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Development of a Campus Disaster Risk Reduction Response System Using ADDIE Model

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ABSTRACT

This study designed, developed, and evaluated a Campus Disaster Risk Reduction Response System (CDRRRS) at North Eastern Mindanao State University–Cantilan Campus using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model. During the Analysis phase, 25 stakeholders (security, staff, and student leaders) participated in a structured interview; field observations and protocol reviews were also conducted to identify challenges in preparedness, communication, and role clarity. Design and Development phases translated these needs into a mobile-responsive application built using Flutter and Laravel, incorporating AI-driven incident categorization (91% accuracy), GPS-based reporting, photo/text submission, real-time SMS alerts (94% delivery), and an administrative dashboard integrating Firebase, OpenAI Vision, and Google Maps. The system was piloted with 50 users in simulated emergency scenarios. Evaluation showed statistically significant improvements in system performance. Compared to the existing system, CDRRRS achieved higher mean scores in timeliness (4.23 vs. 2.82), reliability (4.18 vs. 3.70), and stakeholder satisfaction (4.23 vs. 3.80), all $p < .001$. Response time decreased by 33.3%, user satisfaction reached 4.23/5.0, and usability scored 91/100. The CDRRRS effectively enhances disaster response through technology-driven, inclusive design. It offers a scalable and user-centered model for improving emergency preparedness in higher education contexts.

Keywords: Campus safety, disaster risk reduction, emergency response, ADDIE model, educational technology, AI alerts, GPS reporting, usability evaluation

INTRODUCTION

Disasters such as earthquakes, typhoons, fires, and security threats continue to pose serious dangers to educational institutions, putting lives at risk and disrupting learning activities. In crowded campuses, emergencies require fast, well-coordinated, and inclusive responses. However, many schools and universities still rely on outdated communication methods, which can delay response and put students, faculty, and staff in greater danger (Khan, Rana, & Najam, 2020; Varsha, Mehta, & Roy, 2024). This study focuses on creating a Campus Disaster Risk Reduction Response System (CDRRRS) for North

Eastern Mindanao State University – Cantilan Campus to improve preparedness, coordination, and communication through a digital and accessible platform.

Research shows that technology can greatly improve disaster management. For example, Behravan et al. (2024) highlight how artificial intelligence (AI) and real-time data help speed up emergency response and increase accuracy. Similarly, CrisisSense-LLM (2024) demonstrates that GPS alerts and AI-driven alert categorization enhance situational awareness and decision-making. However, Goh, Tan, and Ong (2023) note that many systems are not designed to include vulnerable groups, such as persons with disabilities or those with limited technology access. Despite advances, many campuses still use basic tools like text messages and radios, which often fail during major emergencies (University College London, 2023).

At NEMSU – Cantilan Campus, the current emergency system has several weaknesses: slow responses, unclear roles for campus members, and poor coordination with outside emergency agencies. The system lacks a centralized platform, which causes confusion and delays during crises. There is also little focus on making communication accessible to all users, especially vulnerable groups. Although safety rules exist, there is no digital system tailored to the campus's specific needs.

To address these problems, this study develops the CDRRRS using the ADDIE model—a step-by-step design framework consisting of Analysis, Design, Development, Implementation, and Evaluation phases (Spatioti, Kazanidis, & Pange, 2022). This approach ensures the system is user-focused, adaptable, and based on real needs. This project also supports wider development goals, such as the Philippines' Ambisyon Natin 2040 and the United Nations Sustainable Development Goals, which call for safe, inclusive, and resilient education systems (Wilkins, Santos, & Lim, 2021). Overall, this study aims to create a modern, accessible, and well-coordinated digital emergency system to better protect campus communities.

METHODOLOGY

This study employed a developmental research design guided by the ADDIE model to develop an enhanced Campus Disaster Risk Reduction Response System (CDRRRS) for NEMSU–Cantilan Campus. The ADDIE model comprising Analysis, Design, Development, Implementation, and Evaluation is widely used in instructional and systems development for its structured, iterative approach (Spatioti, Kazanidis, & Pange, 2022). During the Analysis phase, researchers conducted structured interviews with security personnel, administrative staff, and student leaders, alongside protocol reviews, to identify gaps in emergency procedures, communication, training, and coordination. These insights shaped the Design phase, which outlined key system features such as GPS-enabled incident reporting, real-time SMS alerts, photo and text submissions, and an administrative dashboard, all designed for ease of use and accessibility, including for users with disabilities. The Development phase involved building the mobile app using Flutter for cross-platform support and Laravel for the backend, incorporating OpenAI Vision for image analysis, Firebase for notifications, and Google Maps for live tracking. In the Implementation phase, the prototype was deployed in a controlled campus setting to simulate emergencies and identify technical or usability issues. Finally, the Evaluation phase collected feedback from users and experts to assess functionality, usability, and performance under stress, allowing refinements to ensure the system effectively supports campus disaster preparedness and response.

