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A Model of Disaster Resilience Among Colleges and Universities: A Mixed Method Research Design

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ABSTRACT : This research paper aimed to create a comprehensive framework for measuring disaster resilience in colleges and universities. The study used a mixed method through Exploratory Factor Analysis (EFA), which involved analyzing data from a survey questionnaire. The questionnaire was developed based on in-depth interviews with 12 selected participants from the University of Mindanao, as well as relevant literature and studies. It was reviewed and validated by 10 experts using a method called Content Validity Ratio (CVR). This questionnaire was then administered to 400 students from 10 different colleges in University of Mindanao. After conducting the Exploratory Factor Analysis and performing rotations and iterations, the researchers identified five main constructs that characterize disaster resilience among colleges (1) disaster preparedness, (2) disaster awareness, (3) community readiness, and (4) disaster management, (5) disaster resilience. The researchers aimed to create an organization called "Council of College Disaster Volunteers (CCDV)" which consist of student volunteers. These factors can be used to develop effective management strategies and strengthen efforts in preventing and managing disasters and accidents.

*KEYWORDS:*content validity ratio, criminology, disaster resilience, disaster management, exploratory factor analysis, and Philippines.

I. INTRODUCTION

Leaders, policymakers, emergency management professionals, and academics frequently use the concept of disaster resilience, but there needs to be more consensus on its definition and application (Arbon, 2014). The response to and recovery from disasters is significantly influenced by the citizens' capacity for resilience (Xu, Li, Tan, & Deng, 2021). To ensure sustainable development, disaster resilience must be strengthened. An exercise that can show how the resilience structure be able to remain useful for directing improvement and awareness endeavors must be conducted. Nevertheless, additional resilience research beyond loss estimation modeling is required to fully implement the concept (Chang, 2019).

To demonstrate resilience, university officials must take time for communication and information processing, use substantial assets, as well as concentrate upon expanding emotive or social assets. When faced with disasters, universities practice resilience by drawing on their experience with previous crises (Fernandez, Coulson, & Zou, 2021). Despite its widespread adoption, there are a variety of opinions on the significance and usefulness of the resilient community concept.

This lack of consensus compromises its value in creating disaster and calamity supervision guidelines along with plans by the general, state, territorial, and local levels (Arbon, 2014). Appearing in a global context, the systematic complexity of urban spaces has significantly increased due to the relationships and interdependencies among cities, between cities and regions, and across national and international boundaries (Prior, T., & Roth, F., 2013). The city's central location is discussed in terms of how disasters disrupt life and how disaster consequences can be provided for or reduced. Thus, a significant challenge for city disaster management is balancing the advantages of urbanism against the potentially disastrous consequences of complexity. On average, people in the Philippines needed more money to invest in disaster preparedness (Bollettino, 2018).

In line with that, urbanization at the University of Mindanao is prevalent as there are development and building of new infrastructures like the new library. Additionally, there are problems with the sewage that caused some places on the campus to be flooded. In older buildings, cracks in the walls exist, which causes a risk of danger in the future.

More and more complex, unbounded problems will be involved in dealing with climate change, catastrophe risk reduction, and disaster management; these problems cannot be resolved by making minor adjustments to standard operating methods. Hence, a dynamic awareness of changing risk is necessary to

properly understand and evaluate the resilience system. (Foresight, 2012). Whether evaluated from a single-event or multi-event catastrophe viewpoint, the effect on the anticipated awareness, readiness, and risk management recovery period within the predicted bouncing back and building back better makes a difference in resilience. (Drennan, McGowan, and Tiernan, 2016).

This study assists in identifying important components such as all-hazards extensive plans, training, and programs to build disaster-resilient structures. It also assesses how individual educational institutions around the country have created and carried out these critical elements to be prepared for efficient response to disasters. The findings show that developing an all-hazards strategy, conducting frequent workshops and drills, and forming strong community relationships are the most important measures toward rendering the University of Mindanao and its institutions disaster-resistant and efficient to effectively cope with any crisis or catastrophe. (Kapucu& Khosa, 2013).

