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Analyzing the impact of disaster-related factors on student preparedness using Structural Equation Modelling

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ABSTRACT
This study aims to analyse the relationship of disaster factors to the level of preparedness of students in Central Java in facing disasters. This research uses quantitative methods, because data collection in research is related to numbers and uses statistical analysis. The quantitative approach in this study uses the Structural Equation Modelling (SEM) method. Sampling was carried out by purposive sampling method or an assessment that was taken if it met certain criteria in accordance with the research topic, the sample used was 361 respondents. The method used in this research is SEM analysis, which is a multivariate statistical technique that analyses the relationship between variables. Independent variables include knowledge, attitude, policy, environment, training and religiosity. The dependent variable is preparedness. The results of research from independent variables that have an effect and have a positive direction are the attitude variable with a T-statistic value of 7,357, the training variable with a T-statistic value of 4,839 and the religiosity variable with a T-statistic value of 2,352. Variables that have a positive direction, but no effect are the knowledge variable and the policy variable.

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1. INTRODUCTION

In 2021, Indonesia experienced a total of 5,402 disaster events, based on data from the National Disaster Management Agency (BNPB). The majority of these were floods (1,794 incidents), followed by extreme weather (1,577), landslides (1,321), forest and land fires (579), tidal waves and coastal abrasion (91), earthquakes (24), droughts (15), and a single volcanic eruption. There are five provinces with the highest disaster events, among others: West Java province 1,358 events, Central Java 622, East Java 366, Aceh 279 and South Kalimantan 272 [1].

According to Law No. 24 of 2007 concerning disaster management, a disaster is an event that threatens and disrupts social life, which is caused by natural and non-natural factors or comes from human factors [2]. Thus, it has various impacts, such as the emergence of casualties, property or material losses, environmental damage, and can have a psychological impact on the community. Based on this impact, steps are needed to anticipate the occurrence of disasters or commonly called disaster mitigation. According to [3] in [4] argues

that mitigation is a series of ways to reduce the risk of disaster occurrence, both in the form of physical development and increasing awareness a190nd abilities, in the form of physical development and increasing students' awareness and ability to deal with disaster threats.

Until now, many people have not considered disaster management a priority and see disasters as random events. However, we live in Central Java, the second most disaster-prone region in Indonesia. Therefore, it is necessary to apply environmental education and disaster mitigation to students [5]. The purpose of disaster mitigation is to provide knowledge and readiness for actions that must be taken before or during an unexpected disaster to minimize the impact that occurs. This can improve students ability to think and act effectively when a disaster occurs [6].

Students as social control act as role models in social life, based on their knowledge, thinking patterns and level of education [7]. As the next generation of the nation, students are required to be able to know the steps in disaster preparedness and handling. Therefore, in the world of lectures, it is necessary to provide disaster knowledge which can be an anticipatory step in dealing with disasters [8]. University students, as agents of change, hold a strategic position in advancing climate action aligned with the Sustainable Development Goals (SDGs), particularly through the implementation of STEM-based (science, technology, engineering, and mathematics) education and initiatives [9]. In the domain of disaster risk reduction, students can contribute significantly by taking on roles as educators, volunteers, innovators, and advocates, thereby supporting sustained and community-based disaster preparedness and mitigation efforts.

Disasters can occur anywhere and at unpredictable times [10], as well as in educational environments such as universities. Central Java is a disaster-prone region, including earthquakes, floods, volcanic eruptions, landslides, and forest fires [11]. Students who live or study in this region have a moral responsibility to understand the existing disaster risks and contribute to efforts to reduce disaster impacts. Students are the future generation of the nation and social control in society, so they are required to be able to know the steps in disaster preparedness and handling in a technical manner. So, this scientific research paper aims to analyse the relationship between knowledge and the level of preparedness of students in Central Java in facing disasters and raises several problem formulations which become hypotheses in this study including:

1) H1 = Knowledge attitude has a positive and significant influence on disaster preparedness
2) H2 = Attitudes have a positive and significant influence on disaster preparedness
3) H3 = Policy has a positive and significant influence on disaster preparedness
4) H4 = Environment has a positive and significant influence on disaster preparedness
5) H5 = Training has a positive and significant influence on disaster preparedness
6) H6 = Religiosity has a positive and significant influence on disaster preparedness.

