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Environmental disaster education and communication in Indonesia: A survey among generation Z near Mount Krakatoa

Z. Hidayat

Communication Department, BINUS Graduate Program—Master of Communication Science, Bina Nusantara University, Kemanggisan, Jakarta 11480, Indonesia

Article Info

Abstract

This research paper aims to examine several factors that are thought to be correlations in building environmental awareness and preparedness in the face of earthquake, eruption, volcano, and tsunami disasters. The independent variables include formal learning such as school curriculum, intra-school (co-curricular), and extra-school. Online informal variables are learning from social media, learning from games, and learning from a role model such as Greta Thunberg. Meanwhile, sharing environment knowledge is positioned as an intervening variable, and the dependent variable is disaster preparedness. The survey was conducted in twelve sub-district cities around Mount Krakatoa in Indonesia. As many as 238 respondents were taken purposively among junior high school and senior high school students. Data processing in a structural equation model with path analysis shows that all tested independent variables have a significant correlation on sharing knowledge of environmental awareness and affect disaster preparedness. Formal learning does not directly affect disaster preparedness, but extra-school and informal online learning variables significantly affect disaster preparedness. The implications of the results of this study suggest the widespread adoption of topics on environmental care and disaster preparedness in schools and universities for humans and their environmental protection.

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Introduction

Disaster management, in essence, is the ability of disaster preparedness by communities around volcanoes and areas with potential natural disasters. The policy must instill community resilience in every generation because knowledge and experience dealing with disasters will never stop in one generation. Then, community awareness about the living environment in the volcanic area must be built through a social system. Likewise, formal, and informal knowledge about disaster preparedness must be part of the human lifelong education process in the vicinity of a potential disaster location.

Several natural disasters have resulted in human destruction, especially in communities located in volcanic circles and beaches with potential tsunamis. Natural disasters, which come suddenly, have been recognized

to have a social and psychological impact on victims' collective stress situations (Lindel, 2013). More than that, disasters affect political life on the ability to manage and resolve policies criticized at the local, regional, and national levels (Han et al., 2011). Previous research has highlighted the policy planning process that seeks to improve disaster preparedness methods (Lindel, 1994). Therefore, handling and anticipating disasters requires the community to understand and have solutions for living amid catastrophes.

The consequences of social preparedness are the focus of the discussion of this paper in the context of Indonesia's location as an archipelagic country that is included in the ring of fire. This archipelago in Southeast Asia is famous in history for the largest volcanic eruption in the world, namely Mount Krakatoa. Meanwhile, Indonesia's population was predicted to reach 270.20 million in 2020, so the context of social strengthening is essential. The location of Mount Krakatoa is right in the trajectory of the ring of fire in Indonesia, located in the Sunda Strait between the islands of Sumatra and Java. Two fertile islands surround its position with a high population density. The four provinces' populations closest to Mount Krakatoa are Lampung Province with 9.01 million, South Sumatra Province with 8.50 million, Banten Province with 13.16 million, and DKI Jakarta with 10.56 million (Central Bureau of Statistics, 2021). Thus, a high population density has significant consequences for the risk of natural disasters. This article provides a preventive perspective on disaster education for Gen Z and concern for the environment.

Gen Z has knowledge and experience about caring for the environment and the dangers of disasters that threaten human populations, animals, and nature in various places in the world. Education is critical to producing a generation of people who understand the situation and care about the future. There is a new awareness among Gen Z, and they are fighting world leaders at the country level, regional power alliances, and corporate power. This attention to the youth group segment aligns with the importance of promoting community resilience in disasters by examining the roles of schools, youth, and families (Ronan & Johnston, 2005).

Various previous studies used the dominant psychological perspective in managing disaster victims and social strengthening in disaster preparedness. For example, a social cognitive model of disaster preparedness has also been proposed to describe a process that starts with the factors that motivate people to make ready, strengthen intentions, prepare for disasters,

communicate, and engage rural communities. The other previous research focusing on knowledge and perception of secondary school students about earthquakes as natural disasters used a quantitative approach (Cvetković et al., 2015). However, such research focuses only on students' perceptions of natural disasters and excluded the environmental care. Our research paper's uniqueness is that it complements the psychological perspective, strengthens the sociological community, educational aspects, communication perspectives, and public figures of global public relations activists among Gen Z themselves.

