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Research paper



Data Analytics in the Utilization of ICT for Disaster Preparedness Plan of HEIs Region V

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Abstract

This research paper provides an overview of Disaster Risk Management, its information and communication needs, and the applications of Information Communication Technology in its activities. It aimed to determine the utilization of ICT in Higher Education Institutions of Region V, Philippines through data analytics as basis for decision support for disaster preparedness planning. The results are summarized according to the number of respondents and type of disasters; data mining techniques for proper cooperation mechanisms with the usage of ICT; and the sentiment analysis to the current practices of HEIs in the utilization of ICT in disaster preparedness. By revealing the utilization of ICT for disaster preparedness in the higher education level, a collaborative solution as fundamental to the success of DRM was determined to help school communities better understand the current disaster situation and know how the community is recovering. Finally, a comprehensive disaster preparedness plan for HEIs of Region V in the utilization of ICT has been proposed to show that the potential impact of ICT for DRM policies and measures need to take into consideration on HEIs environment, and ensure that interventions do not increase student's vulnerability to hazards.

Keywords: *ICT tools; disaster preparedness; sentiment analysis; data analytics.*

1. Introduction

Disaster preparedness refers to the readiness of governments, organizations, and communities to respond constructively against the threats from hazards, in order to minimize the negative consequences for lives and properties. It is a set of pre-disaster activities that are undertaken in anticipation of a disaster to ensure appropriate and effective actions in the aftermath. There are many communication tools that can be effectively used for disaster warning purposes. Information Communication Technology (ICT) provide vital support for disaster preparedness through observation, monitoring, recording, classifying, analyzing, sharing, networking, communication and warning dissemination. ICTs are providing an increasing number of solutions across all government and commercial sectors including Disaster Risk Management (DRM). Policymakers can no longer ignore the use and benefits that ICTs can bring to reduce disaster risks in innovative ways. ICTs have become essential to the effective management of all stages of DRM cycle [1].

The Philippine Commission on Higher Education (CHED) encourages all Higher Education Institutions (HEIs) to support, participate and involved their institutions in disaster risk preparedness programs. Region V (Bicol Region) is highly susceptible to natural disasters, in every disaster that might happen to the area, the educational institutions were always the first one affected. The school is an effective platform in transferring information, knowledge and skills to the surrounding communities. Reliable, accurate, and timely information at all levels of HEIs is crucial before, during, and after a disaster. ICTs have their advantages in information sharing and management that can be utilized to improve DRM, particularly in using internet and data mining techniques. These can facilitate planning and policy decisions for disaster preparedness plan of HEIs.

The main objective of the study was to determine the utilization of ICT in HEIs Region V through data analytics as basis for decision support for disaster preparedness planning. Specifically, it achieved the following: (1) identify the respondents and type of disasters recently experience; (2) know the current practices used by the HEIs in the utilization of ICT in disaster preparedness and employ data mining techniques for proper cooperation mechanisms; and (3) proposed a comprehensive disaster preparedness plan as a basis for decision support of HEIs disaster preparedness planning.

2. Related Works

Vogt, Hertweck, and Hales, mentioned that today's society is exposed to an increasing number of disasters and large scale. ICT can help to prevent and mitigate the effects of threatening situations if applied appropriately [2]. In the study of Kandel, Tamir, and Rishe, state that the key for improving disaster preparedness and mitigation capabilities is employing sound techniques for data collection, information processing, and decision making under uncertainty [3]. Kelvin presents the viability of ICT tools and explores various ICT technologies that can be integrated in the disaster preparedness plan. It envisions the use of ICT as a catalyst for effective DRM strategies [4]. Zaman and Biswas, also state that ICTs can provide variety of information beneficial to all communities. Application of ICT in disaster management has brought success in many cases and it is recommended for every

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nation to adapt ICT tools to handle disasters with greater efficiency, higher speed and desired transparency [5]. In the literature survey of Goswami, Chakraborty, Ghosh, and Chakrabarti, shows that there have been many efforts to predict the disasters based on various sources of data, they explore the multidisciplinary nature of the task, where data mining models are being applied on various types of data, requiring deep subject matter expertise [6]. Additionally, in the study of Ulko and Yuksel, it determines the level of disaster awareness of students in higher education institutions. Questionnaire data collection method is applied to the students wherein descriptive statistics are used in the analysis and evaluation of the data. By revealing the level of awareness in the higher education level, the study also aims to point to the need for disaster mitigation education that includes various topics and is accessible to whole society [7].

