Relationship of knowledge and attitudes with disaster preparedness in high school students

Introduction. Gamalama Volcano is one of the most active volcanoes in Indonesia. The eruption of Gamalama Volcano has direct or indirect dangers to the community, especially school students. The potential for casualties and loss of school infrastructure will increase if students do not follow suit when they are at school. The purpose of this study was to determine the relationship between knowledge and attitudes with disaster preparedness that affects students. Then find out the level of disaster preparedness in high school students.

Research methods. The research is a descriptive correlational study, with a total sample of 162 students taken by purposive sampling technique at 4 high schools located in the disaster-prone area of Gamalama Volcano. Data analysis used quantitative descriptive analysis and correlation analysis.

Results. The results show that there was a positive and significant relationship between knowledge and disaster preparedness in students (sig. 0.000 < 0.01). Likewise, the relationship between attitude and student preparedness has a positive and significant relationship (sig. 0.000 < 0.01). Meanwhile, the level of disaster preparedness among students was in the "ready" category, with the value of the preparedness index of 74.57.

Conclusions. Knowledge, attitudes, and student disaster preparedness need to be improved, in order to reduce the loss of life and property during a disaster, especially schools located in disaster-prone areas. Then, real efforts from the government, local communities and non-governmental organizations are needed in the volcanic disaster risk reduction program.

Keywords: knowledge, attitudes, student readiness

For Reference:
Indonesia is one of the countries with the highest disaster risk in the world. Data from the Indonesia National Disaster Management Organization (Badan Nasional Penanggulangan Bencana) showed that 80% of districts/cities in Indonesia are areas with a high level of risk to disasters, with 205 million people exposed to disaster risk including 107 million students [1]. Other data from the Indonesian Ministry of Education and Culture (Kementerian Pendidikan dan Kebudayaan Indonesia) also showed that 266,599 schools and 1,701,302 classrooms had been damaged by the disaster, with the categories of minor, moderate, heavy, and complete damage. It is because 75 percent of the 497,576 schools in Indonesia are located in high-risk areas for earthquakes, volcanic eruptions, tsunamis, floods, and landslides [2]. Some of these schools are located in Ternate City.

Gamalama Volcano is one of the volcanos causing natural disasters in Ternate City. About 60% of volcanoes in Indonesia are active and have high potential damage to the surrounding population, one of which is Gamalama Volcano [3]. Mount Gamalama is a volcano with type A (Strato). Geologically, Mount Gamalama is located on the Arc of Halmahera Island, in the northeast of North Maluku Province. The area is the meeting point of several plates, including the Pacific, Eurasian, and Australian plates as well as other smaller plates, above the subduction zone sloped to the east with a small angle [4].

Gamalama Volcano located on Ternate Island is geographically between 00 48” North Latitude and 1270 19’ 30” East Longitude with an altitude reaching 1,715 M above sea level. Ternate city is an archipelago in North Maluku Province. Ternate Island has a land area of 101.67 km2 of the total area of Ternate City. Ternate City has a population of 233,208 people, and more than 80% of the population of Ternate City live on Ternate Island [5]. According to [6], the population living on Ternate Island is prone to the Gamalama Volcano disaster.

Gamalama volcanic eruption has direct (primary) and indirect (secondary) risks. Direct risks are in the ejected ash-sized material, lava flows and pyroclastic flows, while indirect risks are rain lava and volcanic tsunamis [6; 7]. The first known eruptions were from 1538 to 2003, with more than 65 recorded eruptions [6], then from 1538 to 1770, the average rest period was more than ten years [8]. However, eruptive activity tended to increase, from 1771 to 2013 the rest period is shorter, between 1–2 years. The losses that have been caused by the dangers of the Gamalama Volcano eruption are victims and damage to infrastructure, with the largest number of victims being the eruption in 1775 [4].

