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Prototyping Disaster Preparedness Information System: A Case of Pandeglang District, Indonesia

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Abstract

In December 2018, a tsunami triggered by the eruption of Anak Krakatau Volcano (AKV) devastated the coastal area of Pandeglang, Indonesia, claiming hundreds of lives and leaving thousands missing. This tragedy underscores the critical importance of enhancing tsunami awareness through disaster preparedness and education. However, the lack of disaster preparedness in vulnerable areas, such as Pandeglang, remains a significant challenge. This is evident from the absence of early warning systems and evacuation initiatives at the time of the tsunami, highlighting the urgent need for improved disaster resilience in at-risk communities. This research aims to develop the disaster preparedness information system to equip society with sufficient knowledge and skill in case of the next disaster. The method this research uses is Soft Systems Methodology (SSM) to obtaining system requirements to the development of prototype. The prototype of a disaster preparedness information system was developed as a result. The system can be accessed using a smartphone or computer. This study introduces a novel approach by proposing a new prototype of disaster preparedness information specifically tailored for vulnerable areas in developing countries.

1. Introduction

Natural disasters have always been a concern for humanity, causing devastating consequences that affect communities in various ways. Indonesia, a country located in the "Ring of Fire," is highly susceptible to natural disasters such as earthquakes, tsunamis, volcanic eruptions, and floods. In December 2018, a tsunami hit the coastal area of Pandeglang, Banten, Indonesia, caused by the eruption of the Anak Krakatau Volcano (AKV) in the Sunda Strait [1]. At the time, nobody knew and was aware of that situation. As a result, 431 people were killed, 7,200 were injured, and 15 were missing

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[2]-[4]. The suddenness of the tsunami and the lack of early warning system highlighted the need for disaster preparedness and education in Pandeglang community [5].

According to the United Nations Office for Disaster Risk Reduction (UNDRR), education and public awareness are crucial in reducing the impact of natural disasters [6]. Disaster education enables individuals and communities to be prepared, respond effectively, and recover quickly from the impact of disasters. However, disaster education in Pandeglang is still lacking, and many residents are not fully aware of the potential risks and preparedness measures they need to take.

Previous researches have shown that the disaster education plays crucial role in disaster preparedness purpose. For example, a study by Ranghieri and Ishiwatari in 2014 found communities' disaster education has an important role in saving lives during the devastating Great East Japan Earthquake and Tsunami on March 2011 [6]. Local communities, lacking adequate coastal defenses, relied on their own knowledge and resourcefulness to survive. The success seen in the "Kamaishi Miracle" was not a mere stroke of luck; rather, it was the result of ongoing evacuation drills and disaster risk management (DRM) education ingrained in Japan's school system. In Kamaishi City, where the tsunami claimed the lives of 1,000 individuals out of a population of 40,000, the casualty rate among schoolchildren was remark+7ably low. Another study by Sakurai and Sato (2016) shows that effective approaches include integrating disaster knowledge into curricula, contextualizing hazard information within local environments, incorporating local and indigenous knowledge, and fostering a culture that surpasses disaster experiences, and ensuring that future generations learn from past lessons are the important things [7].

Information and Communication Technology (ICT) can play an essential role in supporting disaster preparedness and education. The widespread use of smartphones in Pandeglang creates an opportunity to leverage ICT to disseminate information and provide educational materials to the community. Through mobile applications, real-time alerts, interactive learning modules, and emergency guidelines can be easily accessed, enabling people to respond more effectively to potential disasters [9]. Moreover, integrating ICT with existing local communication networks can enhance information flow, ensuring that even remote or underserved areas receive timely updates and preparedness resources.

Several studies have explored the use of ICT for disaster preparedness and education. In their study, Fernando, Solomo, and Lagman (2019) developed a mobile application that provides information about disaster preparedness and response [8]. The study found that the application improved knowledge and awareness of disaster preparedness measures among users. Another study by Zhang et al. (2019) explored the use of social media for disaster communication and found that social media platforms could improve communication and disseminate critical information during disasters [9].

Study by Buchori et al. (2018) aimed to develop an information system for disaster risk reduction in the Semarang City, Indonesia. The system was developed by integrating maps with community participation to improve disaster management in the city [10]. The study concluded that the system was effective in increasing community participation and awareness of disaster risk reduction. Another study by Aliperti and Cruz (2020) developed a mobile app for disaster preparedness education and found that the app was effective in increasing knowledge and awareness of disaster preparedness among users [11].