It is crucial to study communicating risk during disaster and preparedness periods. Risk communication becomes essential when discussing disaster management and the involvement of all stakeholders to resolve problems in the field. It is essential to understand the complexity and diversity of risks and the stakeholders and the media's complex nature from a communication perspective (Kondo et al., 2019). Failure to communicate risks can lead to an increase in the number of deaths in the future.

In Indonesia, studies on disaster education are strategies that aim to reduce disaster risk. Disaster education interventions are adopted in schools in the hope of being an effective catalyst to influence community preparedness. However, previous research shows that school readiness is almost always the lowest in social strengthening efforts for disasters (Rafliana, 2012). Therefore, this paper re-examined the importance of the role of environmental education in schools, especially around volcanoes such as Mount Krakatoa.

Finally, the criticism in this paper is a follow-up to the recommendations of Lindel's (1994) research, which suggested specifically improving the ability of coastal communities to respond effectively to the threat of a tsunami. This paper analyzes the importance of disaster preparedness and environmental care content in formal and informal education involving media technology because Gen Z can be identified as dominant users of social media such as Instagram and YouTube.

Based on the description above, several research questions are answered and discussed in this research paper, namely: Do formal education factors have a significant correlation on knowledge and disaster preparedness among Gen Z? Do social media and conventional media have a significant correlation on knowledge and disaster preparedness among Gen Z? Does the role model of the adolescent peer age group have a significant correlation on knowledge and disaster preparedness among Gen Z?

Literature Review

Environmental Formal Learning and Gen Z

Formal education about caring for the natural environment, namely flora, fauna, and their ecosystems, including humans, is an essential subject in the learning process of each generation. Gen Z is experiencing something different from its predecessor generations in the third decade of the millennium. Education about disasters and environmental care is crucial because students' knowledge scores are relatively low about disasters in the new-normal era (Ilyasa et al., 2020).

The need for environmental education and awareness of natural disasters has increased in educating today's young generation with better insight into the earth's future (Rivera & Miller, 2008). Planned formal education is embodied in educational curricula on natural resources, environmental care subjects, and disaster preparedness and management. All topics are discussed through formal lessons in the classroom led by teachers. The education strategy regarding the environment and disasters aims to increase public awareness, primarily through educational curricula in secondary schools and universities. (Rivera & Miller, 2008). Other research shows that formal education through the curriculum is also carried out through practical programs and disaster simulations involving technology for student participants. Multidisciplinary projects involve students from various fields (Dufty, 2020). The formal curriculum in high school and higher education requires a collaborative approach to sharing knowledge and experience. Therefore, formal education remains among the most vulnerable and least prepared population subgroups, such as children and youth (Chirisa & Matamanda, 2019).

Based on the concept explication in the variables above, several hypotheses related to curricular, co-curricular, and intra-school learning are proposed as follows:

H_1: Teaching with a formal curriculum in schools significantly affects environmental knowledge and disaster preparedness.

H_2: Co-curricular teaching significantly affects environmental knowledge and disaster preparedness.

H_3: Extra-curricular activities significantly affect environmental knowledge and disaster preparedness.

Environmental and Disaster Social Media Learning

The factors tested in this research are related to the attributes of the communication technology used and which has become part of the identity of Gen Z, such as the use of social media. Various formats of social network sites (SNS) such as Instagram, Line, Twitter, Facebook, YouTube, and live streaming applications such as Tiktok, Bigo, Nano Live, and others are part of the daily lives of young people. Their life routine is always in two modes: interacting online and offline, both recorded on social media as knowledge-seeking activities and experience documentation (Hidayat & Hidayat, 2020).

Social media plays an essential role in disaster, knowledge dissemination, disaster preparedness, and environmental care socialization. In a disaster, Twitter is increasingly becoming an essential source of information for disaster-affected communities, governments, and external parties contributing to recovery (Rahim & Jalaladeen, 2016). Other social media have even become the main information channel for young people to improve disaster preparedness for the wider community. Communities share knowledge and experiences about everything in everyday life, including disaster preparedness, and build agreements to pay attention to a comfortable future of a pollution-free environment.

