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Enhancing Disaster Awareness through Earthquake Detector Project Using Micro: Bit

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A R T I C L E I N F O

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A B S T R A C T

This community service project aimed to enhance disaster awareness among students through a hands-on earthquake detector project using Micro:bit technology. Conducted at Sekolah Menengah Kebangsaan Keramat Wangsa, Malaysia. The activity combined educational seminars on earthquake preparedness with interactive sessions on programming Micro:bit devices to detect vibrations. Students were guided through coding processes, sensor calibration, and device testing in small groups, promoting active learning and critical thinking The results showed increased student engagement, improved technical competencies, and the development of creative problem-solving skills. In conclusion, the program effectively demonstrated that integrating practical technology into community education can build awareness, develop essential skills, and empower youth to take proactive roles in disaster mitigation.

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INTRODUCTION

In the midst of the increasing need for the involvement of the younger generation in global issues, cross-country collaborative activities that combine education, technology, and social care are becoming increasingly important. One concrete form of this is the realization of cooperation between Krisnadwipayana University (UNKRIS) and Universiti Teknologi Malaysia (UTM) in the implementation of the International Community Service program at Sekolah Menengah Kebangsaan Keramat Wangsa, Malaysia. This program is designed as a place to exchange science, practical technology, and cultural values, as well as a space for students to be directly involved in community empowerment, especially in the field of education.

This program has a theme about the Internet of Things (IoT), and one of the projects carried out is about disaster mitigation by emphasizing the importance of education from school age on the dangers of earthquakes and preparedness in dealing with them. Through an interactive and applicative approach, the student team introduced the Earthquake Detector project using Micro:bit devices to the students. The device is designed to detect vibrations as a simple simulation of an earthquake early warning system, which is expected to provide a fun and meaningful learning experience for students. In addition to introducing simple technology, the project also aims to build awareness of the importance of awareness of natural disasters and strengthen students' ability to understand and respond to emergency situations quickly and appropriately. The issues raised in this project cannot be separated from the fact that globally, earthquakes are a type of natural disaster that has a large number of impact and often has serious consequences, ranging from damage to infrastructure, disruption of social and economic systems, and the loss of life, as can be seen in the 2011 earthquake and tsunami in Japan which resulted in economic losses of US$ 239 billion, the highest figure in a disaster event ever (UNDRR, 2020).

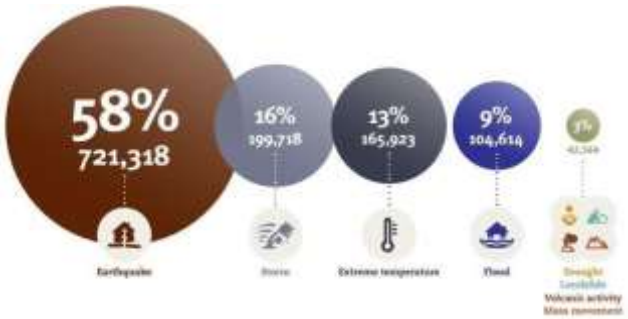

Figure 1. Total Deaths By Disaster Type

In the past two decades, earthquakes have been the deadliest disaster, accounting for 58% of total deaths by disaster type (Picture 1). However, there were some years when earthquakes caused less than 1,000 deaths worldwide, while in other years, earthquakes killed more than 100,000 people. As in 2014-2019, there were no earthquake events that killed more than 10,000 people. This can be seen from the 2015 earthquake in Nepal that caused a total of 8,969 deaths and the 2018 earthquake in Palu, Indonesia that caused 4,340 deaths, which reminded the world of the potential dangers of earthquakes (UNDRR, 2020).

In the meantime, in Indonesia, earthquakes are a very frequent natural phenomenon because the region is located at the confluence of three of the world's active tectonic plates. Based on data from the Meteorology, Climatology and Geophysics Agency (BMKG), every year on average there are more than 5,000 earthquakes with various levels of strength and impact. Unfortunately, the level of public awareness, especially among students and teenagers, of the importance of mitigation and the use of simple technology in detecting disasters is still relatively low. This is what makes the introduction of devices such as Micro:bit that can be used to make a simple Earthquake Detector very relevant. In addition to providing practical insights into science and technology, this tool also plays an important role in instilling awareness of the importance of disaster preparedness from an early age. Through the Micro:bit-based Earthquake Detector project, the program is designed to introduce simple technology to students as part of an effort to build disaster awareness and preparedness. This approach not only helps students understand basic concepts about earthquakes and how to detect them, but also encourages them to think critically and solve.