Based on the Disaster-Prone Areas (Kawasan Rawan Bencana/KBR) map, Gamalama Volcano Disaster is divided into three levels: KRB III, KRB II, and KRB I. KRB III are located closest to the center of the eruption (main crater) which has a higher danger threat, with a radius of 1.5 km from the center of the eruption. This area occupies part of the peak area and river originating at the peak. Meanwhile, KRB II has a radius of 2.5 km from the center of the eruption including sub-district located in Ternate Island District, North Ternate District, and several sub-districts located in Central Ternate District and South Ternate District. KRB I covers a radius of 3.5 km from the center of the eruption. However, the eruption in ash rain follows the direction of the wind; it occurs throughout residential areas on Ternate Island. The danger of the eruption caused by KRB, either KRB III, II, and I was a direct or indirect danger so that it threatens the surrounding community [6; 9].
Based on the history of the Gamalama Volcano eruption and its dangers in disaster-prone areas, the community on Ternate Island is very vulnerable to the Gamalama Volcano disaster. One of the sectors exposed to the dangers of the eruption is education. There have been many accidents and losses of assets and school infrastructure due to volcanic eruptions, such as the eruption of Mount Tambora in 1815 which killed more than 80,000 people, the eruption of Mount Krakatau in 1883 claimed 36,000 lives [10; 11]. The eruption of Mount Merapi in 2010 caused 554 deaths and missing, 4,692 houses heavily damaged, and 732 educational facilities damaged [12]. The eruption of Mount Sinabung in 2010 also caused infrastructure damage, including 185 schools damaged [2], and four deaths, and several missing [13].

The impact of the volcanic disaster is very worrying for the education areas. Therefore, schools in the disaster-prone areas of Gamalama Volcano need to identify and improve students' disaster preparedness abilities [14]. Recently, disaster preparedness has received high attention from researchers around the world [15]. It is significant because preparedness is effective to survive, reduce injuries, limit property losses, and minimize all kinds of disruption caused by disasters [16].

Knowledge and attitudes related to natural disasters can improve disaster preparedness because both can increase individual preparedness against disasters. Knowledge and attitudes have a significant effect on disaster preparedness [17]. Also, based on the research results by [18] knowledge and attitudes have a positive relationship with disaster preparedness. Therefore, knowledge and attitudes related to disasters need to be developed in every student through formal educational institutions, so that students can survive when a disaster happens. Schools are formal institutions that are critical in contributing to students' awareness of disasters [19].

Since 2006, the United Nations secretariat of the International Strategy for Disaster Reduction (UN/ISDR) in collaboration with UNESCO, started a campaign called disaster risk reduction starting from schools to encourage the integration of disaster risk education into school curricula in disaster-prone countries [20]. Even within the Sendai Framework for Disaster Risk Reduction 2015-2030, schools as formal educational institutions play an essential role in disaster risk reduction, one of which is through increasing disaster preparedness. As stated by [21], disaster preparedness will not be effective without the participation of the community and formal or informal educational institutions. Through formal education, schools can neutralize approaching disasters or minimize the impact through increasing disaster preparedness [22].

It is crucial to develop students' disaster preparedness to minimize losses in schools. Therefore, this study aimed to determine the disaster preparedness levels of high school students in the disaster-prone areas of Gamalama Volcano. Also, this study investigated the relationship between knowledge and attitudes with high school students' disaster preparedness. Students' knowledge and attitudes are thought to increase preparedness for volcanic eruptions.

The research design is a descriptive correlational study. The research locations were four Senior High Schools in Ternate City, namely National Senior High School 5 Ternate City, Islamic Senior High School 1 Ternate City, National Senior High School 6 Ternate City, and
private Senior High School of Muhammadiyah Ternate City, located in the Disaster-Prone Area (KRB) of Mount Gamalama in Ternate Island, Indonesia. The research was conducted from March 16 to April 20, 2020. This study involved 397 eleventh-grade students from four high schools on Ternate Island, with a total sample of 162 students, taken using a purposive sampling technique. The research location can be seen on the following map.

Figure 1 Research locations and volcanic disaster-prone areas
1. Research Instruments

Researchers used indicators of school community preparedness in anticipating natural disasters developed by the Indonesian Institute of Sciences (LembagaIlmuPengetahuan Indonesia) and UNESCO/ISDR to determine the students’ preparedness levels: 1) Knowledge and attitude, 2) Emergency response plans, 3) Disaster warning systems, and 4) Resource mobilization [23]. Based on the four indicators, then the students’ disaster preparedness levels were analyzed and scored.

The instruments used were questionnaires and essays. The questionnaire was used to measure the students’ disaster preparedness levels and attitude towards disaster risk. Meanwhile, the essay was used to measure students’ knowledge about the natural disaster of Gamalama Volcano. Research instruments can be seen in the following table.