Previous studies have extensively explored disaster knowledge. Using qualitative approaches, several researchers have developed appropriate models of disaster education, particularly for early childhood [12]. Other studies have examined the relationship between disaster mitigation knowledge and community attitudes using Structural Equation Modelling (SEM) [6]. Research investigating the relationship between knowledge, attitude, and flood disaster preparedness among university students has also been conducted using a cross-sectional design [8]. However, cross-sectional designs are limited in their ability to establish causal relationships, as data are collected at a single point in time. This limitation can be addressed by employing SEM, which allows for the simultaneous and comprehensive analysis of complex latent constructs. Therefore, the present study adopts a quantitative approach using SEM to examine the influence of disaster knowledge on disaster preparedness among university students in a more robust and integrative manner.

The results of this study are expected to serve as a basis for evaluation and proposals for improvement of the disaster preparedness system, especially in the higher education environment. In addition, the findings of this research are also expected to contribute to the formulation of anticipatory measures, such as organizing disaster education programs and providing adequate facilities and infrastructure to enhance the resilience of higher education institutions in facing potential disasters.

2. MATERIALS AND METHODS

2.1. Object, Population, and Research Sample

The object of this research is university students in Central Java with a total of 361 respondents and in this study the minimum sample used was 30. Sampling using purposive sampling, by determining the sample

based on certain considerations or criteria in accordance with the research needs [13] which has a sample requirement must be from university students in Central Java.

2.2. Type of Data

The data sources used in this study are primary and secondary data. Primary data used is data obtained directly from respondents through structured questionnaires distributed to students in Central Java. Secondary data is a data source obtained from existing data, such as data from previous research results or journals that have existed before.

2.3. Data Collection Method

Literature study aims to find similar research that has existed before as a reference for researchers that can be used as a reference and strengthen the reasons for the research to be carried out. It also has the aim of finding differences between previous research and the research to be carried out. Reference sources used by researchers such as journals and books are used to find methods or methods that will be used in solving research problems in accordance with existing conditions in the field.

Field studies have the aim of knowing the conditions that exist in university students in Central Java, besides that it is also used to find data that will be used in research. In this field study, observations were made by direct observation of the conditions in the universities and continued with open interviews with various faculties students regarding their opinions about the preparedness of students in facing disasters. Based on the observations and interviews that have been conducted, it can be used as a reference for making questionnaires in collecting research data regarding respondents' responses to the variables used as research using a Likert scale. The Likert scale used has 4 scales, namely strongly agree (SA), agree (A), disagree (D), strongly disagree (SD) [14], [15].

2.4. Data Analysis Method

Based on the objectives and problem formulations that have been prepared, the framework in this study illustrated with the following structural model in Figure 1. This study employs a quantitative research method, which is grounded in the positivist philosophy. It involves examining specific populations or samples, utilizing structured research instruments for data collection. The data is then analyzed using quantitative or statistical techniques, with the primary objective of testing predefined hypotheses [16]. The quantitative approach in this study uses the Structural Equation Modelling (SEM) method which is a multivariate analysis technique that brings together factor analysis [17], path analysis and regression (correlation) [18], with the intention of testing the relationship between variables [19]. This method employs statistical techniques to assess the correlation between variables and to determine the significance of their relationships [20]. SEM allows for the simultaneous analysis of three key activities: evaluating the validity and reliability of measurement instruments (confirmatory factor analysis) [21], examining the relationships among variables [22], and identifying an appropriate model for prediction through regression analysis or structural modelling [23]. The Structural Equation Modelling method is applied to a study whose variables cannot be measured directly, but are described by several indicators (manifest variables) which are examined through surveys of respondents directly [24].

Data processing was carried out using SmartPLS4 software which was carried out in two ways:

1. Evaluation of the Measurement Model
   a. Validity Test (Test the accuracy or accuracy of the instrument in measurement)
      1) Convergent Validity measures the amount of correlation between constructs and latent variables. The correlation can be said to be valid if it has a loading factor value> 0.7, while the loading factor <0.7 is removed from the model. Then for the AVE value> 0.5 it is acceptable [25].
      2) Discriminant Validity, the model has good discriminant validity if the AVE square value of each exogenous construct (the value on the diagonal) exceeds the correlation between the construct and other constructs (the value below the diagonal) [26].
   b. Reliability Test (Test the consistency of respondents in answering the instrument)
      1) Composite reliability. The criterion for being reliable is the composite reliability value> 0.70 [27].