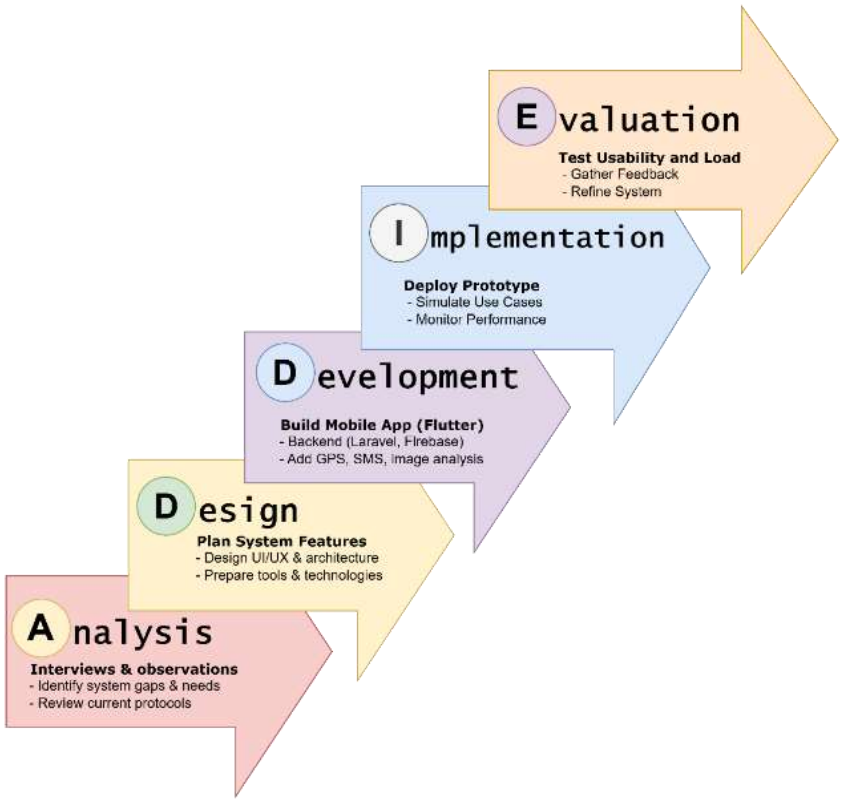

Figure 1 ADDIE Model

RESULT AND DISCUSSION

Analysis Phase

The Analysis phase focused on identifying gaps and inefficiencies in the current emergency response practices at North Eastern Mindanao State University (NEMSU) – Cantilan Campus. Researcher gathered data through structured interviews with security and medical personnel, administrative staff, selected IT faculty and student leaders, supplemented by observations of campus protocols and safety document reviews. Findings revealed that many staff were unclear about emergency procedures and their roles during disasters, while emergency drills and training were infrequent and insufficient. Communication methods like texts, phone calls, and radios were slow, unreliable, and not accessible to persons with disabilities or visitors. Additionally, poor coordination between departments, a lack of clear command structure, and insufficient safety equipment were major concerns.

These insights highlight the need for a disaster response system that offers clear role-based guidance, supports training and simulations, and provides a faster, multi-channel communication platform. The system should also enable real-time coordination, track emergency supplies, and include incident logging and evaluation tools to improve safety standards. Importantly, staff showed a strong willingness to participate in training and improvements, indicating that the system must be user-friendly and responsive. Overall, the Analysis phase provided a clear understanding of the current challenges and user needs, forming a solid foundation for designing an effective and context-specific disaster response system for NEMSU.