Table 1
The Instruments of Students’ Preparedness, Knowledge, and Attitudes in Facing Volcanic Disaster

<table>
<thead>
<tr>
<th>Variables</th>
<th>Indicators</th>
<th>Total Question Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparedness</td>
<td>Knowledge and attitude</td>
<td>Understanding natural disasters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The causes and effects of the volcanic disaster.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Type, source, magnitude, and location of natural disasters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Actions taken in the volcanic eruption</td>
</tr>
<tr>
<td>Emergency response plans</td>
<td>Evacuation plan</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Emergency response drills and simulations</td>
</tr>
<tr>
<td>Disaster warning systems</td>
<td>Recognizing disaster warning signs</td>
<td>4</td>
</tr>
<tr>
<td>Resource mobilization</td>
<td>Human resources (students’ participation in disaster activities</td>
<td>3</td>
</tr>
<tr>
<td>Knowledge</td>
<td>The types and characteristics of natural disasters</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Disaster management cycle</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Distribution of prone areas to natural volcanic disasters</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Institutions in natural disaster management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Community participation in volcanic disaster mitigation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Creating a volcanic disaster evacuation map in the surrounding environment</td>
<td></td>
</tr>
<tr>
<td>Attitude</td>
<td>Plans to respond to disaster emergencies</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Rescue for self-victims during a disaster</td>
<td></td>
</tr>
</tbody>
</table>

The questionnaire was measured using a Likert scale, consisted strongly agree (score 4), agree (score 3), disagree (score 2), and strongly disagree (score 1). The instruments developed, both questionnaires and essay questions, were checked and verified by learning experts. The validity and reliability of the research instrument was tested using the Pearson test and alpha Cronbach to 25 respondents with a significant level of 5%, and the correlation coefficient table value was 0.396. The test results of all instrument question items met the valid criteria, indicated by each item of the question $r_{count} >$ from the value of $r_{table}$. Moreover, the results of the reliability test on all instruments were reliable. The reliability value indicated that the preparedness instrument was 0.961. The reliability value for the knowledge instrument was 0.777. Meanwhile, the reliability value for the attitude instrument was 0.788.
2. Data Analysis

The research data were analyzed using quantitative descriptive and correlation analyses. Quantitative descriptive analysis was used to determine students’ disaster preparedness levels. The students’ preparedness levels were measured using a composite index value per indicator. The index value per indicator was obtained from the total real score of the indicator divided by the maximum score of the indicator multiplied by 100. Meanwhile, to measure the students’ preparedness levels using a weighted composite index formula [23]. The index is in the range of values from 0 to 100, so the higher the index value, the higher the students’ disaster preparedness level. The students’ readiness levels were categorized into five, namely the index scores of 80 - 100, 65 - 79, 55 – 64, (40 – 54, and 0 – 39 for very ready, ready, almost ready, less ready, and not ready categories, respectively. Correlation analysis to determine the relationship between students’ knowledge and attitudes with their readiness employed the Spearman rank correlation test. The results were analyzed using SPSS version 17 software with a significant level (α) = 0.01.

Table 2

<table>
<thead>
<tr>
<th>No</th>
<th>Indicators</th>
<th>Frequencies</th>
<th>Total</th>
<th>Preparedness Index of Per Indicator</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Very Ready</td>
<td>Ready</td>
<td>Almost Ready</td>
<td>Less Ready</td>
</tr>
<tr>
<td>1</td>
<td>Knowledge and attitudes</td>
<td>40</td>
<td>113</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Emergency response plans</td>
<td>28</td>
<td>110</td>
<td>17</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>Disaster warning systems</td>
<td>83</td>
<td>52</td>
<td>19</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>Resource mobilization</td>
<td>45</td>
<td>88</td>
<td>19</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Index value of students’ preparedness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on table 2, the preparedness level of high school students in the disaster-prone area of Mount Gamalama Ternate was measured based on four indicators: knowledge and attitudes, disaster emergency response plans, disaster warning systems, and resource mobilization. Based on the research results presented in table 2, all measured indicators of students’ readiness have an index value of the "ready" category. However, each indicator has a different index value determined by the index value of each respondent on that indicator. Indicators of knowledge and attitudes have an index value of 74.92 with the “ready” category. Respondents on this indicator also show that the majority have an index value for the “very ready” category of 113 respondents, compared to the “very ready” category which is only 40 respondents, the “almost ready” category is six respondents, the “less
ready” category is three respondents, and no respondents in the “not ready” category. Some respondents were below the index value of 64 because the respondent could not answer the questions correctly. On average, respondents on this indicator could only answer eight question items out of 23 question items. Respondents could only correctly answer questions on the questions about risks arising from volcanic disasters and types of disasters, and several question items on the attitude aspect.