This research attempts to determine operational strategies for constructing resilience to catastrophes schools. A variety of characteristics influencing how schools adapt to catastrophes are considered in operational methods to developing disaster-proof schools. These tactics have an impact on both before and afterwards preparation. Knowledge of these factors, together with planning in advance of disasters, can aid in the construction of a secure, disaster-resistant educational as well as boosting academic achievement after disasters. (Barghi, Moslehi, Rasouli, & Masoumi, 2022). The model technique is vital for the proper action and preparation towards an interprofessional population. As a result, the purpose of this research was to investigate the factors influencing disaster resilience models during calamities and catastrophes (Mirzaei, Tafti, Mohammadinia, Nasiriani, Rahaei, Falahzadeh, & Amiri, 2019).

Resilience theory's definitions and elements underlines its inherent complexity. Furthermore, the critical role of community resilience in effective recovery, awareness, preparation, and risk management has been investigated using community currencies including time banking schemes, focus groups, neighborhood meetings, and precisely planning community layout. (Aldrich & Meyer, 2015). It anchors to social cognitive theory, which entails that a one's conduct may be labelled in terms of separate and related fundamentals rather than being only ruled by external factors or internal forces (Bandura, 1978).

The identification of the dimensions is the first approach towards the development of the evaluation tool. Figure 1 represents the hypothetical model of the latent dimensions that could measure the Disaster Resilience among Colleges. The following factors are F1, F2, F3, F4, F5,…Fn.
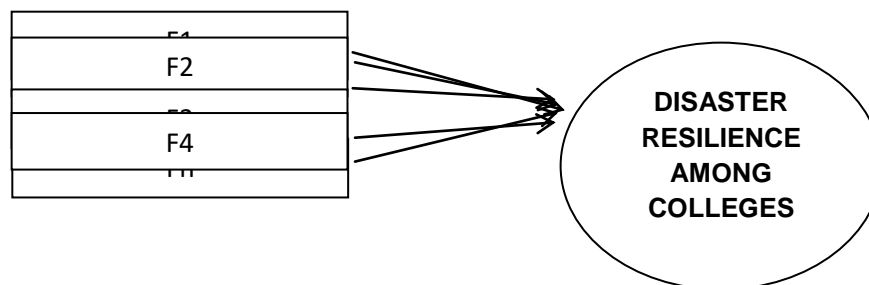

Figure 1. Hypothetical Path Diagram of the Latent Dimensions that Could Measure Disaster Resilience among Colleges

II. METHODOLOGY

Presented in this section are the methods that were used in terms of research design and procedure, participants, and research instrument.

Design and Procedure

The researcher employed a mixed-methods approach, specifically an exploratory design, to gather data on student disaster resilience. This study utilized a combined research design, primarily relying on a quantitative approach. It was an investigative method that integrated the philosophies of constructivism and pragmatism. Hence, it went beyond merely gathering and examining both types of data; it also involved combining both approaches to enhance the overall strength of the study. This design embodied a knowledge representation process view that comprehends phenomena in terms of student resilience and could be reaffirmed through pragmatism (McWilliams, 2015). The realistic worldview of this design involved a subsequent collection of scholarly encounters and survey questionnaire responses. To better understand this research problem, a theory based on diverse data collection strategies was applied (DeCuir-Gunby & Schutz, 2016).

In the first phase, the researchers conducted in-depth interviews using an interview-guided questionnaire. Employing purposive sampling techniques as outlined by Nikolopoulou (2022), the researchers interviewed a total of 12-15 individuals, including students, nurses, members of the disaster response

committee, and University of Mindanao SSO officers. The gathered data was analyzed to develop a survey questionnaire, which served as a tool for constructing a disaster resilience model.

The succeeding stage of the investigation entailed a random selection of research participants. The researchers distributed survey questionnaires to 400 students and staff from various programs and offices within the University of Mindanao. This sample size was deemed sufficient to provide reliable and generalizable findings regarding disaster preparedness among students and staff. Upon completing data collection, the researchers utilized the gathered information to create a model of disaster resilience specific to the University of Mindanao context. Ethical concerns were accurately followed to all through the study procedure. The researchers ensured that the rights and well-being of all participants were protected and respected.