3. Methodology

The main idea of sentiment analysis is to convert unstructured text into meaningful information [8]. Figure 1 shows how sentiment analysis can be done on data, following the detail description for it.

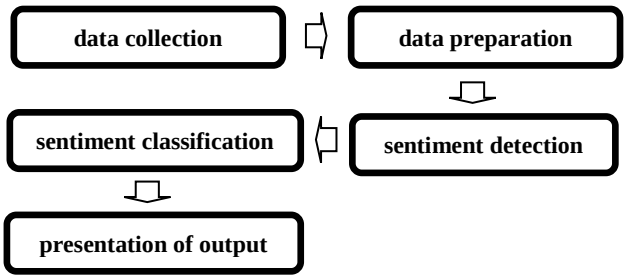


Fig. 1: Sentiment Analysis model

Data Collection. The first step is data collection. Opinions and feelings are expressed in different way, with different vocabulary, context of writing, and usage of short forms, making the data huge and disorganized. Natural Language Processing (NLP) or other text mining can be done on this data to extract information.

Data Preparation: The second step is data preparation. Data can be cleaned and prepare for sentiment analysis. Data preparation is nothing but filtering the extracted data before analysis. It includes identifying and eliminating non-textual content and content that is irrelevant to the area of study from the data.

Sentiment Detection. At this stage, each sentence of the review and opinion is examined for subjectivity. Sentences with subjective expressions are retained and that which conveys objective expressions are discarded. Sentiment analysis is done at different levels using common computational techniques like Unigrams, lemmas, negation and so on.

Sentiment Classification. Sentiments can be broadly classified into two groups, positive and negative. At this stage of sentiment analysis methodology, each subjective sentence detected is classified into groups-positive, negative, good, bad, like, dislike.

Presentation of Output. The final step is representing the output of analysis data. After the completion of analysis, the text results are displayed on graphs like pie chart, bar chart and line graphs.

In its simplest form, ICTs provide the necessary platform to keep communication channels open, given the underlying infrastructure is available. This research examined good practices and innovations made to improve awareness and preparedness to disasters induced by natural hazards in HEIs. Figure 2 shows the Conceptual Framework model of the research study.

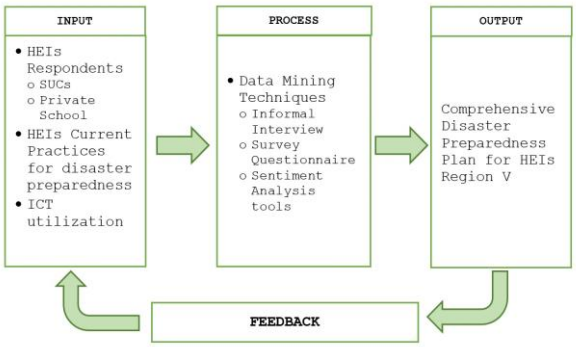


Fig. 2: Conceptual Framework Model

Input. The respondents are from HEIs State University & Colleges (SUCs) and Private Schools of Region V, within the provinces of Albay, Camarines Norte, Camarines Sur, Catanduanes, Masbate, and Sorsogon. The main respondents are the focal person(s) of every HEIs disaster management committee. It identifies the current practices of HEIs for DRM and its ICT utilization.

Process. Data mining techniques were employed by the researchers through informal interview, survey questionnaire and sentiment analysis tools. Informal interview was used in order to collect information from a person who knows about school disaster preparedness plan. Survey questionnaire, to know the extent they work or not, and how they can be improved and implemented, as well as an evaluation of another suitable ICT means. Sentiment Analysis tools were also used to get the positive or negative sentiments of the respondents and to get comprehensive and historical information in the utilization of ICTs for HEIs disaster preparedness plan.

Output. Based on the collected data and results of evaluation, a comprehensive disaster preparedness plan for HEIs was proposed by the researchers. Descriptive research was applied to gather the tangible data needed for the research study and provide necessary inputs that help the researchers fully understand the existing procedures and best practices of HEIs in conducting disaster preparedness. The study was limited to SUCs and Private Schools in every province of the Region.

4. Results and Discussion

Analysis and interpretation of the data gathering conducted are presented based on the requirements of the study "Data Analytics in the Utilization of ICT for Disaster Preparedness Plan of Region V". The topics underscored by the study are in accordance with the following: 1) HEIs respondents and type of disasters recently experience; 2) current practices used by the HEIs in the utilization of ICT in disaster preparedness and its sentiment analysis; and the 3) proposed comprehensive disaster preparedness plan for HEIs.