2) Cronbach's alpha. A variable can be declared reliable or meet Cronbach's Alpha if it has a Cronbach's Alpha value> 0.7 [28].

2. Structural Model Evaluation

a. Path Coefficient shows the direction of influence between two variables. Variables are said to have a positive relationship if the path coefficients value> 0, and are said to have a negative relationship if the path coefficients value < 0 [18].
b. T - Statistics are used to determine the significance value between exogenous variables and endogenous variables. The relationship between the two variables is said to be significant if the t-statistic value> 1.96 [29].
c. P Value is a value used to determine how likely the proposed hypothesis is in accordance with the research results. The research hypothesis can be declared accepted if the P-Values value <0.05 [30].

This study consists of exogenous latent variables, namely knowledge [31], attitudes [32], policy [33], environment [34], training [35] and religiosity [36], and endogenous latent variables, namely preparedness [37]. Research variables are formed based on a scientific framework, with the intention of being made theoretically and empirically and logically acceptable.

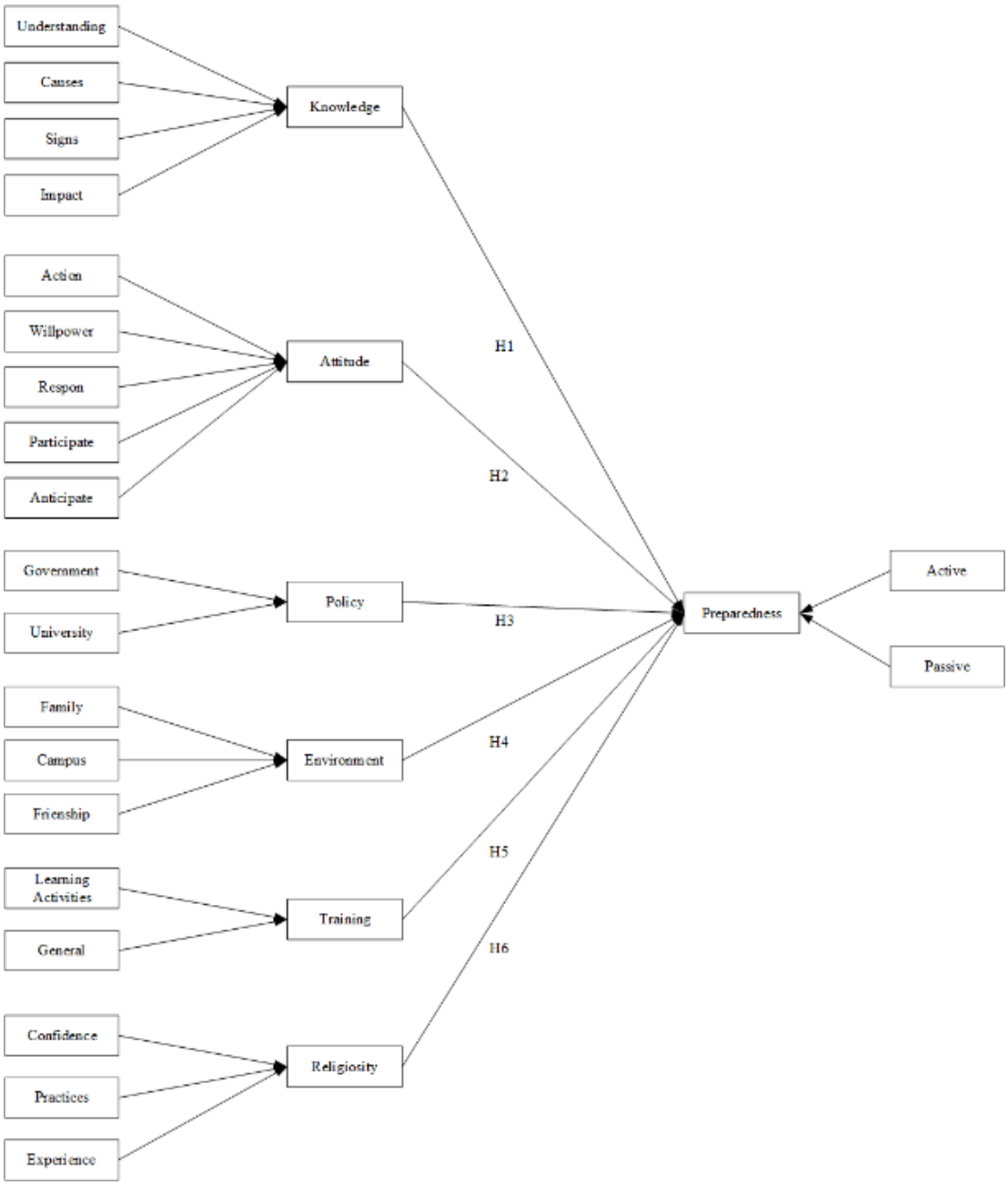

Figure 1. Structural model

3. RESULTS AND DISCUSSION

The results of selecting data in accordance with the criteria for respondents obtained 361 then processed the data obtained based on gender, age and education level. Descriptive Analysis of the characteristics of respondents on variables in the study is divided into several explanations. The questionnaire uses a Likert scale with a score of 1 to 4 where the minimum value is 1 and the maximum value is 4, then the interval distance is obtained, namely 0.75 with the following scale categories in Table 1.

Table 1. Descriptive analysis of scale

Scale		Category
1.00	1.75	Very Less
1.76	2.51	Less
2.52	3.27	Good
3.28	4.00	Very good

Based on this table, an analysis of each variable of the respondent's characteristics is obtained. The average results of the answers to each variable from the characteristics of male gender with a total of 207 respondents with a percentage of 57.3%, can be seen in Table 2.

Table 2. Descriptive analysis of men

Variable	Average	Category
Knowledge	3.14	Good
Attitude	2.92	Good
Policy	3.04	Good
Environment	2.98	Good
Training	2.76	Good
Religiosity	3.33	Very Good
Preparedness	2.63	Good

The average results of the answers to each variable from the characteristics of female gender with 154 respondents with a percentage of 42.7% can be seen in Table 3.

Table 3. Descriptive analysis of women