Overall, the studies discussed above highlight the importance of using information and communication technology in disaster preparedness and education. The case of Pandeglang District, Indonesia, provides a unique opportunity to develop and test an information system that combines ICT potential with disaster education to equip society with sufficient knowledge and skills to mitigate the impacts of future disasters, particularly tsunami triggered by volcanic eruption.

For this reason, this study aims to prototype a disaster preparedness information system for Pandeglang district using Soft Systems Methodology (SSM) [14] by identifying the system requirements from the society and government to develop an effective information system that can improve disaster preparedness and education.

The paper is organized as follows. Section 1 provides a development of the system. Steps from System Requirements to Test in Figure 1 are written in this section. Section 2 presents the testing of the system, namely validation and verification. The last part provides a discussion of the implications of the study, conclusion and recommendations for future research.

2. Development of The System

2.1 Methods

This section dedicated as a section to explain the development of the system. The method of this research uses prototyping system. Prototyping is the process of creating an initial model or version of a system or concept. The prototyping stage of this study has five steps as shown in the Figure 1. Starting from deciding the requirements for system, deciding the functional specification, designing the internal specification of system, then development of the system, and the last is testing the system. By following those procedure, it can help to achieve the aim of this study to develop the information system from scratch.

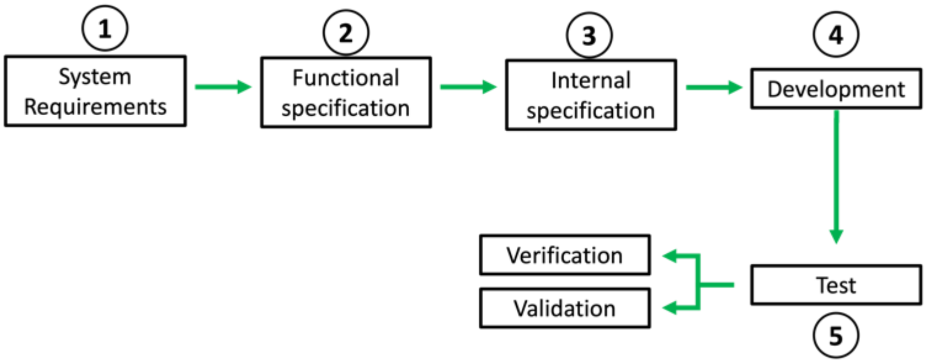

Figure 1. Stages of prototyping system

Firstly, system requirements are obtained from local residents and the government by using Soft Systems Methodology (SSM) refer Figure 2. SSM is a problem-solving approach that uses systems thinking to understand complex situations and improve them [14]. It emphasizes the importance of stakeholder involvement in problem-solving processes. SSM might be useful in situations where there are no clear boundaries, multiple perspectives, and differing opinions, which are often present in disaster preparedness situations.

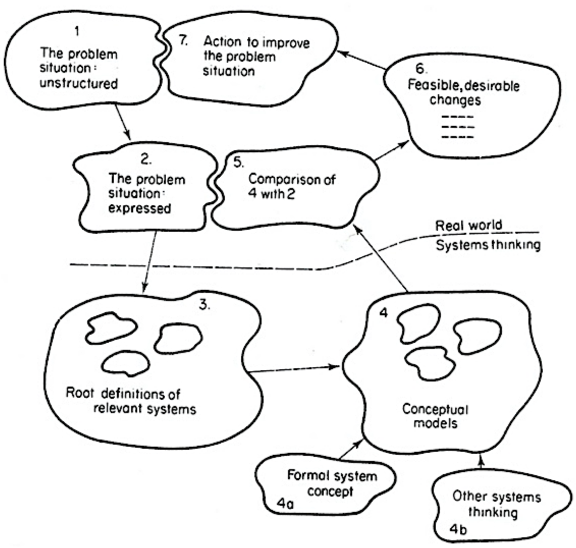

Figure 2. The methodology in summary [14]

To obtain the local residents and some government agencies perspective of the problems, the interview was conducted. The details of the interview respondents were from the Development Planning Agency (DPA) of Pandeglang, Regional Disaster Management Agency (RDMA), headmasters of an elementary and a junior high school, and a leader of an RT / RW (neighbor association). The DPA has a role to plan and built the environment for Pandeglang society and RDMA has a role to cope with the disaster in Pandeglang district. Both of agencies have significant role to dealing with disaster preparedness planning and training for district resilience.