Study Participants

The researchers interviewed a select group of 12-15 individuals, including students, nurses, members of the disaster response committee, and University of Mindanao SSO officers who were directly involved in the disaster response. Participation in the study is strictly voluntary, and all potential participants have the right to decline involvement at any point during the interview process or questionnaire distribution. Participants are not obligated to provide any responses or engage in any aspect of the study. To protect confidentiality, sensitive information such as names, ages, and academic programs would be kept confidential. All participants would be asked to provide informed consent before their involvement in the study. It is important to note that this study does not pose any foreseeable high-risk factors, such as physical, psychological, or socioeconomic concerns. Additionally, the research presented in this study is original and has not been plagiarized or fabricated from other sources.

Material/Instrument

In the first phase of the study, the researcher used a questionnaire guided questionnaire to collect data. This approach allowed researchers to gain insight and a deeper understanding of students' experiences during disasters. As mentioned by Bhat (2021), in-depth interviews were conducted to collect the necessary data for the study. In the second phase of the survey, a Likert scale was used to collect qualitative data, according to Bhandari and Nikolopoulou (2020). Researchers developed a survey questionnaire to model student resilience. In addition, the study used a quantitative exploratory factor analysis (EFA) to analyze the data collected from the survey questionnaire. To guarantee the authenticity of the survey, an intensive evaluation and validation process involving 10 experts was conducted, using the Content Validity Ratio (CVR).

Ethical Considerations

Following the research procedure evaluations and defined criteria, researchers followed comprehensive ethical guidelines in their conduct of the study, notably in handling the sample and data, including, but not restricted to:

Voluntary Participation: All research participants were given the freedom to choose whether to participate in the study. A comprehensive orientation was provided to potential participants, clearly explaining the nature of the research, and allowing them ample time to make an informed decision regarding their involvement.

Privacy and Confidentiality: The utmost confidentiality of participants' personal and professional information was maintained throughout the study. All data collected was treated with the highest degree of privacy and security, safeguarding the sensitive nature of the information entrusted to the researchers.

Informed consent process. To ensure informed consent, the researcher questionnaire was carefully crafted using clear and concise language, avoiding technical terms to facilitate easy comprehension for all participants. The questionnaire provided participants with a transparent understanding of the study's goals, potential benefits for the school, and the voluntary nature of their involvement. The administration of the questionnaires was conducted with the full consent and support of the relevant authorities, adhering to established research protocols. No research questionnaires were distributed without prior authorization from the designated command channels. To protect participants' identities and privacy, informed consent was obtained from each individual before they participated in the study.

Risks. The study did not pose any potential harm or negative consequences to the participants, either physically, psychologically, or socio-economically.

Biosafety. The study did not involve any medical or scientific experiments that could pose risks to biological or environmental subjects. Moreover, the researchers meticulously adhered to all ethical considerations, including plagiarism, fabrication, falsification, conflict of interest, focus group participation identification, deceit, observation of people in public, technology issues, and concerns relating to authorship.

III. RESULTS AND DISCUSSIONS

This chapter presents the analysis and outcomes derived from the collected data. The results are presented sequentially, including the sampling adequacy and sphericity, a matrix, identified factors illustrating disaster resilience in colleges and universities, latent roots criterion for the identified factors, and the context

established created on the study's results. Additionally, a comprehensive discussion is provided to elucidate and interpret the results.

Measures of Sampling Adequacy and Sphericity

Table 1 presents both the Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett's Test of Sphericity. The Kaiser-Meyer-Olkin (KMO) statistical technique, employed to assess the competence of the sample size for factor analysis (Effendi, Matore, Khairani, & Adnan, 2019), utilizes a value interpreted by Kaiser (1974). According to Kaiser, a KMO value >.90 is considered marvelous, in the .80s, meritorious, in the .70s, middling, in the .60s, mediocre, in the .50s, miserable, and less than .5, unacceptable. With a KMO score of 0.935 in this study, signifying a marvelous sample size, it is deemed acceptable and well-connected. Consequently, factor analysis emerges as the most suitable method for the dataset, indicating a significant partial correlation and substantial information overlap between variables. This underscores the rationale for conducting factor analysis in examining disaster resilience among colleges and universities.