The Importance of Teaching Technology to Children Introducing technology at an early age is essential for equipping children with 21st-century skills such as critical thinking, problem-solving, and digital literacy. Kewalramani et al. (2020) highlight that integrating technology into early childhood education fosters collaboration, communication, and cognitive development. The study emphasizes that technology, when used appropriately, can enhance play-based and child-centered learning without replacing traditional pedagogical approaches. Similarly, Ogegbo (2020) explored teachers' attitudes towards technology in early learning environments and found that despite positive perceptions, many teachers face challenges such as inadequate training and limited resources, which hinder the effective use of educational technology.

Micro: bit is a compact, programmable microcontroller designed specifically for education. It enables students to learn coding and STEM concepts in an accessible and interactive way. Voštinár and Knežník (2020) concluded that integrating Micro: bit into programming lessons significantly increased students' motivation and their understanding of computer science fundamentals. Syamsudin et al. (2023) also found that using Micro:bit in informatics education improved students' creative thinking skills. The project-based learning model encouraged students to apply coding knowledge to real-world problems, enhancing their engagement and comprehension.

IMPLEMENTATION AND METHODS

This community engagement project was carried out as part of an international collaboration between Krisnadwipayana University (UNKRIS) and Universiti Teknologi Malaysia (UTM). The program took place at Sekolah Menengah Kebangsaan (SMK) Keramat Wangsa, Malaysia, in a period of one day.

Team Composition and Participants:

The project team consisted of three community service members from UNKRIS two from the Faculty of Economics and one from the Faculty of Engineering. The participants were Vocational Secondary school students aged 15–17, selected based on their interest in science and technology. The team included: Bulan Suci Rohuluna, also from the Management program, Faculty of Economics, Riza Luthfiansyah, a student from the Information Systems program, Faculty of Engineering, Chicita Mutiara Bangsawan, a student from the Management program, Faculty of Economics.

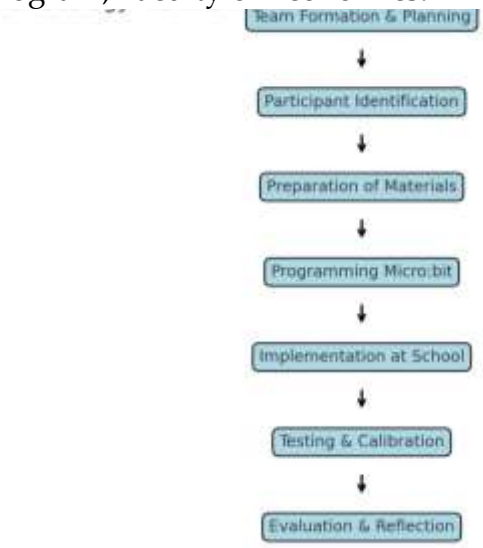

Figure 2. Workflow of the Project

Prior to field implementation, all necessary materials were prepared, including BBC Micro:bit kits, USB cables, battery packs, and laptops. These tools were pre-tested and configured to avoid technical setbacks during the field sessions. Once on site, the program commenced with an introductory seminar on disaster awareness, particularly focusing on earthquakes. This segment provided the students with foundational knowledge on seismic risks and the importance of early warning systems.

Subsequently, the facilitators introduced the students to the BBC Micro: bit platform using the web-based MakeCode interface. Students were guided step-by-step in programming the accelerometer to recognize vibrations and trigger visual or auditory alerts an experiential simulation of an earthquake detector. In small groups, they engaged in collaborative learning to upload code, troubleshoot errors, and physically test their devices. The calibration phase involved simulated tremors of varying intensities. Here, students adjusted sensitivity thresholds and interpreted data responses, enhancing both their technical understanding and critical thinking abilities. The process encouraged iterative learning as students repeatedly refined their prototypes to achieve optimal detection performance.

To conclude the program, a reflective session was held in which students shared insights gained from the experience. They discussed both technical challenges and personal growth, highlighting how the activity had changed their perspective on disaster readiness and the role of technology in everyday life. This final stage not only reinforced the objectives of the program but also fostered a sense of agency and responsibility among the participants.