The purpose of this interview is to collect information on current conditions regarding disaster management in Pandeglang, identify problems in existing disasters, and potential utilization of Information and Communication Technology (ICT) for disaster management using written style interview. The written style interview was done from 16 April – 10 June 2020 by using Google Forms tools. The interview question form was sent via email to the respondent.

Secondly, functional specifications are determined. Functional specification is a function should be on the program or system. In order to design the system, functional specification is needed. Functional specification described by using the screen transition.

Thirdly, internal specifications are designed. The employment of internal specifications enables the attainment of diverse functional prerequisites. And fourthly, the system is developed. The development consists with the prototyping. Prototyping is an important activity in most new product development processes [15] and usually used in software development. The prototyping process is based on repeating trial-and-error iterations. In this step, the first version of the prototype of an information system was created. To ensure its functionality and effectiveness, the prototype underwent a verification and validation process, which included system testing, user feedback collection, and performance evaluation. Verification was conducted through internal testing, ensuring that all system components functioned as intended. Validation involved user trials with selected participants from vulnerable communities to assess usability, accessibility, and relevance of the information provided. The feedback gathered from these stages was used to refine and enhance the system before final implementation.

2.2 Result of Prototyping

This section is describing the results of each stage in prototyping.

2.2.2 System Requirements

After getting the results of the interviews, it was found that there were many answers and different points of view from the respondents.

The first stage of the SSM is the Problem Situation: unstructured. At this stage the problem was found with an unstructured composition. This means that there are many problems from various points of view and answers from the interview. For that reason, the answer should be expressed in problems (Stage 2). The summary of the expressed problems from the questions can be seen in Table 1.

Table 1. The problem summary expressed from the various point of view

Questions	Expressed Problems
Q1. What do you do in preparing for disaster management	Preparing food supplies, important documents, and evacuation route
Q2.What does 'preparation' mean	Anything related to planning before the disaster occur
Q3.Can you utilize RT/RW system for disaster education	Yes
Q4.Disaster training activity should be implemented for the community	Disaster preparedness training involving social activists and the community
Q5.Disaster training activity should be implemented for students in school	Disaster preparedness education that is easy to understand, interesting and fun
Q6.Disaster did hit Pandeglang District recently	Tsunami (some respondents said floods)
Q7.Did you receive information on the warning	Most respondents said Yes
Q8.Actions were taken to save yourself or others' life	Save our life, and go to safety place
Q9.Problems faced in the past disaster management	Lack of preparation and knowledge
Q10.Most important for disaster management	Social volunteers, disaster preparedness
Q11.The role of ICT	Important
Q12.Pandeglang community familiar with ICT	Most respondents said familiar, while the others said some
Q13.Media is the most commonly used	Social media on mobile phone

The next step is finding root definition of system. In Soft Systems Methodology, the root definition was determined by using CATWOE. CATWOE is an abbreviation from Customer, Actor, Transformation, Welthanschauung, Owner, and Environmental constraint. By using the information from Table 1, the Customer, Actor, Transformation, Welthanschauung, Owner, and Environmental constraint were determined.

In this study, Pandeglang community will be the customer, because they are the ones who will receive benefit from this system. The actor and owner of this system will be Disaster Regional Management Agency. Because they are the institution that relates to and is responsible for disaster management in Pandeglang. The transformation will be disaster training to increase the capacity of the community. From the interview, it can be concluded that the Pandeglang people still do not have adequate disaster training. Weltanschauung or the basic world view, is that preparedness is important in disaster management. And the environmental constraint will be limited for the utilization of ICT, since the Pandeglang area is in a developing area. To summary, CATWOE in this study will be like below.

Table 2. CATWOE

Customer	Community
Actor	Regional Disaster Management Agency
Transformation	Training to increase the capacity of the community in forming resilient communities in facing disasters
Welthanschauung	Disaster preparedness is important in disaster management
Owner	Regional Disaster Management Agency
Environmental constraint	Limited utilization of ICT

Therefore, based on the Table 2 of CATWOE, the root definition in this case study is a system owned and implemented by the Regional Disaster Management Agency of Pandeglang (O) (A) train and teach the community (C) to increase the capacity of the community in forming resilient communities in facing disasters (T) that can save more people (W), in the environment where the utilization of ICT is limited (E).

After determined the root definition, the next step is to create a conceptual model of the system. In this system, the conceptual model covering what should be in the system refers the information from CATWOE. That is, the conceptual model of this system consists of input, process, output (Figure 3).