Table 1. *Measures of Sampling Adequacy and Sphericity*

	Measurement		Value
	Kaiser-Meyer-Olkin Measures of Sampling Adequacy		.935
Sphericity	Bartlett's Test of	Approx. Chi-Square	8413
		df	496
		Sig.	.000

Similarly, Bartlett's Test of Sphericity serves as a statistical tool to assess the overall significance of relationships within the employed instrument (Effendi, 2019). It compares the identity matrix with an observed correlation matrix, aiming to determine if there is any discernible overlap between variables that can be condensed into a few numerical elements. The dataset's degree of freedom is 496, and Bartlett's Test of Sphericity yields a p-value of 0.000, indicating non-identity and establishing it as multivariate. Consequently, factor analysis emerges as the most appropriate technique for identifying variables indicative of disaster resilience in colleges and universities. The notable statistical significance (p-value 0.000) attests to the correlation matrix's deviation from an identity matrix, as illustrated in the table above.

Extracted Factors of Disaster Resilience Among Colleges and Universities

Table 2 presents the factors extracted through the application of extraction and retention techniques to differentiate disaster resilience among colleges and universities. Items meeting the criterion of > 0.50 are considered qualified, while those with factor loadings of 0.50 and below were excluded (Lee et al., 2017). The identified underlying constructs then underwent thematic analysis, a method utilized to discern patterns or themes within data, as outlined by Braun and Clarke (2006). Consequently, four latent constructs emerged in this study: (1) disaster preparedness, (2) disaster awareness, (3) community readiness, (4) disaster management, and (5) disaster resilience.

The Factor 1, labeled as Disaster Preparedness 1 encompasses nine items, contributing to 28.13% of the total variance. This theme underscores the critical role of preparedness in mitigating the impact of disasters. Notably, the highest loadings on this factor are represented by the following items: Q27, highlighting the obstacle of a lack of funds in disaster preparedness (.799); Q26, emphasizing the readiness of local officials and volunteers to respond to natural disasters (.747); and Q30, addressing the lack of knowledge about dangerous disasters during catastrophic times (.716). Grounded in the Social Cognitive Theory (SCT), this component aligns with previous research that applied SCT to understand disaster preparedness, indicating that individuals' motivation to prepare for disasters stems from their cognitive and emotional responses to natural dangers (Lee & Lemyre, 2009).

Factor 2, termed as Disaster Awareness comprises six items, contributing to 18.75% of the total variance. The theme associated with this dimension underscores the significant impact of literature on disaster awareness. As articulated by Glago (2019), the collective knowledge about the risks and contributing variables of disasters influences individual or collective actions in managing exposure and vulnerability to hazards. This alignment is reflected in items with the highest loadings for this factor, including Q11, emphasizing the relevance of research or information to fill knowledge gaps in disaster preparedness and management (.778); Q12, focusing on maintaining a list of contacts in the medical community (.767); and Q8, highlighting the accessibility of research literature on disaster preparedness and management (.724). According to Wanjala and Onyango (2018), strategies to integrate disaster awareness into educational settings involve methods such as prominently displaying safety instructions, installing firefighting equipment, establishing evacuation exits, and maintaining well-maintained structures.

Table 2. *Extracted Factors Characterizing Disaster Resilience*

Item	Extracted Dimensions	Loading

Factor 1 Disaster Preparedness		
21	I have an initiative with loved ones and family members on how to execute	.566
25	I would feel confident in providing health education in case of stress.	.680
26	I feel that our local officials and volunteers are well-prepared to respond to natural disaster.	.747
27	Lack of funds is an obstacle in disaster preparedness.	.799
28	I am confident to provide basic first aid in times of disaster.	.629
29	In the event of a natural disaster, I know that I can count on my community to face the event and move forward.	.560
30	I feel lack of knowledge about disasters that are dangerous in times of catastrophe.	.716
31	I easily understand emergency signs.	.684
32	Awareness of emergency procedures in the university is utilized.	.519
Factor 2 Disaster Awareness		
8	I find that the research literature on disaster preparedness and management is easily accessible.	.724
9	I find that the research literature on disaster preparedness is understandable.	.617
10	Finding relevant information about disaster preparedness related to my community needs is an obstacle to my level of preparedness.	.688
11	I know where to find relevant research or information related to disaster preparedness and management to fill in gaps in my knowledge.	.778
12	I have a list of contacts in the medical community in which I practice. I know referral contact in case of a disaster situation (health department, e,g).	.767
14	I am aware of the potential risks in my community (e.g., earthquakes, flood, terror, etc.).	.567
Factor 3 Community Readiness		
22	I can describe my role in the response phase of a disaster in the context of my workplace, the public, media, and personal contact.	.590
23	I am familiar with the organizational logistics and roles among local agencies in disaster response situation.	.521
24	I would feel confident implementing emergency plans, evacuation procedures, and similar functions.	.534
33	Communication system is provided by the university during disaster.	.656
34	The university has enough first aid boxes.	.735
35	The university is responsible for the students' safety.	.689
36	The university has an online platform regarding disaster preparedness.	.656
37	The university has enough evacuation centers during disaster.	.543
Factor 4 Disaster Management		
1	I participate in disaster drills or exercises at my university on a regular basis.	.675
2	I have participated in emergency plan drafting and emergency planning for disaster situations in my community.	.720
3	I know who to contact (chain of command) in disaster situations in my community.	.759
4	I participate in one of the following educational activities on a regular basis: continuing education classes, seminars, or conferences dealing with disaster preparedness.	.569
5	I read journal articles related to disaster preparedness.	.575
Factor 5 Disaster Resilience		
16	I consider myself prepared for the management of disaster.	.549
17	I would be considered a key leadership figure in my community in a disaster situation.	.738
19	I am familiar with accepted prioritized principles used in disaster situation.	.717
20	I have personal/family go-bag disaster situation.	.611