Variable	Average	Category
Knowledge	3.09	Good
Attitude	2.97	Good
Policy	3.06	Good
Environment	3.15	Good
Training	2.79	Good
Religiosity	3.31	Very Good
Preparedness	2.68	Good

Description analysis based on age is grouped into 4, namely age <20 years, 20-24 years, 25-30 years, >30 years with average answers grouped by scale. The average results of the answers from each variable characterizing age <20 years with a total of 36 respondents with a percentage of 10.0% can be seen in Table 4.

Table 4. Descriptive analysis of age <20 years

Variable	Average	Category
Knowledge	3.16	Good
Attitude	3.02	Good

Variable	Average	Category
Policy	3.07	Good
Environment	3.03	Good
Training	3.01	Good
Religiosity	3.37	Very Good
Preparedness	2.78	Good

The average results of the answers from each variable characterizing the age of 20-24 years with 315 respondents with a percentage of 97.2% can be seen in Table 5.

Table 5. Descriptive analysis of age 20-24 years

Variable	Average	Category
Knowledge	3.12	Good
Attitude	2.93	Good
Policy	3.04	Good
Environment	3.04	Good
Training	2.75	Good
Religiosity	3.32	Very Good
Preparedness	2.63	Good

The average results of the answers from each variable characterizing the age of 25-30 years with a total of 7 respondents with a percentage of 1.9% can be seen in Table 6.

Table 6. Descriptive analysis of age 25-30 years

Variable	Average	Category
Knowledge	3.00	Good
Attitude	3.09	Good
Policy	3.50	Very Good
Environment	3.05	Good
Training	2.86	Good
Religiosity	3.14	Good
Preparedness	2.83	Good

The average results of the answers from each variable characterizing age> 30 years with a total of 2 respondents with a percentage of 0.6% can be seen in Table 7**.**

Table 7. Descriptive analysis of age >30 years

Variable	Average	Category
Knowledge	3.00	Good
Attitude	2.40	Less
Policy	2.75	Good
Environment	3.17	Good
Training	2.50	Less
Religiosity	2.83	Good
Preparedness	2.50	Less

Description analysis based on education level is grouped into 4 namely D3, D4, S1, and S2 with average answers grouped by scale. The average results of the answers from each Variable characterizing the D3 education level with a total of 15 respondents with a percentage of 4.2% can be seen in Table 8**.**

Table 8. Descriptive Analysis of Education Level D3

Variable	Average	Category
Knowledge	3.05	Good
Attitude	3.20	Good
Policy	3.37	Very Good
Environment	3.04	Good
Training	3.03	Good
Religiosity	3.36	Very Good
Preparedness	2.88	Good

The average results of the answers from each variable characterizing the D4 education level with a total of 13 respondents with a percentage of 3.6% can be seen in Table 9.