4.1. HEIs Region V Respondents and Type of Disasters

Table 1 shows 135 total the number of respondents from HEIs. There are 15 respondents from SUCs and 120 respondents from private schools of Albay, Camarines Norte, Camarines Sur, Sorsogon, Catanduanes and Masbate.

Table 1: HEIs Region 5 Respondents

HEIs Respondents		
Province	No. of Respondents	
	SUCs	Private
Albay	3	54
Camarines Norte	3	9
Camarines Sur	3	42
Catanduanes	3	3
Masbate	0	3
Sorsogon	3	9
Total	15	120

For the type of disasters recently experience by HEIs, Table 2 shows 135 or 100% of the respondent's experience typhoon, cloudburst and flood; 44.4 or 37% of the respondent's experience storm surge; 10.8 or 9% of the respondents experience volcanic eruption; 2.4 or 2% of the respondents' experience fire disaster and 0% of the respondents has no recent experience on earthquake, landslide and tsunami.

Table 2: HEIs Region 5 Type of Disaster

Type of Disaster recently experience	Frequency	Percentage
Typhoon	135	100%
Storm Surge	44	37%
Cloudburst	135	100%
Earthquake	0	0%
Landslide	0	0%
Flood	135	100%
Tsunami	0	0%
Volcanic Eruption	11	9%
Fire	3	2%

4.2. Current Practices of the HEIs in the utilization of ICT in disaster preparedness and its sentiment analysis

Data mining techniques can improve the quality and power of analysis of natural hazards assessments, guide development activities and assist planners in the selection of lessening measures and in the implementation of emergency preparedness and response action. Table 3 shows the current practices used by the HEIs in the utilization of ICT in disaster preparedness using sentiment analysis tool, whereas, Figure 3 shows the graphical representation of the sentiment analysis results.

Positive response of the respondents was gathered under Use ICT on School Action Plan for disaster management with a value of 126 or 22.50; 84 or 14.00 for establish InfoBlast texting system; 108 or 18.00 used SMS, social media, school website in DRM school preparedness standard operating procedures; 126 or 20.00 conduct emergency drill using information gather from different ICT platform; 117 or 19.50 has school-disaster response task force that used ICT tools in their cooperation mechanism; 114 or 21.00 conduct/attend training in DRM using ICT; and 135 or 24.00 used other practices in the utilization of ICT in DRM specifically, information from television and radio as well newspaper.

On other practices, it has negative response under integrate DRM in ICT curriculum structure and content with a value of 81 or 15.00; 90 or 16.50 in integrate DRM in ICT development and implementation plan; and 99 or 18.00 to Early Warning System with SMS support.

Table 3: Current Practices of the HEIs in the utilization of ICT in disaster preparedness and its Sentiment Analysis

Current Practices of the HEIs Region V in the Utilization of ICT in Disaster Preparedness	Sentiment Analysis	Sentiment Analysis Value
Use ICT on School Action Plan for disaster management	positive	22.50
Integrate DRM in ICT curriculum structure and content	negative	15.00
Integrate DRM in ICT development and implementation plan	negative	16.50
Has Early Warning System with SMS support	negative	18.00
Establish InfoBlast texting system	positive	14.00
Use SMS, social media, school website in DRM school preparedness Standard Operating Procedures	positive	18.00
Conduct emergency drill using information gather from different ICT platform	positive	20.00
Has school-disaster response task force that used ICT tools in their cooperation mechanism	positive	19.50
Conduct/Attend training in DRM using ICT	positive	21.00
Other practices in the utilization of ICT in Disaster Risk Management: information from television, radio, or newspaper	positive	24.00

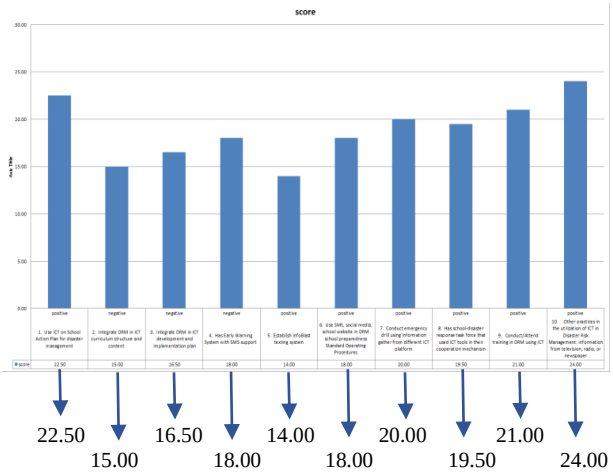


Fig. 3: Sentiment Analysis Graph Results

4.3 Proposed Comprehensive Disaster Preparedness Plan for HEIs

Disaster preparedness requires plans or preparations to ensure a rapid and efficient action when disaster occurs, taking into consideration the school community, local disaster management system and adjusting it according to the local condition. The acquired measurement of the related schools determines the level of school resiliency toward a specific hazard. ICT utilization is one of the most effective means to facilitate capacity building and institutional strengthening of service providing agencies and stakeholders engaged in different cycles of disaster management. ICT can play a significant role in highlighting HEIs risk areas, vulnerabilities and potentially affected populations.