The test of the preparedness variable for the arrival of a disaster was carried out with various independent factors that were thought to affect the community (Daellenbach et al., 2018). The strategic goal in building community and environmental cohesiveness is to achieve sustainable disaster management in disaster-prone areas (Siriporananon & Visuthismajarn, 2018). Social learning through communication technology is a determinant for a community that is aware of disasters and cares about the environment.

Based on the conceptual explanation and analysis of several previous research pieces, a hypothesis related to social media variables as a channel of communication for social learning regarding environmental care and disaster preparedness is formulated as follows:

H_4: Interaction using social media significantly affects sharing knowledge about the environment and disaster preparedness.

Disaster and Environmental Education through Games

Young people find entertainment and informative messages in games. The world of education also involves games with creative and educational content. The advantage of online games is that they directly involve participants physically and mentally to achieve each content's goal. Each participant must find their competing position within the specified duration and in a tight competitive situation to integrate creativity, mind concentration, and the agility of physical movements

(especially the fingers) to achieve the best performance. Education in the environment, concern for flora and fauna, and understanding the importance of future planet earth are inserted in various online games.

Thus, the high duration of consumption of online games by children and adolescents throughout the day allows them to apply much knowledge and share experiences about the environment and disaster with peer groups. Thus, this research paper proposes a hypothesis to be tested as follows:

H_5: The interaction and messages of games and online games significantly affect environmental knowledge and disaster preparedness.

The Role Model such as Greta Thunberg to Environmental Care

Young people around the world are easily connected and interact. The social movement in Scandinavia, which then spread to Europe and North America, is also rapidly spreading to other parts of the world. Greta Thunberg's profile was quickly recognized and gained support from their peer group. Greta Thunberg has become a role model for Gen Z as an informal world leader, who dares to question and asks to stop exercising power that is destroying planet earth. Her struggle to build a social movement that calls for Friday off to care about the safety and future of the earth is watched and followed. Young people have followed Greta Thunberg argue in various official world forums against senior generation leaders such as Donald Trump and Vladimir Putin.

Therefore, this research article proposes a hypothesis that considers Greta Thunberg's character factors in building solidarity and concern among Gen Z as follows:

H_6: Role models from peers like Greta Thunberg significantly affect environmental knowledge and disaster preparedness.

Sharing Knowledge among Peer Groups on Environmental Care and Disaster

Interaction and communication among Gen Z peer groups can be face-to-face in the school environment, during free time to play, and online through social media. Groups of young people also seek and share news about the attitudes and statements of world leaders related to environmental issues of concern and often criticize the senior generation for opposing their stance on the environment and the future of the earth.

The ease of sharing experiences and knowledge is one of the essential factors in predicting the attitudes and actions of young people today and in the future. They provide information and news coverage about the damage and victims of natural disasters, volcanoes, tsunamis, floods, and pollution. Dissemination of knowledge among Gen Z is crucial to be tested in research so that the following hypothesis is proposed:

H_7: Sharing knowledge of the environment significantly affects disaster preparedness.

Research Model

This research paper proposes several independent and dependent variables to be tested for their relationship by considering the educational context in an area prone to natural disasters, mainly volcanoes and tsunamis. All variables are modeled using a structural equation model (SEM), which describes the indirect correlation and direct influence of the independent variable on the dependent variable, bridged by intervening. Based on the explication of the concept derived from the theoretical perspective stated above, several independent variables include School curriculum (X_1), Intra-school (co-curriculum) (X_2), Extra-school (X_3), Learning from social media (X_3), Learning from games (X_4), and Learning from a role model such as Greta Thunberg (X_5) while the intervening variable is Sharing knowledge of the environment (X_6), and the dependent variable is Disaster preparedness (Y).

Figure 1 illustrates the structural form of the relationship that will be tested by path analysis in this research paper to obtain empirical evidence for strategic decision making in sustainable environmental management and disaster management at critical times and its preparation over time in ring of fire areas such as Mount Krakatoa circle in Indonesia.
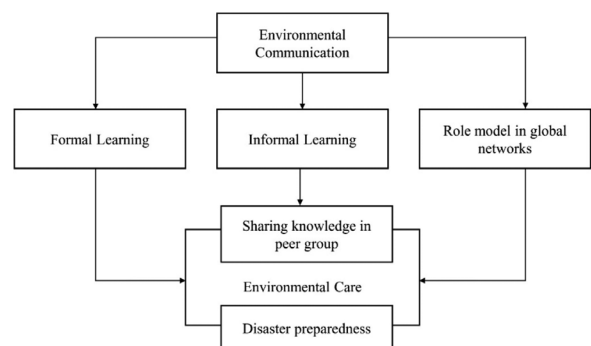