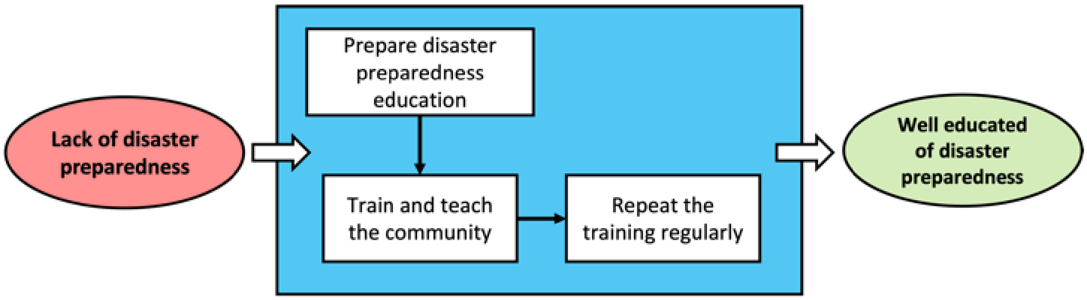

Figure 3. Conceptual model diagram

The input to this system is the condition of the Pandeglang community which still lacks disaster preparedness. This can be seen from the answers in the previous written style interview. The process of the conceptual model consists of three actions. Namely, 'prepare disaster preparedness education', then 'train and teach the community', and finally 'repeat the training regularly'. The expected output from the process in the system is the people of Pandeglang who are well educated of disaster preparedness.

In order to find out the system requirements, the conceptual model must be broken down into context. The context is what will be done in for every steps in the conceptual model. The context will be shown in Table 3.

Table 3. Find out system requirements using context

Conceptual Model	Context
Prepare disaster preparedness education	Regional Disaster Management Agencies will prepare a set of curriculum theories related to disaster preparedness. The curriculum is expected to increase public awareness and knowledge related to disaster preparedness. The curriculum will be available on the Regional Disaster Management Agency's disaster preparedness training website and can be accessed by the public.
Train and teach the community	The Regional Disaster Management Agency has prepared a trainer who will guide the course of disaster preparedness training, especially for evacuation training.
Repeat the training regularly	On the Regional Disaster Management Agency website, a routine calendar of disaster preparedness training schedules is available. The community can find out when the next training.

After the breakdown process in Table 3, the system requirements can be identified in two parts. The first requirement is for the content of the information system and the second is the requirement for the user interface of the system. The details of each part are shown in Table 4.

Table 4. System requirements

Requirements for the content	-To have knowledge related theories of disaster preparedness -To have disaster preparedness training regular schedule -To be able to increase public awareness and knowledge related to disaster preparedness -To have bilingual languages (English and Bahasa Indonesia)
Requirements for the user interface of the system	-Can be accessed by the public via PC or smartphone -To be interactive and user friendly

Besides the three of main requirements for contents, this study also added one requirement, namely the bilingual language consists of English and Bahasa Indonesia. The English version is used later for the validation and verification process during research work and the Indonesian version also is used later for the Indonesian people, especially the Pandeglang area, where the majority still use Indonesian.

2.2.3 Functional Specifications

After the system requirements identified, the next step is determining the functional specification. To do this, use case diagram and screen transition diagram are required. The process of making a screen transition uses the Miro application (Khusid 2011). Details will be explained below [14].

Use case diagrams are diagrams that summarizes the details of user activities on a system. In a use case diagram, users such as Society, Development Planning Agency, and Regional Disaster Management Agency are also known as actors. Actors with this interaction activity will describe the running of a system.