As shown in Table 4, the researchers were able to come up with a comprehensive disaster preparedness plan for HEIs, employing ICT utilization with intended learning outcomes. The plan was an output of merging different best practices of HEIs in disaster preparedness plan. This preparedness plan can be effectively contributed towards the utilization of ICT in identifying hazardous areas, monitor the school for its changes on a real-time basis, provide emergency communication and timely relief measures, and give early warning to HEIs community about many impending disasters.

Table 4: Comprehensive Disaster Preparedness Plan for HEIs Region V

Current Practices	Disaster Preparedness Plan	Intended Learning Outcomes
Use ICT on School Action Plan for disaster management	To develop ICT Strategic Plan to ensure that is aligned with views of the school community. To formulate School Action Plan through a participatory approach of the HEIs communities and stakeholders.	Leadership is distributed across the HEIs community to ensure the integration of ICT is a focus in planning and determining the hazards, vulnerability, capacity disaster risk and history surrounding of the school.
Integrate DRM in ICT curriculum structure and content	To evaluate using annual surveys, the effects of integrating ICT with teaching and learning and to maintain high levels of security and safety for access to ICT.	The HEIs has a clearly articulated shared vision for ICT in teaching and learning and improve broader curriculum delivery issues in order to provide timely intervention strategies to assist individual students in using ICT in DRM.
Integrate DRM in ICT development	To submit annual reports that document the	Allow the HEIs to respond to modern

and implementation plan	progress towards the goals within the ICT plan.	trends and rapidly take advantage of future improvements in ICT delivery and infrastructure for DRM.
Has Early Warning System with SMS support	To provide secure and reliable data access to be used as basis for appropriate plans and preparations.	Enables the HEIs community to have an effective communication avenue and to act appropriately in any disaster risk issues.
Establish InfoBlast texting system (cell broadcasting)	To facilitate proper public warning message in the educational process.	Systemizing the public warning message across HEIs community and reduction of unreliable information to the students and parents.
Use SMS, social media, school website in DRM school preparedness Standard Operating Procedures	To collaborate with global communities and diverse cultural types.	Allow HEIs community to connect with a diverse range of cultures and resources and enables them to more accurately track the disaster risk issues.
Conduct emergency drill using information gather from different ICT platform	To facilitate better interactions and sharing of content and ideas in conducting emergency drills.	Educates HEIs community to be efficient and effective users of ICT and to be highly aware on disaster mitigation.
Has school-disaster response task force that used ICT tools in their cooperation mechanism	To enable HEIs to work individually and collaboratively within the school and other stakeholders.	Share information, practices and understandings across schools and reflect on their learning and in planning their educational pathways using ICT in DRM.
Conduct/Attend training in DRM using ICT	To personalize and extend learning in using ICT for disaster management.	Use ICT systems in DRM that facilitate the creation, sharing, reviewing and integration of digital content within the school and beyond.
Other practices in the utilization of ICT in Disaster Risk Management: information from television, radio, or newspaper	To continue used the traditional ICT communication tools that allow effective communication avenues within the school.	Establish local and global resources that contribute learning to the application of ICT in DRM.

5. Conclusion

The current practices used by the HEIs in the utilization of ICT in disaster preparedness are properly implemented as perceived by the respondents. Based on the results of the study, efficient management of disaster risks using ICT was recognized. School policy frameworks for disaster preparedness and ICT applications are in place. Institutional arrangements are set. Application of ICT tools have been started in almost all phases of disaster preparedness.

The data mining tools used for proper cooperation mechanisms in the usage of ICTs in HEIs are efficient and effective in implementing school disaster preparedness. The proposed comprehensive disaster preparedness plan generated and produced by the researchers for HEIs are usable to the end-users. Findings show that this new technique of employing data analytics as basis for decision support is fast and efficient. The main advantage is the quickness and automation of the procedure. Furthermore, future developments in ICT tools, like application of GIS and their adoption will further improve the disaster preparedness activities.

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