Figure 1   Research model

Methodology

Procedure

Two provinces as survey locations were Lampung and Banten as the area is closest to the center point of Mount Krakatoa, a distance of five to ten kilometers. Each sub-district city was determined on the coastline. Six sub-districts were found in Lampung, namely, Ketapang, Kalianda, Katibung, Kelumbayan, Kota Agung, and Belimbing, and six in Banten, namely, Cilegon, Labuan, Patia, Cibaliung, Sumur, and Angsana. The sampling locations included 12 sub-districts with 12 high schools. A purposive sample of 25 respondents was taken at each school, and 300 questionnaires were distributed. After verification, 238 units were filled out entirely and deserved to be inputted into data processing. The questionnaires were distributed face-to-face to each school or in public spaces like each school campus, bus terminal, train station, and county sports facility. A total of 47-unit questionnaires were distributed as printouts, and 191-units of questionnaires were distributed via the Google Form.

Samples

The total population of high school students between 16 and 18 in 2020 in Banten Province was 458,122 people. In Lampung Province, it was 192 428, so the total population in the two provinces closest to Mount Krakatoa was 690,550 (Central Bureau of Statistics, 2021). Characteristics of respondents tended to be homogeneous because the population selected was in the same age group. Respondents were teenagers and young adults sitting in junior and senior high schools, so in the cohort concept, respondents were categorized using the term Gen Z. The characteristics of these respondents were chosen as the purpose recommended in this study to investigate a group of generations living in areas of natural disaster. Characteristics that tend to be homogeneous because of the age group include the level of education, knowledge, experience, habits in using media, language, thoughts, hobbies, liking for playing online games, and ways of communicating with others.

Out of 238 people in the age group of 14 to 19 years, 53 percent were female and 47 percent male. The level of education showed that 27 percent were studying in junior high schools, and 73 percent of respondents were students in senior high schools.

Data Collection and Constructs

School curriculum is a decisive factor for efforts to build a more friendly future to nature (Fauville et al., 2014). The younger generation will determine the future with development policies that improve the interdependent relationship between humans and nature. Therefore, the School curriculum variable includes several indicators such as "learn about environment and disaster," "the topics are incorporated into biology, geography, and or geology," and "the teacher's briefing."

In addition to the availability of a curriculum for topics related to environmental awareness and preparedness for natural disasters, the curriculum must also be supported by co-curricular activities (Fauville et al., 2014). The independent intra-school variable includes constructs such as "co-curricular activities," "tree planting school program," "clean up trash," "maintain school garden," and "donate tree seedling."

Extra-school activities significantly shape their attitudes, experiences, and mental education. The school inserts several extra activities to support the curriculum as part of hands-on practice in the field (Horváth, 2019). This extra-school activities variable includes several indicators such as "school nature lovers' group or scouts," "the group teaches environment and earth's future," "hacking and climbing in nature," "group always preserves flora and fauna," and "group instills nature and human values."

Factors for using social media for learning about the environment and disaster preparedness (Boulianne et al., 2020; Chung et al., 2020) includes "watch the disaster news which struck our mind," "watch the damage done by disaster," "watch the earthquake, volcano, and flood on social media," "watch the damage brought by tsunami and floods," and "listening to the experts for environmental care."

Figure 2 Map of Mount Krakatoa and twelve spots research sampling locations

Young people are actively playing online games in the virtual world. The educational content is also obtained in online games such as environmental care and disaster preparedness (Chiang, 2021; Kankanamge et al., 2020). The variables tested in learning from games include indicators with statements such as "care for the environment when playing games," "love the natural environment when playing games," "understand the message in the game contents about maintaining the existence of planet earth," "through games understand the importance of preserving the environment and having disaster awareness," and "being prepared in case of a famine with games."