Design Phase

Using the findings from the analysis, the Design phase focused on outlining the system's key features to directly address the needs identified during the Analysis phase at NEMSU–Cantilan Campus. The design

included GPS-enabled incident reporting to allow users to quickly and accurately share their location during emergencies, and AI-powered emergency categorization to automatically prioritize and classify reports for faster response. Communication was enhanced through real-time SMS alerts and push notifications, ensuring rapid dissemination of critical information to all stakeholders. An administrative dashboard was created to enable efficient monitoring, coordination, and management of emergency responses by campus authorities. The system's user interface was designed to be intuitive and accessible, supporting both mobile app and web platforms. Special attention was given to inclusivity, with features tailored for users with disabilities, such as alternative text options and clear visual cues, ensuring no one is left behind during emergencies. Additional functionalities included interactive emergency maps for situational awareness, real-time tracking of responders to improve coordination, and easy access to emergency hotlines and instructional guides like CPR and first aid. These components were integrated to provide a comprehensive, user-centered disaster response system that supports timely, informed decision-making and effective action during critical campus situations. The overall design aimed to create a responsive, efficient, and inclusive platform aligned with the specific safety goals and challenges of NEMSU–Cantilan Campus.

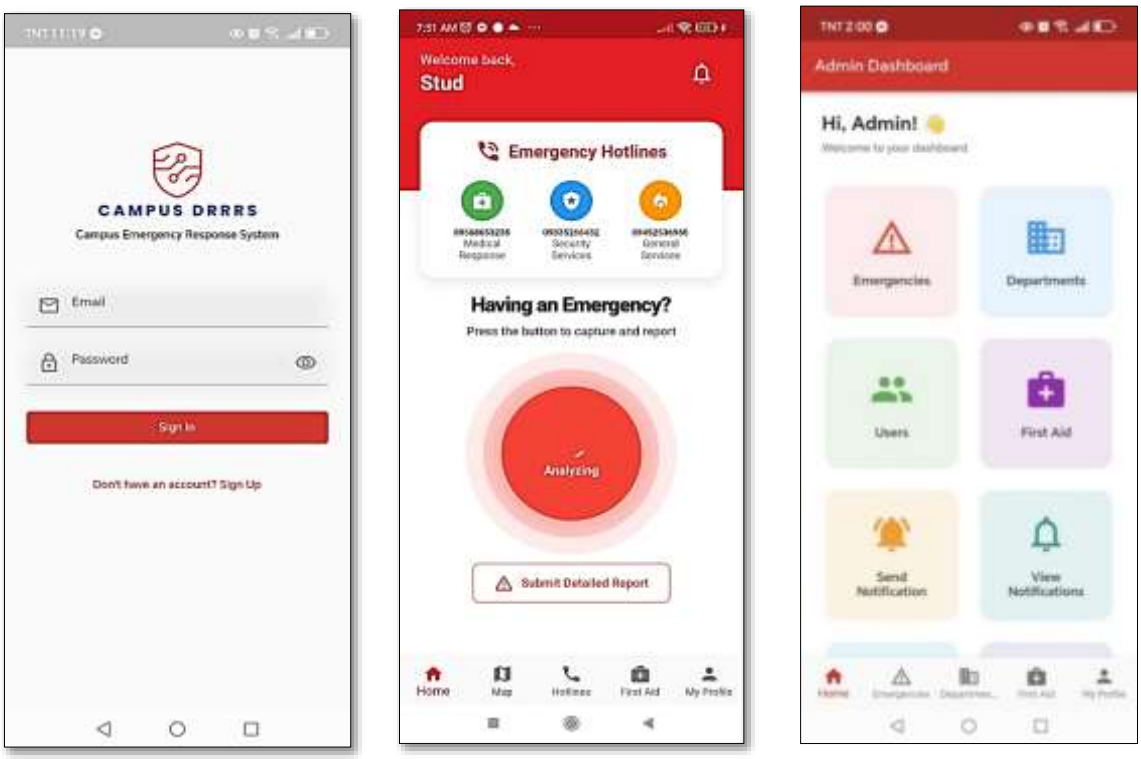

Figure 2 System Design

Development Phase

In the Development phase**,** these design plans were translated into a fully functional system using modern, cross-platform technologies. The mobile application was developed using Flutter to support both Android and iOS platforms, ensuring widespread accessibility. The backend infrastructure was built on Laravel (PHP 8.1+) with MySQL/PostgreSQL databases, incorporating Laravel Sanctum for secure user authentication. Integration with the OpenAI Vision API enabled automated image classification, allowing the system to route reports to the appropriate emergency department (fire, health, or security) based on

visual input. GPS modules were integrated using native plugins, providing automatic location detection and real-time tracking of responders. Communication features were powered by Firebase Cloud Messaging for push alerts and Semaphore SMS Gateway for critical offline communication. Continuous testing, feedback loops, and system validation were carried out throughout the development to ensure stability, reliability, and scalability, especially during high-traffic or high-stress conditions.