The second indicator, namely the emergency response plan, has an index value of 72.71 and is categorized “ready”. The indicator is the same as the first indicator where the majority of 110 respondents have an index value in the “ready” category compared to the “very ready” category which is only 28 respondents, the “almost ready” category with 17 respondents, the “less ready” category with seven respondents and no respondents in the “not ready” category. Some respondents were below the index value of 64 because many questions were not answered correctly. On average, respondents could only answer two question items out of six question items and could only correctly answer a few question items on the questions about evacuation plans.

The third indicator, namely the disaster warning systems, is included in the “ready” category because it has an index value above other indicators of 77.12. It was because the number of respondents included in the very ready category was more than 83 respondents compared to the “ready” category with 52 respondents, 19 respondents in the “almost ready” category, seven respondents in the “less ready” category, and one respondent in the “not ready” category. Respondents obtained index values below 64 because most of the questions were not answered correctly. On average, respondents on this indicator could only correctly answer one question item out of four question items and could only correctly answer the questions about recognizing natural signs that a volcano will erupt.

The fourth indicator, namely resource mobilization, is included in the “ready” category with a value of 72.42 and is an indicator with a smaller index value than other indicators. There were 88, 45, 19, 10 respondents in the ready, very ready, almost ready, less ready categories, respectively and no respondents in the “not ready” category. Respondents attained an index values below 64 because most of the questions were not answered correctly. On average, respondents on this indicator could only answer one question item out of three question items and could only correctly answer the questions about the benefits of following a training/simulation/seminar on natural disasters.

From the results of four disaster preparedness indicators, the preparedness level of high school students in the disaster-prone areas of Gamalama Volcano, Ternate City was categorized as “ready”. It was indicated by the index value of students’ preparedness reaching 74.57. The index value achieved was the combined index value of each indicator. Indicators of knowledge and attitudes played a significant role in increasing students’ preparedness. Although the index value was in the second-order of the four indicators measured, the number of respondents with the “very” ready and “ready” category had more knowledge and attitude indicators than the other indicators. It is aligned with the research results by [24] stating that students’ knowledge and attitudes had a significant influence on their readiness.

2. Relationship between Students’ Knowledge and Attitudes with Their Preparedness

The relationship between knowledge and attitudes with preparedness of high school students was tested using non-parametric statistical analysis and the Spearman rank correlation test because the data were not normally distributed. The following table is the analysis of the relationship between students’ knowledge and preparedness.
Table 3
The Analysis Results of the Relationship between Students’ Knowledge and Preparedness

<table>
<thead>
<tr>
<th></th>
<th>Spearman's $r_{ho}$</th>
<th>Knowledge</th>
<th>Preparedness Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>Correlation Coefficient</td>
<td>1.000</td>
<td>.672**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>162</td>
<td>162</td>
</tr>
<tr>
<td>Preparedness Level</td>
<td>Correlation Coefficient</td>
<td>.672**</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>162</td>
<td>162</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).

Based on the analysis results presented in Table 3, the sig value (2-tailed) is 0.000 < 0.01, so that there was a positive and significant relationship between knowledge and preparedness of high school students in the disaster-prone areas of Mount Gamalama, Ternate. Meanwhile, the correlation coefficient value of 0.672 showed a strong relationship between students’ knowledge and readiness. It showed that the better the level of students’ knowledge of natural disasters, the students’ preparedness level to face natural disasters of Gamalama Volcano was better as well. The results of this study are aligned with the research results by [24; 25] stating that the respondents’ knowledge related to individual preparedness levels in facing disasters. Apart from knowledge, students’ attitudes are considered to have a relationship with disaster preparedness. The following table is the relationship analysis between students’ attitudes and preparedness.

Table 4
Analysis Results of the Relationship between Students’ Attitudes and Preparedness

<table>
<thead>
<tr>
<th></th>
<th>Spearman's $r_{ho}$</th>
<th>Attitude</th>
<th>Preparedness Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>Correlation Coefficient</td>
<td>1.000</td>
<td>.740**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>162</td>
<td>162</td>
</tr>
<tr>
<td>Preparedness Level</td>
<td>Correlation Coefficient</td>
<td>.740**</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>162</td>
<td>162</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).

Based on the results presented in Table 4, the sig value (2-tailed) is 0.000 < 0.01, so that there was a positive and significant relationship between attitudes and preparedness levels of high school students in the disaster-prone areas of Mount Gamalama, Ternate City. The correlation coefficient value of 0.740 showed a strong relationship between students’ attitudes and readiness. It means that the better the students’ attitudes towards disaster risk mitigation, their preparedness levels to face the natural disaster of Mount Gamalama was better as well. The results of this study are aligned with the research by [24] stating that there was a significant relationship between students’ attitudes and readiness.
Discussion

The students’ preparedness index value to face natural disasters Mount Gamalamawas in the “ready” category and it cannot be separated from the school. It is considered to be related to the integration of disaster risk education materials into the school curriculum. During data collection, students received the natural disaster mitigation topic in high school. Therefore, schools as formal educational institutions have a significant role in increasing students’ preparedness. It is consistent with the research results stating that the integration of disaster risk education into school curricula [26] and in universities [27] could improve students’ disaster preparedness. Students’ experiences also contributed to improving their preparedness.