Table 9. Descriptive analysis of education level D4

Variable	Average	Category
Knowledge	3.10	Good
Attitude	3.11	Good
Policy	3.19	Good
Environment	2.38	Less
Training	2.38	Less
Religiosity	3.08	Good
Preparedness	2.36	Less

The average results of the answers from each Variable characterizing the undergraduate education level with a total of 331 respondents with a percentage of 91.7% can be seen in Table 10.

Table 10. Descriptive analysis of education level S1

Variable	Average	Category
Knowledge	3.12	Good
Attitude	2.92	Good
Policy	3.03	Good
Environment	3.05	Good
Training	2.78	Good
Religiosity	3.33	Very Good
Preparedness	2.63	Good

The average results of the answers from each Variable characterizing the S2 education level as many as 2 respondents with a percentage of 0.6% can be seen in Table 11.

Table 11. Descriptive analysis of education level S2

Variable	Average	Category
Knowledge	3.25	Good
Attitude	2.80	Good
Policy	3.00	Good
Environment	3.67	Very Good
Training	2.75	Good
Religiosity	3.33	Very Good
Preparedness	2.90	Good

Data analysis in this study used SmartPLS4 software. The outer model test consists of 2 stages, namely validity test and reliability test. In the validity test there are convergent and discriminant validity tests, the loading factor value must be> 0.7 and the AVE value> 0.05 to be considered valid [29]. Indicators with a value <0.7 are not included in further validity tests, because they are declared invalid. It can be seen in Figure 1 that the AT1 and AT2 indicators have a loading factor value <0.7 which indicates that the indicator is invalid, so it is necessary to delete the indicator and carry out the validity test again so that the results in Figure 2 are obtained where all loading factor and AVE values have met the requirements and can be said to be valid. Based on the results of the validity test in Figure 3, the results of the Cronbach's alpha and composite reliability tests have a value of> 0.5 and> 0.7 which states that the measuring instrument used is reliable which is then presented in Table 12.