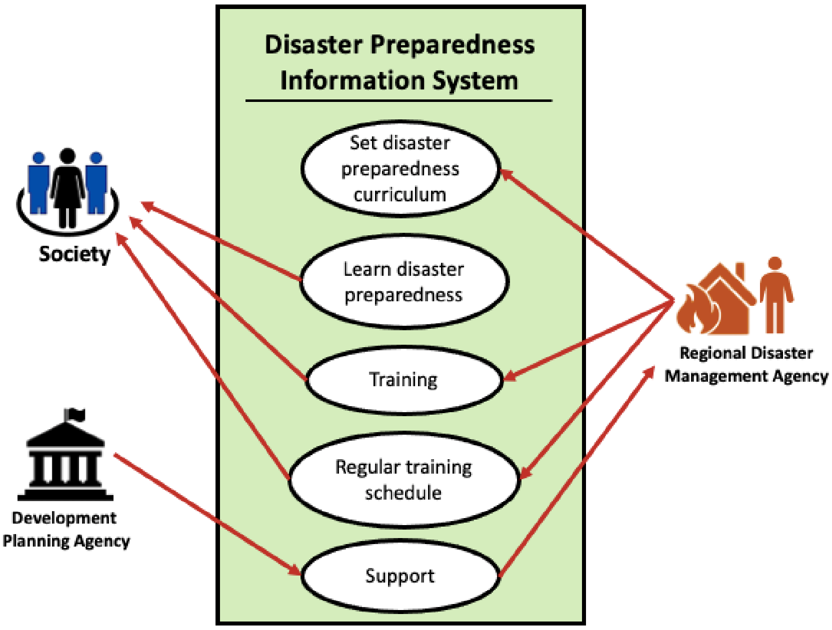

Figure 4. Use case diagram

As shown in the picture above (Figure 4), the actors activities on this system are interrelated. In this context, Development Planning Agency (DPA) which has a role to plan and built the environment, giving a support to RDMA for this disaster preparedness activities. At the same time, RDMA which has a role to develop the emergency plan and recovery, setting and conduct the disaster preparedness for Pandeglang society. The Society received the disaster preparedness education which includes curriculum, training, and schedule from RDMA.

After the breakdown of use case diagrams, each detail activity can be known. From this information, a screen transition, which illustrates the functional specification of prototype information system, can be made. In this study, screen transition diagram is made by using a tool called Miro (Khusid 2011). Miro is a free application that allows users to collaborate to create unique canvases containing project ideas. One thing that can be used from the Miro application in this study is the creation of a screen transition design that displays smartphone mock-ups. Miro also has features that suit the screen transition design needs [14].

The screen transition diagram in this study, in which fifty-three screens and these interrelations are described, is divided into two, namely Webadmin part (Figure 5) and General Users part (Figure 6). Webadmin is the name of the administrator. The name of Webadmin will be the name of administrator of Regional Disaster Management Agency. Webadmin part is a screen that describes the steps for webadmin to manage website content. And General Users part is for people when visiting and using the website.

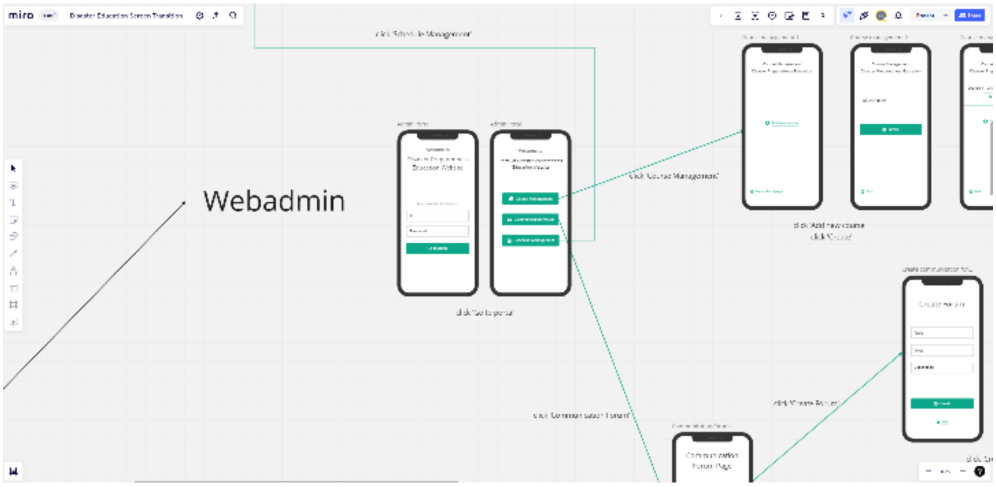

Figure 5. Screen transition of Webadmin interface (a part)