Gamalama volcano is a very active volcano in Indonesia [6]. Therefore, all student respondents had experienced the natural disaster of Gamalama Volcano because the students’ houses were located in a disaster-prone area. Respondents experiencing previous disasters had a higher level of disaster preparedness [28] and significantly contributed to increasing community capacity [29]. Furthermore [30; 31] reported that people living or near risk areas showed better knowledge about the risks, through increasing preparedness.

High school students’ disaster preparedness needs to be improved to achieve an index score in the “very ready” category. The low value of the students’ preparedness index was because students only relied on the material provided by the teacher. However, the students’ personal experiences regarding previous disasters and integration with the school curriculum can increase student preparedness through the implementation of the Disaster Preparedness School (Sekolah Siaga Bencana/SSB) program. Based on interviews with school principals from the four schools, the school had not implemented the Disaster Alert School (Sekolah Siaga Bencana) program or similar programs, even though the school’s location was in an area prone to volcanic eruptions.

The implementation of the SSB program established by the government and non-government can improve students’ disaster preparedness. Following the Regulation of the Head of the National Disaster Management Agency Number 4 of 2012 on Guidelines for Implementing Disaster-Safe for Schools/Madrasahs (Islamic schools), the SSB program carries out various structural and non-structural disaster risk reduction activities. Structurally, the activities include safe locations from disasters, safe building structures, safe class design and arrangement, support for safe facilities and infrastructure. Meanwhile, non-structural activities include increasing knowledge, attitudes, and actions, school/madrasah safe policies, preparedness planning, resource mobilization [32]. According to the results of research conducted by [19], schools that implemented the SSB program were effective in increasing disaster knowledge, risk perception, critical awareness, and attitudes towards disaster preparedness compared to non-SSB schools.

Students with better knowledge about natural disasters can improve preparedness. Knowledge is a principal aspect that must be considered in improving disaster preparedness [33]. It is aligned with the opinion of [23] stating that knowledge is a major factor and a key to preparedness. Schools as formal educational institutions have an essential role in building students’ knowledge of natural disasters through disaster learning in schools. Further, [34; 35] reported that students receiving disaster topics in school could increase their knowledge of disasters. The results of other studies indicated that students obtaining
disaster education topics had a good level of knowledge about disasters [36]. In addition to the role of disaster education in schools, students living in disaster-prone areas could also influence their knowledge of natural disasters. It is also supported by the research results by [37; 38] stating that students in the area around Mount Merapi had good knowledge. Thus, students with good knowledge will improve preparedness in facing disasters.

The research results indicated the significance of students' attitudes towards disaster risk reduction. A good attitude in dealing with disasters will also have a good level of preparedness in facing disasters. This result is supported by the research [17] stating that attitude had a significant effect on disaster preparedness. Students’ experiences also influenced their attitudes towards reducing the risk of the Gamalama Volcano disaster. Students' experiences have an essential role in building students' attitudes in dealing with disasters. According to [39], respondents will have good attitudes about disaster preparedness because they have experienced disasters before. Besides experiences, schools are also considered to have a significant role in building students’ attitudes. According to [19], the implementation of the SSB program could effectively improve students' attitudes towards disaster preparedness.

**Conclusion**

The results show that the relationship between science and disaster preparedness in students showed a positive and significant relationship. As well, the relationship between attitudes and student preparedness has a positive and significant relationship. When, the level of disaster preparedness for high school students is in the "ready" category. The student’s experiences of previous volcanic eruptions and the integration of disaster topics into the curriculum in school, as well as live in disaster-prone areas, have a good influence on student preparedness against volcanic eruptions. The disaster preparedness index for high school students in Ternate could be increased to the "very ready" category by transforming several Senior High School into Disaster Alert School (Sekolah Siaga Bencana). Also, socialization and disaster mitigation simulations need to be carried out sustainably. Further research is needed on variables that affect student preparedness for disasters such as behaviors, experiences, perceptions and levels of student trauma to disasters, student socioeconomic level, gender and other demographic factors.

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