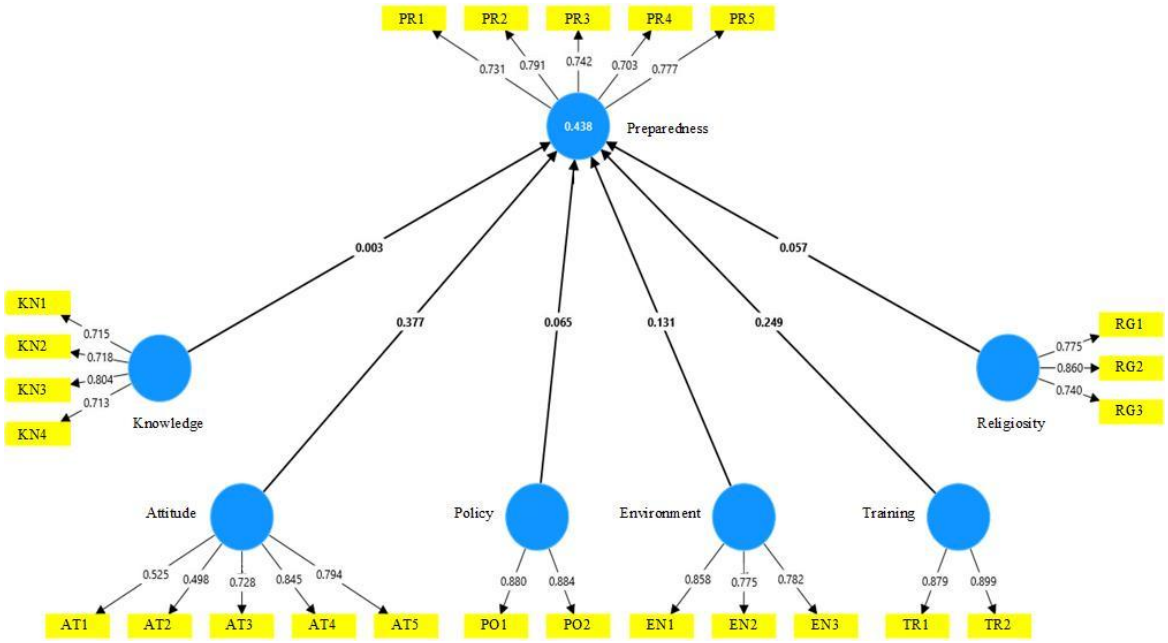

Figure 2. Validity test 1

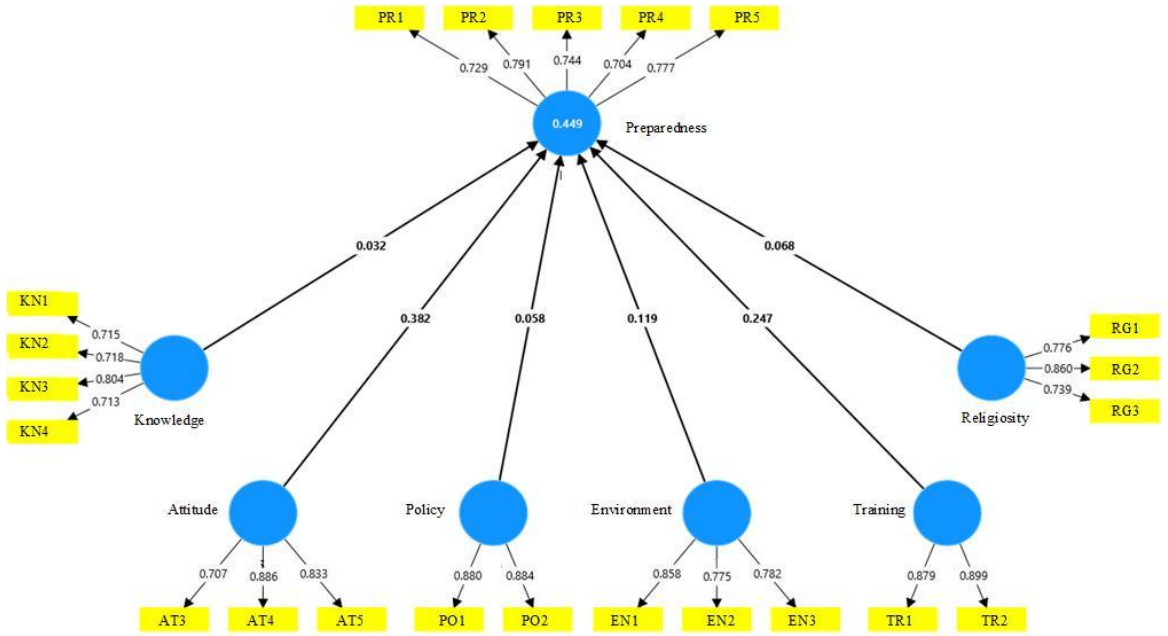

Figure 3. Validity test 2

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Table 12. Reliability output test

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Policy	0.715	0.715	0.875	0.778
Preparedness	0.804	0.806	0.865	0.562
Environment	0.731	0.745	0.847	0.649
Training	0.723	0.737	0.827	0.545
Knowledge	0.736	0.740	0.883	0.791
Religiosity	0.705	0.720	0.835	0.629
Attitude	0.744	0.782	0.852	0.660

Furthermore, the significance test is carried out with the aim of testing the hypothesis and the effect of exogenous variables on endogenous variables. Hypothesis testing is carried out through a bootstrapping process with a significance level of 0.05. There are several results obtained, namely the path coefficient which aims to determine the direction of the influence relationship between variables, if it has a value of 0-1 it has a positive relationship and if the result has a value <0 then it has a negative relationship, the results of the path coefficient test and T-statistic test can be seen in Table 13.