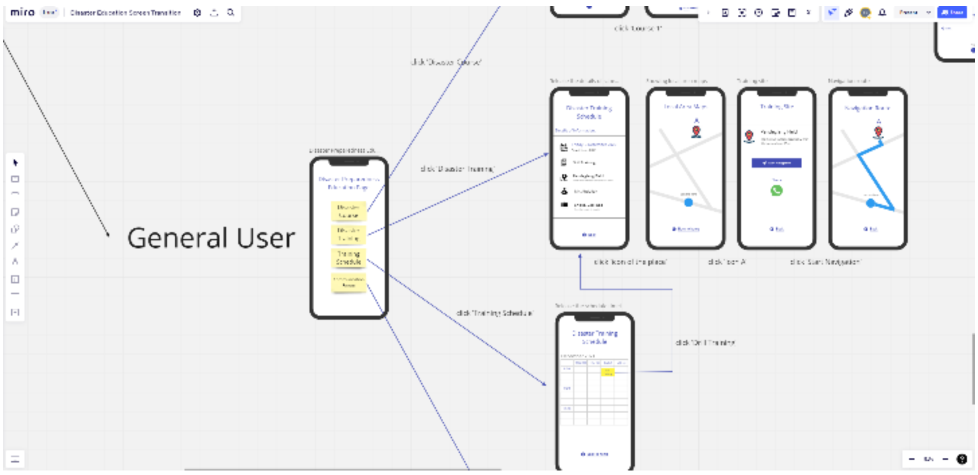

Figure 6. Screen transition of General User interface (a part)

The initial interface presented in the webadmin section is the administrative portal, where the web administrator must provide their username and password to access the webadmin dashboard. The dashboard encompasses three primary functionalities: Course Management, Communication Forum, and Schedule Management (Table 5). From this central hub, the webadmin has the capability to manage the website according to their requirements.

In the general user section, users can directly access the website and utilize the available disaster learning features. These features include Disaster Course, Disaster Training, Training Schedule, and Communication Forum. The Disaster Course feature provides structured educational content covering a wide spectrum of disasters, particularly earthquakes and tsunamis, equipping users with essential knowledge about their causes, preventive measures, and evacuation methods as well as a disaster prevention guidebook. Complementing this, the Disaster Training function offers hands-on simulations and practical exercises, enabling users to experience and learn how to respond effectively during emergencies. The Training Schedule feature allows users to plan and participate in upcoming disaster preparedness sessions or workshops, providing them with opportunities to enhance their skills and preparedness.

Additionally, the Communication Forum serves as a collaborative space where users can engage in discussions, seek advice, share experiences, and access a wealth of information and support from experts and the community. Collectively, these functions empower users with knowledge, practical training, access to scheduled programs, and a supportive network, fostering a proactive approach to disaster prevention and response.

The screen transition diagram elucidates the functional specifications derived from the system. By depicting the sequence of screen transitions, the diagram effectively demonstrates the specific functionalities that are encompassed within the system.

Table 5. Functional specifications shown in the screen transition

	User type	Functional specification
Screen transition diagram	Webadmin	Course management
		Communication forum
		Schedule management
	General users	Disaster course
		Disaster training
		Training schedule
		Communication forum

After making the screen transition and determined the functional specifications, the next step is to determine the internal specification. The internal specification is realized as web service. The main specifications for the server are using PHP, vCPU/Memory is 128 cores/1024GB, vCPU/Memory Resource Guarantee is 6 cores/8GB, and disk space for storage is 300GB. The expected hardware to be use by clients are personal computer or smartphone. And the content management system (CMS) using the WordPress platform version 6.4 series (PHP 7.4 to PHP 8.2).

WordPress is an open-source content management system (CMS) and is free [19]. In making a prototyping disaster education information system using the WordPress platform, a domain and hosting are needed. Domain that serves as the website address later, and hosting as a place to store data on the website. The domain name for this information system is www.belajarbencana.com. It means disaster education. In addition, some plugins are used for this system (Table 6) such as file management plugin, discussion forum plugin, calendar plugin, pdf displayer plugin, navigation plugin, and schedule plugin.

Table 6. Functional specifications realized by using internal specifications

Functional Specification	Software used	Hardware used
Course management	WordPress open source, file management plugin	Smartphone
Communication forum	WordPress open source, discussion forum plugin	Smartphone
Schedule management	WordPress open source, calendar plugin	Smartphone
Disaster course	WordPress open source, pdf displayer plugin	Smartphone
Disaster training	WordPress open source, Google maps and navigation plugin	Smartphone
Training schedule	WordPress open source, calendar and scheduling plugin	Smartphone

On the basis of functional and internal specifications, the prototyping of the system has been made. The display of the prototyping information system in smartphone mode will be shown like the figures below.

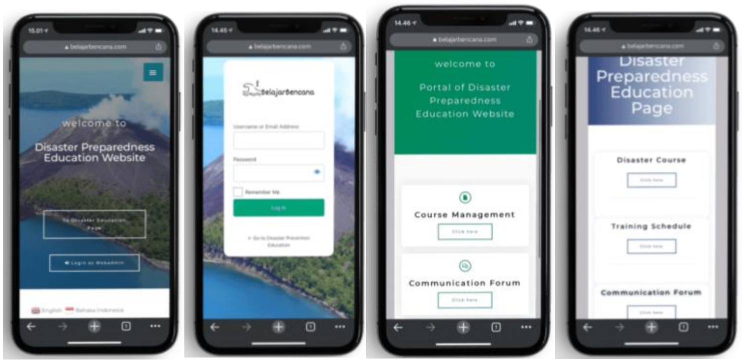

Figure 7. Prototype of the system

3. Testing of The System

The final step is testing. Testing is to check the system that has been made. Testing consists of two stages, verification and validation.