Implementation Phase

The system prototype was deployed in a controlled setting within the campus. Simulated emergency scenarios were conducted to test the real-time functionality, such as report submission, SMS alert delivery, and admin response coordination. Performance metrics, user actions, and system responsiveness were closely monitored to detect errors and assess reliability in actual use conditions.

Evaluation Phase

During the Evaluation phase, the Campus Disaster Risk Reduction Response System (CDRRRS) was carefully tested to see how well it works compared to the old system. The evaluation focused on three key areas: timeliness, reliability, and user satisfaction.

The results showed clear improvements. For timeliness, or how quickly the system sends alerts and information during emergencies, the new system scored 4.23, much higher than the old system's 2.82. This means alerts now reach people faster and more efficiently. For reliability, or how well the system works without errors or delays, the new system scored 4.18, compared to the old score of 3.70—showing that the system can be trusted to perform even during emergencies. Finally, for stakeholder satisfaction, the new system again did better, scoring 4.23 versus 3.80 for the old one. This shows that users find the new system easier to use, more helpful, and better overall.

All differences were proven to be statistically significant ($p < 0.001$), meaning the improvements were not due to chance. These results confirm that the CDRRRS meets the needs of the campus by being fast, dependable, and user-friendly, which are all essential for disaster preparedness.

Table 1 Comparison of the Effectiveness and Efficiency of the Existing and the Campus Disaster Risk Reduction Response Systems

Characteristic	System	Mean	t-value	p value	Decision on Ho	Interpretation
Timeliness	Proposed Existing	4.23 2.82	20.873	<0.001	Rejected	Significant
Reliability	Proposed Existing	4.18 3.70	5.566	<0.001	Rejected	Significant
Stakeholder Satisfaction	Proposed Existing	4.23 3.80	4.871	<0.001	Rejected	Significant

References

1. Spatioti, A. G., Kazanidis, I., & Pange, J. (2022). A Comparative Study of the ADDIE Instructional Design Model in Distance Education. *Information*, *13*(9), 402. https://doi.org/10.3390/info13090402

2. Prasetyo, T., Rachmadtullah, R., Samsudin, A., & Aliyyah, R. R. (2021). General Teachers' Experience of the Brain's Natural Learning Systems-Based Instructional Approach in Inclusive Classroom. *International Journal of Instruction*, *14*(3), 95-116.
3. Goh, Y. L., Lim, A. R., Tan, S. M., & Wong, J. T. (2023). Inclusive disaster communication for persons with disabilities in higher education. *International Journal of Disaster Risk Science*, 14(1), 77–91. https://doi.org/10.1007/s13753-023-00452-8
4. Behravan, M., Mohammadrezaei, E., Azab, M., & Gracanin, D. (2024). Multilingual standalone trustworthy voice-based social network for disaster situations. *arXiv*. https://arxiv.org/abs/2411.08889
5. CrisisSense-LLM: Instruction fine-tuned large language model for multi-label social media text classification in disaster informatics. (2024). *arXiv*. https://arxiv.org/abs/2406.15477
6. Khan, M. S., Rana, M. A., & Najam, U. (2020). Disaster management challenges in educational institutions: A case study. *International Journal of Disaster Risk Reduction*, 43, 101364. https://doi.org/10.1016/j.ijdrr.2019.101364
7. University College London. (2023). Enhancing institutional disaster preparedness: Coordination between campuses and local agencies. *UCL Disaster Management Review*, 8(2), 23–36. Retrieved from https://www.ucl.ac.uk/research/publications/ucl-disaster-management-review-2023
8. Varsha, A., Mehta, R., & Roy, S. (2024). Risk exposure and disaster mitigation in academic institutions: A cross-national review. *Global Education Review*, *11*(1), 22–36. https://doi.org/10.3102/ger.2024.01103
9. Wilkins, K. G., Santos, R. B., & Fernandez, J. C. (2021). *Resilient campuses and sustainable futures: Education's role in Ambisyon Natin 2040 and the SDGs*. *Philippine Journal of Development Policy*, *48*(1), 63–80. https://doi.org/10.5997/pjdp.2021.48105
10. Aydin, M. D., Yildirim, S., Sahin, A. R., & Ugurlu, S. Y. (2023). Development and pre-evaluation of a “DiagNurse” mobile app to support nurses in clinical diagnosis using the ADDIE model. *Healthcare*, 11(7), 1057. https://doi.org/10.3390/healthcare11071057
11. Saeidnia, H. R., et al. (2022). Development of a mobile app for self-care against COVID-19 using the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model: Methodological study. *JMIR Formative Research*, 6(9), e39718. https://formative.jmir.org/2022/9/e39718/