Factor 3, designated as "Community Readiness," comprises eight items and contributes to 25% of the total variance. The items in this factor illuminate the roles of communities in disaster preparedness and awareness. According to CivicPlus (2017), community preparedness involves collective endeavors within a community to equip citizens with the training, education, and resources needed to proactively prepare for potential local disasters at both individual and collective levels. Illustrative examples of community readiness include Q34, addressing the adequacy of first aid boxes in the university (.735), Q35, indicating the university's responsibility for students' safety (.689), Q36, highlighting the existence of an online platform for disaster preparedness at the university (.656), and Q33, emphasizing the provision of a communication system by the university during disasters (.656). The ERMA study (2018) emphasizes the importance of school safety and the

Disaster Risk Reduction (DRR) initiatives aimed at reducing vulnerability and mitigating the impact of disasters on schools. These initiatives prepare both teachers and students for potential disasters, ultimately minimizing their impact.

Factor 4, denoted as "Disaster Management," comprises five items and contributes to 15.63% of the total variance. The items associated with this factor convey that disaster management involves active engagement in disaster preparedness. As defined by Tulane University (2021), disaster management is a systematic process aimed at proficiently preparing for and responding to disasters, strategically mobilizing resources to mitigate the impact of such events. This concept is reflected in items such as Q3, emphasizing knowledge of who to contact in disaster situations within the community (.759), Q2, indicating participation in emergency plan drafting and planning for disasters in the community (.720), and Q1, highlighting regular participation in disaster drills or exercises at the university (.675). Furthermore, the University of Central Florida (2022) states that disaster management involves the organized coordination and utilization of resources to address and cope with disasters.

Factor 5, designated as "Disaster Resilience," comprises four items and contributes to 12.5% of the total variance. The items associated with this factor indicate that disaster resilience entails our capacity to prevent, endure, and recover from the detrimental impacts of natural hazards. As Graveline & Germain (2022) elucidate, resilience has emerged as a foundational aspect in both risk management and disaster reduction. This concept is also reflected in responses to items like Q17, signifying being regarded as a key leadership figure in the community during a disaster (.738), and Q19, indicating familiarity with accepted prioritized principles in a disaster situation (.717). Additionally, the theory of resilience posits the socialization of responsibility for resilience, sustained interest in risk management with a focus on partnerships as facilitating mechanisms, and a nuanced exploration of the concept of adaptive resilience (Foresight, 2012).

Latent Roots Criterion of the Extracted Factors

Table 3 exhibits the latent root criterion, indicating that only five dimensions defining disaster resilience in colleges and universities could be derived from the dataset subjected to 17 iterations of factor analysis. These identified factor structures include: (1) disaster preparedness with an initialized eigenvalue of 13.662 and a variance of 17.82; (2) disaster awareness, possessing an initialized eigenvalue of 2.101 and a variance of 13.97; (3) community readiness, marked by an initialized eigenvalue of 1.988 and a variance of 1.988; (4) disaster management, characterized by an initialized eigenvalue of 1.545 and a variance of 9.62; and (5) disaster resilience, initiated with an eigenvalue of 1.194 and a variance of 9.20.