3.1 Methods

Verification is the process to confirm what is system like. Verification process compares the system that has been created with the design on the screen transition. Verification process was done by students who are not related to the prototyping.

Validation is confirmation that the system works correctly and get feedback from users. For validation, the local stakeholders in Pandeglang, Banten asked for feedback. Stakeholders consist of Pandeglang Government, Regional Disaster Management Agency, School, and RT/RW (neighborhood association). Written style interview using Google Forms was used once again for collect the feedback from users. Written style interview was done from 29 June – 4 July 2021. The interview question form was sent via email and personal message of the respondent.

3.2 Result of the tests

In the verification process, the system that has been created has undergone several improvements and adjustments. From the verification process, some features were added to the system, namely downloadable manuals for webadmin and users, as well as connection of the system to Twitter for received the latest information regarding the situation of Anak Krakatau Volcano from internet users on Twitter. Manuals for webadmin and general users will be helpful to using the website since the manuals explain step by step the function and features of the website**.**

For the validation, the following is a summary of eight responses and feedback from stakeholders by using written style interview and Google Forms. Questions for feedback to stakeholders are divided into two patterns. Pattern one is for School and RT/RW (neighborhood association), and pattern two is for Government and Regional Disaster Management Agency. The responses and answers were summarized by choosing the most frequent answers on each question (Table 7).

Table 7. Summary of answers from school and RT/RW

Questions	Answers Summary
Is this system good for education preparedness?	Yes
Is this system easy to use?	It's easy and very informative
Is this system easy to understand?	Yes, easy
Are the Disaster Course contents easy to understand?	Yes, easy to understand
Are the Disaster Course contents enough?	Enough
What is a good point of this website?	Available in two languages, connect with social media, informative, the material is quite useful
Rate this website (for score 1 - 10)	8 in average

On the other hand, there are also comments that suggest that the system still needs improvement in the future. The responses and answers were summarized by choosing the most frequent answers on each question (Table 8).

Table 8. Summary of suggestion answers from users

Questions	Answers Summary
Are the Disaster Course contents enough?	Need to add animated pictures/videos
What kind of contents do you need in the Disaster course?	Still need to add animated pictures/videos, map of disaster-prone locations
In your opinion, are the features in this system good for disaster preparedness education?	- The features are good enough, for even more massive information to the public the platform is made more accessible, such as on Android, or other digital platforms that are easier -Use a language with local wisdom, an easily accessible language
Is this system easy to understand?	No
What is a weak point of this website?	-Interactive features need to be added -Since the main server was established from Japan, sometimes Japanese words appear and make Indonesian users confuse
Do you have any suggestions for improvements to this system?	-Easy login access -Providing various learning materials

4. Discussion

The prototype of the disaster preparedness information system was developed based on the needs of the community and the Pandeglang Government, identified through Soft Systems Methodology (SSM). This system aims to educate and inform residents about disaster preparedness, ensuring they have access to the necessary knowledge and resources to respond effectively in emergencies. The study evaluates the effectiveness of this system and its potential to enhance disaster preparedness and education in Pandeglang. Given that the region is highly vulnerable to the unpredictable eruption of Anak Krakatau Volcano (AKV) and potential tsunami events, a reliable information system is essential to mitigate risks and improve community resilience.

The validation phase provided crucial feedback from schools, neighborhood associations (RT/RW), and government agencies. Schools and RT/RW users generally responded positively, highlighting that the system meets their expectations in terms of disaster education, ease of use, and accessibility. They particularly appreciated its ability to simplify disaster preparedness concepts, making it more approachable for the general public. The system received an average rating of 8 out of 10 from these users, with suggestions for improvements, such as incorporating more engaging educational materials, illustrations, and interactive features. Similarly, feedback from government agencies and disaster management organizations was mostly positive, especially regarding content clarity and ease of access via smartphones. However, they suggested enhancements in interactivity, including animations, additional features, and improved navigation. Their rating averaged 5 out of 10, indicating that further refinements are needed to increase institutional usability.