Role models from Gen Z can be examples for many teenagers worldwide. Greta Thunberg, who dared to protest and ask for a Friday day off to care for the environment, is one of the figures followed by many youth and young adult activists in many countries (Moriarty, 2021; Nässén & Rambaree, 2021). Therefore, the variable learning from a role model such as Greta Thunberg includes "know who Greta Thunberg is," "young people must take a role for the future of the earth," "see Greta Thunberg's activities on IG," "the younger generation must protest against the senior generation who doesn't care about the earth," and "take Greta Thunberg as a role model."

Sharing knowledge and discussing issues of environmental care and disaster in various places is part of their conversation in the group, both face-to-face and through social media (Barton et al., 2020; Norton & Gibson, 2019; Paton, 2009). Therefore, this study proposes sharing knowledge as an intervening variable by covering several indicators such as "talk about environmental care and disaster with friends," "sharing about awareness of living in disaster areas," "interacting and communicating with others about the environment and disaster risk," "the family always shares knowledge," and "share disaster content through the social media."

This research investigated the preparedness of the younger generation against the risk of a sudden earthquake disaster (Baker & Ludwig, 2018). Variables of disaster preparedness include "my family has communication devices," "my family is always prepared in case of a disaster," "neighbors' cohesiveness," "have a first-aid kit or easy access to a community health center," and "have an evacuation route in an emergency."

Data Analysis

Measurement in each item on each variable is arranged with a Likert scale that represents each respondent's experience and knowledge. The Likert scale was given seven choices, such as "strongly disagree" with a score of [1] to "strongly agree" with a score of [7].

Furthermore, the data are verified and processed with statistical tools, path analysis. Path analysis is one of the techniques used in the structural equation model (SEM). Structural equation modeling is a statistical method like multiple regression analysis, that provides researchers with the opportunity to evaluate the relationship between observed and latent variables and to develop and test theoretical models (Hoyle, 1995).

Results

The testing of all variables summarized in descriptive statistics shows that raw scores and z-scores vary. In the raw scores group, each variable was in the median (M) between 3.21 (School curriculum) to 6.34 (Learning from a role model such as Greta Thunberg). The smallest standard deviation is on the school curriculum variable (0.81), and the highest is on the Intra-school or co-curricular variable (4.17).

In the z-scores category, all variables show a positive median number, where the school curriculum variable gets the smallest score (0.19), and the Learning from a role model variable such as Greta Thunberg gets the highest median (1.37). Meanwhile, the lowest standard deviation was in the Intra-school or co-curricular variable (0.97), and the highest standard deviation was in the Learning from a role model variable such as Greta Thunberg (1.74). The complete descriptive statistics are shown in Table 1.

Table 1   Disaster preparedness: Descriptive statistics of raw- and z-scores

Variable	raw scores		z-scores			
	M	SD	M	SD	Min	Max
School curriculum	3.21	0.81	0.19	1.38	-1.06	3.97
Intra-school (co-curricular)	4.17	2.93	0.21	0.97	-4.87	2.25
Learning from social media	5.59	3.98	0.42	1.29	-1.76	2.42
Learning from games	3.78	1.26	0.55	1.07	-1.53	2.87
Learning from a role model such as Greta Thunberg	6.34	1.91	1.37	1.74	-1.79	3.21

Descriptive Statistics and Reliability Indexes

The descriptive statistics shows the heterogeneity of the factors tested and calculated in achieving the condition of the segment of young people. See Table 2 to see the consistency of the respondents' answers. The tested factors showed good internal consistency with a strong and adequate Cronbach alpha coefficient number. The Cronbach alpha is (0.796) for the school-curriculum variable (SCC) to the highest Cronbach alpha (0.898) for the Sharing knowledge of environment (SHK). This reliability index shows that the internal consistency in the setting of this survey tool is good. Each variable internally also shows a solid and adequate reliability index number so that the scale used for the assessment concludes that all the scales in each variable have a good consistency.