Table 13. Hypothesis test results

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Policy -> Preparedness	0.058	0.058	0.049	1.198	0.231
Environment -> Preparedness	0.119	0.122	0.051	2.352	0.019
Training -> Preparedness	0.247	0.247	0.051	4.839	0.000
Knowledge -> Preparedness	0.032	0.036	0.050	0.641	0.522
Religiosity -> Preparedness	0.068	0.070	0.047	1.459	0.145
Attitude -> Preparedness	0.382	0.380	0.052	7.357	0.000

Based on Table 13, the variable with the strongest influence on disaster preparedness is the attitude variable, as indicated by the highest t-statistic value. A research hypothesis is considered accepted if the p-value is less than 0.05. Additionally, for a two-tailed test, the hypothesis is accepted if the t-statistic (t-count) exceeds 1.96. The analysis results are as follows:

1. The effect of knowledge on disaster preparedness yields a t-statistic of 0.641, which is below the threshold of 1.96, indicating that the first hypothesis is rejected. The p-value is 0.522, which is greater than 0.05, further supporting the rejection. The original sample value is 0.032, suggesting a positive direction of influence, albeit insignificant.
2. The effect of attitude on disaster preparedness shows a t-statistic of 5.8, exceeding 1.96, so the second hypothesis is accepted. The p-value is 0.000, which is less than 0.05, also supporting the acceptance. The original sample value is 0.382, indicating a positive and significant relationship.
3. The effect of policy on disaster preparedness has a t-statistic of 1.198, which is below 1.96, leading to the rejection of the third hypothesis. The p-value is 0.231, which is greater than 0.05. The original sample value is 0.058, indicating a positive but statistically insignificant influence.
4. The effect of the environment on disaster preparedness results in a t-statistic of 2.352, which exceeds 1.96, indicating that the fourth hypothesis is accepted. The p-value is 0.019, which is below 0.05. The original sample value is 0.119, suggesting a positive and statistically significant effect.
5. The effect of training on disaster preparedness shows a t-statistic of 4.839, which is well above 1.96, so the fifth hypothesis is accepted. The p-value is 0.000, indicating strong statistical significance. The original sample value is 0.247, reflecting a positive relationship.

6. The effect of religiosity on disaster preparedness yields a t-statistic of 1.459, which is below 1.96, resulting in the rejection of the sixth hypothesis. The p-value is 0.145, which is above 0.05. The original sample value is 0.068, suggesting a positive but insignificant effect.

Efforts to improve disaster preparedness for students in Central Java require seriousness in order to run optimally. Based on statistical tests conducted, there are 3 variables, namely attitude, training, and environment.

Variables that are stated to have an influence on improving disaster preparedness must receive attention, but also do not exclude other variables that may also be important in improving disaster preparedness and in future research, additional factors can be carried out that influence disaster preparedness so that the results can be maximized.

4. CONCLUSION

Based on the results and discussion, it can be concluded that the measured variables have a path coefficient value> 0 so that the measured variables have a positive relationship. Attitude, training, and environment variables have a significant influence on preparedness with t-statistic values of 7.357, 4.839, and 2.352 respectively where the value is > 1.96, while religiosity, policy and knowledge variables do not have a significant influence on preparedness with T-statistic values of 1.459, 1.198 and 0.641 respectively where the value is < 1.96.

The 3 variables that are declared influential are used as recommendations and the focus in efforts to improve disaster preparedness for students in Central Java, namely as follows:

1. Improve students' attitudes in facing disasters with the aim of ensuring that students are ready and responsive in facing emergency situations by utilizing the role of mass media in providing easily accessible information for students in the form of emergency numbers and evacuation routes. Then also integrating the lecture curriculum regarding disaster preparedness. By involving students in disaster education, it is hoped that their attitude towards preparedness can become more positive and responsible.
2. Improving disaster preparedness training is an important step to ensure that students have sufficient knowledge, skills and preparedness in dealing with emergency situations. Efforts to improve training can be done by organizing training for general students and existing organizations at the university covering types of disasters, warning signs, evacuation procedures and first aid and the use of emergency equipment. Training can be conducted based on realistic disaster scenarios, so that students can be better prepared and trained in preparedness efforts.
3. Improving disaster preparedness through the environment involves efforts to design, manage and utilize the environment in a sustainable manner to make it more resilient to disaster threats. Improving disaster preparedness through the environment can be done by planting trees and vegetation around settlements and open areas and conducting environmental awareness campaigns to encourage people to keep the environment clean and not litter.

Further research is recommended to examine the possibility of mediating or moderating variables that could strengthen the influence of these variables on preparedness. Subsequent studies are also suggested to expand the respondent coverage across various institutions and different geographical areas to obtain a more comprehensive picture and improve the generalization of the research results.

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