For wider community adoption, two primary implementation strategies have been considered. First, integrating the system into schools can serve as an effective approach to embedding disaster education into formal curricula. A junior high school in Pandeglang has expressed strong interest in adopting the system, potentially serving as a pilot project before broader implementation in other educational institutions. Second, collaboration with local disaster preparedness communities such as Tagana (Youth Disaster Prevention) and Katana (Disaster Response Village) offers another viable pathway. These organizations have been active in disaster risk reduction efforts since the 2018 tsunami, conducting regular training programs. By incorporating the disaster preparedness information system into their activities, awareness and usage can be expanded to a broader audience, ensuring community-based dissemination and adoption.

This research utilized WordPress as the platform for system development, primarily due to its open-source nature and ease of customization. However, this choice also introduces concerns regarding security vulnerabilities, particularly in the use of third-party plugins. Some plugins may pose risks due to outdated versions or potential security loopholes. To address these challenges, the system administrator must regularly update plugins and select only those that are verified and compatible with the latest version of WordPress to maintain security and stability. While initially designed for the Pandeglang district, this system has the potential for broader application in other disaster-prone areas. Given the widespread availability of smartphones and internet access, the system can be adapted for different communities worldwide, provided it is tailored to their specific needs and integrated into existing disaster management frameworks.

To further enhance the system's effectiveness, integrating Artificial Intelligence (AI) could play a crucial role in improving early warning capabilities [20]. AI can be leveraged to analyze historical disaster data, real-time sensor readings, and environmental patterns to provide more accurate and timely tsunami predictions. By incorporating AI-driven predictive modeling, the system could issue automated alerts level based on seismic and oceanographic data, reducing response time and enabling better decision-making for communities at risk [21]. Additionally, AI-powered learning tools could personalize disaster education by adapting content based on user engagement levels, ensuring a more interactive and effective training experience. While AI integration presents promising opportunities, further research is needed to develop machine learning algorithms capable of optimizing early warning accuracy while ensuring practical usability for end users.

This research highlights the importance of disaster preparedness information systems in vulnerable communities such as Pandeglang. The developed prototype has demonstrated its potential in improving disaster education and awareness, yet further enhancements are required, particularly in terms of system interactivity, accessibility, and community engagement. By continuously refining the system based on user feedback and exploring technological advancements such as AI integration, disaster preparedness initiatives can become more effective and scalable. If properly implemented and expanded, this system could contribute significantly to building resilience in disaster-prone regions, ensuring that communities are better prepared to respond to future natural hazards.

5. Conclusions

Based on disaster preparedness experiences from Japan, disaster education remains one of the most fundamental and crucial aspects of building community resilience. In Pandeglang, where the majority of residents rely on smartphones and benefit from mobile phone location data [22] as their primary means of communication, leveraging Information and Communication Technology (ICT) presents a significant opportunity to enhance disaster education and preparedness. The implementation of a disaster preparedness information system through ICT offers a strategic approach to raising awareness and improving access to critical disaster-related information.

This study employed Soft Systems Methodology (SSM) to analyze the complex dynamics of disaster preparedness, taking into account the diverse perspectives of various stakeholders. The development and validation of the disaster preparedness information system demonstrated its effectiveness in educating communities and providing accessible resources for disaster risk reduction. Feedback from users, including schools, local community organizations (RT/RW), and government agencies, was generally positive, with key suggestions for enhancing interactivity, incorporating visual content, and expanding system features. The validation phase also underscored the potential of collaborating with local disaster response groups, such as Tagana and Katana, to ensure broader community engagement and sustainable implementation.

Further improvements are necessary, particularly in enhancing the system’s educational materials with interactive content, animations, and real-time disaster updates. Additionally, integrating Artificial Intelligence (AI) for early warning capabilities could further strengthen disaster preparedness by enabling automated alerts, predictive modeling, and personalized risk assessments. AI has already proven to be a valuable tool in disaster-related contexts, such as mask detection during the pandemic [23] and early detection systems in healthcare [24]. With these refinements, the system could provide a more comprehensive and adaptive learning experience for at-risk communities.

Once the necessary enhancements are implemented, this disaster preparedness information system has the potential to be officially transferred to the Regional Disaster Management Agency of Pandeglang, ensuring long-term sustainability and integration into local disaster management strategies. Moreover, given the system's scalability, it could be further adapted and deployed in other disaster-prone regions, both in Indonesia and globally, to support broader disaster risk reduction efforts. By continuing to refine and expand the system, it can serve as a valuable tool in fostering disaster resilience and improving emergency preparedness worldwide.

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