Table 2 Formal learning, online informal learning, role model, sharing knowledge, and disaster preparedness descriptive statistics and reliability indexes

Variable	Scale	*M*	*SD*	Min	Max	Cronbach's α
School curriculum	SCC-01	3.67	0.71	1.12	4.72	0.796
	SCC-02	3.42	0.52	1.47	4.91	
	SCC-03	3.13	0.57	1.71	4.90	
	SCC-04	3.51	0.65	1.81	4.83	
	SCC-05	3.55	0.61	1.96	4.77	
Intra-school (co-curricular)	INS-06	3.13	0.59	1.09	4.80	0.812
	INS-07	3.28	0.61	1.75	4.89	
	INS-08	3.71	0.75	1.18	4.67	
	INS-09	3.08	0.49	1.67	4.90	
	INS-10	3.67	0.70	1.09	4.59	
Extra-school	INS-11	3.07	0.55	1.01	4.79	0.816
	INS-12	3.11	0.67	1.55	4.91	
	INS-13	3.09	0.60	1.27	4.72	
	INS-14	3.23	0.67	1.81	4.88	
	INS-15	3.19	0.61	1.12	4.63	
Learning from social media	LSM-16	3.01	0.60	1.00	4.80	0.812
	LSM-17	3.12	0.59	1.09	4.82	
	LSM-18	3.07	0.61	1.10	4.81	
	LSM-19	3.03	0.59	1.00	4.80	
	LSM-20	3.15	0.63	1.11	4.83	
Learning from games	LEG-21	3.09	0.60	1.25	4.75	0.848
	LEG-22	3.11	0.69	1.54	4.93	
	LEG-23	3.53	0.70	1.95	4.79	
	LEG-24	3.28	0.69	1.76	4.88	
	LEG-25	3.79	0.77	1.22	4.63	
Learning from a role model such as Greta Thunberg	LGT-26	3.01	0.57	1.02	4.78	0.820
	LGT-27	3.23	0.68	1.80	4.95	
	LGT-28	3.15	0.64	1.10	4.61	
	LGT-29	3.09	0.59	1.00	4.50	
	LGT-30	3.27	0.69	1.69	4.93	
Sharing knowledge of environment	SHK-31	4.12	0.91	1.21	6.71	0.898
	SHK-32	4.09	0.89	0.94	6.68	
	SHK-33	4.31	1.00	1.35	7.00	
	SHK-34	4.24	0.93	1.29	6.82	
	SHK-35	4.19	0.98	1.26	6.75	
Disaster preparedness	DIS-36	3.21	0.68	1.59	4.87	0.884
	DIS-37	3.19	0.62	1.11	4.65	
	DIS-38	3.55	0.65	1.96	4.89	
	DIS-39	3.72	0.75	1.17	5.05	
	DIS-40	3.35	0.67	1.70	4.94	

Correlation and Regression Analyses

All independent variables tested were correlated with the two dependent variables examined, accompanied by regression analyses. The correlations and regressions for the sharing knowledge scale and disaster preparedness scale are described below.

Sharing Knowledge Scale

The correlation between independent variables is significant to test, so correlation analyses and regression analyses are shown in Table 3. The correlation shows that sharing knowledge and experience as fellow teenagers goes well regarding the environment and dangers in their residence. For example, "Share disaster content through the social media" (SHK-35) has the highest coefficientβ (0.391), followed by "Talk about environmental care and disaster with friends" (SHK-31) with 0.386, "Sharing about awareness living in a disaster area" (SHK-32) with 0.372, "The family always shares knowledge" (SHK-34) with a score beta 0.357, and "interacting and communicating with others about the environment and disaster risk" (SHK-33) with beta 0.319.

Correlation and regression showed that each indicator on all independent variables determined a strong positive correlation in conversation, interaction, and knowledge sharing among young students. It shows a projection that the several independent variables are significant to build a shared understanding within the community by starting from the educated young people segment in the sub-district cities around Mount Krakatoa.

Disaster Preparedness Scale

The dependent variable disaster preparedness is influenced directly and indirectly by the independent variables. Through sharing knowledge about the environment and disaster intervening variable, standardized coefficient-beta is shown on each scale or indicator. In Table 4, all scales show a positive coefficient-beta such as "My family has communication devices" (DIS-36) with a score of 0.391, which indicates that on average, families in the community living around Mount Krakatoa have communication devices. Several other scales are "Have an evacuation route in an emergency" (DIS-40) with coefficient-beta 0.289, "Neighbors' cohesiveness" (DIS-38) with coefficient-beta 0.279, "Have a first-aid kit or easy access to a community health center" (DIS-39) with coefficient-beta 0.238, "My family always prepares in case of a disaster" (DIS-37) with coefficient-beta 0.208.

