Alfabeta." CV, 2015.

22. T. Cannon, "Vulnerability analysis and the explanation of 'natural'disasters," Disasters, Dev. Environ., vol. 1, pp. 13–30, 1994.

23. N. Khoirunisa, "Disaster knowledge of student for disaster preparedness," 2016.

24. L. Jones et al., "Responding to a changing climate: Exploring how disaster risk reduction, social protection and livelihoods approaches promote features of adaptive capacity," 2010.