Table 3. *Latent Roots Criterion of the Extracted Factors*

Factors	Initial Eigenvalues	Percentage of Variance	Cumulative Variance %
1 Disaster Preparedness	13.662	17.82	17.82
2 Disaster Awareness	2.101	13.97	31.79
3 Community Readiness	1.988	1.988	45.22
4 Disaster Management	1.545	9.62	54.84
5 Disaster Resilience	1.194	9.20	64.03

Multidimensional Framework on Disaster Resilience Among Colleges and Universities

Illustrated in Figure 2 is a thematic framework portraying the five dimensions that define disaster resilience in colleges and universities. These dimensions encompass disaster preparedness, disaster awareness, community readiness, disaster management, and disaster resilience. Through thematic analysis, the researcher examined these factor structures to pinpoint the most effective constructs explaining the clustered components. These five measures exert a significant influence on disaster resilience within the context of colleges and universities. Additionally, the framework serves as a visual representation of the developed measurement tool. Future researchers can employ this scale for assessing disaster resilience in colleges and universities using various research designs, techniques, or alternative units of analysis to assess its efficacy and validity.
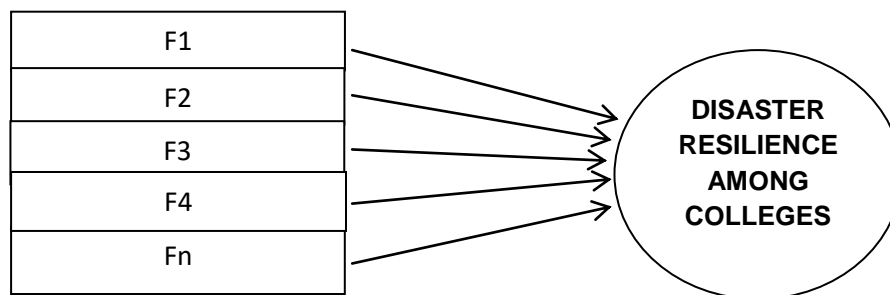
Figure 2. Hypothetical Path Diagram of the Latent Dimensions that Could Measure Disaster Resilience among College and Universities.

IV.   CONCLUSION

The researchers aimed valuable insights into comprehending the resilience of colleges and universities in the face of disasters. Through exploratory factor analysis, the researchers determined that there are multiple dimensions to disaster resilience in Colleges in the University of Mindanao. The researchers identified four key factors, (1) disaster preparedness, (2) disaster awareness, (3) community readiness, (4) disaster management, (5) disaster resilience. These factors were presented in a thematic framework. The measures generated because of this study are now integrated into the toolkit for assessing disaster resilience.

Furthermore, the findings of this research align with Aldrich and Mayer's (2015) anchor theory on resilience. This theory emphasizes the growing interest in risk management, highlighting the importance of partnerships as facilitators, the communal acceptance of responsibility for resilience, and a comprehensive examination of adaptive resilience. The development of health policy is also recognized as a pivotal aspect of building resilience. Resilience, as a concept, can be defined, evaluated, and gauged through various approaches, influenced by an array of factors.

Additionally, the impact on anticipated awareness, preparedness, and recovery management timeframe in the context of both immediate rebounding and enhanced reconstruction following disasters, whether single or multi-event, significantly contributes to resilience. In conclusion, the identified factor structures, including the effectiveness of disaster preparedness, level of disaster awareness, community readiness, and proficiency in disaster management, serve to reinforce and substantiate the theory of Disaster Resilience.

Based on the insightful findings of this study, it is evident that several key factors contribute significantly to the level of disaster resilience at the University of Mindanao. The findings have illuminated key factors that significantly influence disaster resilience within the university community, and addressing these factors can lead to a more resilient and disaster-ready institution.

The researchers suggest creating a student organization called "Council of College Disaster Volunteers (CCDV)", which consist of student volunteers from all colleges who have an experience and affiliations in disaster response. This would help to strengthen the disaster resilience of the University of Mindanao. Furthermore, the researchers recommend utilizing disaster organizational chart every building within the university. It enables the students to be aware of the focal contact during disaster.

V.   ACKNOWLEDGEMENTS

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