Path Analysis

The hypothesized model tested in this research compares the direct and indirect correlations to provide an overview of the factors influencing disaster preparedness. Table 5 shows a comparison of the two models applied to the test. There is no significant direct correlation between the independent variables of formal learning (education) both school curriculum, intra-school, and extra-school to disaster preparedness.

Table 3 Sharing knowledge scale: Linear regression coefficients

Items	Standardized coefficients beta	t	p
(Constant)		-1.137	0.108
"Talk about environmental care and disaster with friends" (SHK-31)	0.386	3.521	0.013
"Sharing about awareness of living in disaster areas" (SHK-32)	0.372	2.849	0.037
"Communicate with others about the environmental and disaster" (SHK-33)	0.319	2.746	0.041
"The family always shares knowledge" (SHK-34)	0.357	2.983	0.029
"Share disaster content through the social media" (SHK-35)	0.391	2.872	0.047

Table 4 Disaster preparedness scale: Linear regression coefficients

Items	Standardized coefficients-beta	t	p
(Constant)		-0.512	0.289
"My family has communication devices" (DIS-36)	0.391	4.574	0.008
"My family always prepares in case of a disaster" (DIS-37)	0.208	2.119	0.012
"Neighbors' cohesiveness" (DIS-38)	0.279	1.017	0.017
"Have a first-aid kit or access to a community health center" (DIS-39)	0.238	2.255	0.021
"Have an evacuation route in an emergency" (DIS-40)	0.289	2.703	0.029

Table 5 Path analysis: Fit indexes of assessed models

Model	χ^2	df	χ^2/df	CFI	TLI	RMSEA [90% CI]	SRMR
1	727.17	237	3.06	0.712	0.698	0.152 [0.112–0.169]	0.221
2	163.22	73	2.73	0.881	0.871	0.103 [0.091–0.198]	0.126
3	170.09	74	2.61	0.901	0.897	0.105 [0.089–0.201]	0.127

A curriculum containing environmental awareness and disaster preparedness may still be seen as merely imparting knowledge because, for students, practice and simulation in the field can be considered more critical and affect disaster preparedness. The possibility gets smaller if the teachers are leading and providing knowledge sharing.

The second model in Figure 3 shows an insignificant direct correlation between formal learning and disaster preparedness. Therefore, the direct correlation was dropped and shifted with the third model in Figure 4. In Model 3, the direct correlation is significant only on independent online informal learning variables such as learning from social media (X_4) and learning from games/online games (X_5). Meanwhile, the direct influence between learning from a role model such as Greta Thunberg (X_6) has also been removed because it is insignificant. Therefore, Model 3 is a significant model for testing several hypotheses in this research.

Discussion

First, the discussion is about curriculum, co-curricular, and extra-schools that support each other. Teaching and discussing in the classroom is a group communication process to increase understanding and action commitment to environmental awareness and disaster preparedness. The educational curriculum is seen as a formal effort, and activities outside the classroom are seen as informal learning. This finding shows the importance of communication in monitoring, disaster preparedness, and critical assistance during disasters for communities around volcanoes (Chirisa & Matamanda, 2022), thus requiring a curriculum innovation for natural disaster reduction (Chirisa & Matamanda, 2022). Formally in Indonesia, knowledge about the environment and disaster has been included in the geography and other subjects in schools aims to motivate students to act and provide solutions in disaster preparedness (Kamil et al., 2020). Capacity building is in social learning programs for disasters and the socio-economic development of farmers and fishermen in volcanic areas (Adu et al., 2018; Saqib et al., 2018; Somboonsuke et al., 2018).

Second, the discussion about the role of social media as a channel of communication and interaction in building understanding and cohesiveness. The communication process is driven by a combination of social, economic, environmental, institutional, and other relevant processes that interact and influence each other (Pal et al., 2021), because online channels of communication are increasingly making it easier for people to learn. The findings in this research paper are in line with several previous studies that place the role of social media. Social media can be a helpful surveillance tool during natural disasters and other environmental issues. Social media play a crucial role in warning people to help each other and coordinate when responding and recovering victims (Dufty, 2015). Yuan et al. (2021) also have identified more sensitive groups so that they are right on target. However, this research focuses on Gen Z, where social media has been proven to increase understanding about
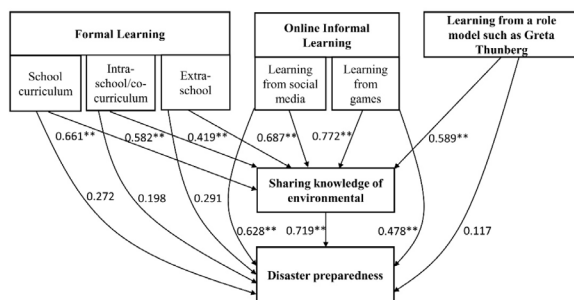
Figure 3 Path analysis: Model 2
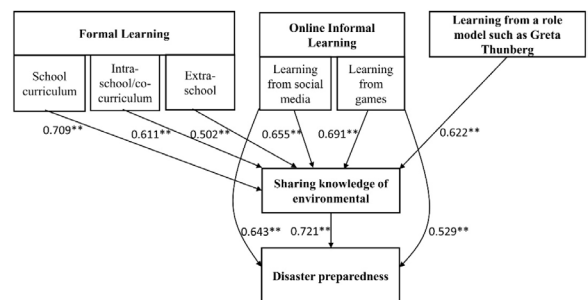
Figure 4 Path analysis: Model 3

environmental awareness and preparedness for possible disasters. The insignificant relationship between formal education may be caused when students are more active in using online devices to find out what information is related to disasters and the environment. Informal learning through social media is done because Gen Z has a higher awareness of disasters and environmental concerns. Thus, they seek more dynamic information and knowledge independently through social media and the Internet. It is proven that informal learning is significantly correlated. Sim et al. (2021) calls this trend due to increased public awareness and participation.

The third discussion is about the role of games or online games as a learning channel and practice of disaster preparedness simulation. Games, for adolescent participants, serve to instill awareness of disasters, audio-visually providing an overview that approximates the real dangers of disasters, including vulnerabilities, capacities for simulative handling, and conditions of victims. According to Rahmayanti et al. (2020), two games, *Difmol and Ilmizi*, are used in disaster mitigation lessons. Gampell and Gaillard (2016) also identified and recommended games such as Stop Disasters, Disaster Watch, Inside Haiti, Earthquake Response, Fallout, and SimCity with learning content that can instill environmental and disaster awareness for participants.

Fourth, discussion about influential role models from Gen Z such as Greta Thunberg and many local figures in various countries. The meaning of Greta, a representative of adolescence, a student, emerged and has become a social phenomenon, a "global sensation". Western (2021) mentions that Greta has become a role model with a social meaning that evokes reactions and is a "social imaginary" world. Bergmann and Ossewaarde (2020), presented the figure of Greta Thunberg as a responsible 'young hero'. The presence of young people challenged their future sustainability due to the strengthening of global collectivity, connection, and solidarity, especially during the COVID-19 pandemic (Jandrić et al., 2021). The persona of the young girl Greta Thunberg is framed significantly in the discourse of the local movement, especially towards the peer group (Díaz-Pérez et al., 2021).

Finally, a discussion of knowledge sharing and disaster preparedness from the results of this study compared with several previous studies. Presentation of information is critical in disaster management and preparedness. Therefore, disaster management applications for communities in volcanic circles are urgently needed. However, community empowerment requires integrated collaboration between all interested parties (Sitas et al., 2016). Communication channels, in this case, play a role in facilitating the exchange of information and the co-production of knowledge, experience, and commitment.

Conclusion and Recommendation

All independent variables categorized into formal learning, informal online learning, and role models have significantly associated with the intervening knowledge-sharing and disaster preparedness dependent variables. Formal education with the curriculum has no direct correlation to disaster preparedness. Likewise, the role model does not directly associate disaster preparedness, but the extra-school and learning from games variables significantly correlate with disaster preparedness. All independent variables indirectly relate to the sharing knowledge intervening variable first and then to disaster preparedness.

The results of this study show several models as test results. The resulting model shows an insignificant correlation of the low direct influence of formal learning variables on disaster preparedness. However, it indirectly has a significant correlation on disaster preparedness. The alternative model shows a change with the removal of the direct correlation of the correlation of formal learning to disaster preparedness.

The implications of this study point to the importance of government, community, and higher education institutions to collaborate in all stages of preparedness. The collaboration is in education, informal education for adults, alignment and development of curricula-based disaster risk reduction, and early warning systems by communication technology.

Conflict of Interest

The author declares that there is no conflict of interest.

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