Figure 3. The Project

RESULTS AND DISCUSSION

The implementation phase, conducted at Sekolah Menengah Kebangsaan Keramat Wangsa in Malaysia, yielded several key outcomes:

Enhanced Student Engagement

Students were actively involved in assembling and testing the Micro:bit earthquake detector. Initially skeptical of the device's capabilities, they became increasingly enthusiastic after observing the accelerometer's real-time responses.

Improved Technical Competence

Participants successfully modified sensor thresholds and experimented with various output functions (e.g., sound, LED patterns). Despite facing initial difficulties with programming logic and sensor calibration, students overcame these through collaborative learning and iterative troubleshooting.

Creative Problem-Solving

Some students proposed adding extra features such as buzzers and warning lights, showing an ability to extrapolate beyond the basic task and apply creative thinking in enhancing the tool's utility.

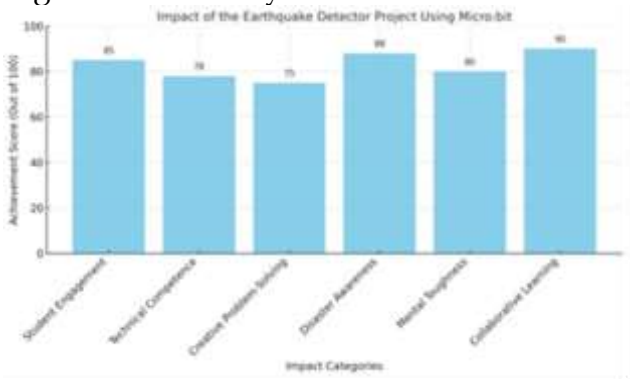

Figure 4. Impact Earthquake Detector Project Using Micro:bit

The project demonstrated that introducing simple yet effective technology such as the Micro:bit can significantly influence students' perceptions of disaster preparedness. The transition from passive learning to active experimentation fostered critical thinking, resilience, and teamwork.

Challenges faced such as unfamiliarity with coding syntax or understanding accelerometer outputs served as valuable entry points for deeper learning. The trial-and- error process allowed students to internalize scientific principles while developing essential 21st-century skills, including digital literacy, collaboration, and communication. This initiative also acted as a catalyst for broader intellectual curiosity. Several students expressed interest in continuing exploration in fields like sensors, electronics, and artificial intelligence, suggesting that the project succeeded not only in disaster education but also in sparking long-term academic motivation.

Beyond the classroom, the project contributed meaningfully to social and psychological development:

Disaster Awareness and Responsibility

Students recognized their role in promoting safety and readiness within their communities, viewing technology as a proactive tool for risk mitigation.

Mental Toughness and Persistence

Failures in early prototypes were met not with frustration, but with determination encouraging a growth mindset and resilience.

Collaborative Learning Culture:

Working in teams helped students realize the importance of collective effort. Many acknowledged that success was more dependent on teamwork than individual ability.

In conclusion, this project demonstrated that low-cost, easily replicable innovations, when tied to meaningful real-world contexts, can have lasting educational and societal benefits. It underscores the potential of technology education not just as a means of skill acquisition, but as a platform for empowerment, empathy, and civic engagement.

The implementation of the earthquake detector project yielded highly positive educational and social outcomes. Students displayed increased enthusiasm toward STEM subjects and gained firsthand experience in building and calibrating a technological device. Importantly, the activity also raised their awareness of earthquake hazards, which is crucial in a region vulnerable to natural disasters.

These results align with findings from Syamsudin et al. (2023), who conducted a community education program using Micro:bit in vocational schools in Indonesia. Their study concluded that students who participated in project-based learning activities involving Micro:bit showed enhanced problem-solving skills and a deeper interest in pursuing STEM fields.

Moreover, compared to other community service initiatives focusing solely on disaster lectures or simulations, this project combined education with experiential learning. As also supported by Kalogiannakis, M., Tzagkaraki, E., & Papadakis, St. (2021). in a systematic review, Micro:bit serves not just as an educational gadget but as a bridge to real-world problem-solving—making it an ideal tool for outreach activities aimed at young learners.

The students' resilience in troubleshooting and their team collaboration mirrored outcomes from similar educational interventions where interactive tools were used to engage learners. Furthermore, post-activity reflections revealed a shift in students' perception: from viewing disasters as uncontrollable to seeing them as manageable risks that could be mitigated through preparedness and innovation.

CONCLUSIONS AND RECOMMENDATIONS

The implementation of the earthquake detector project using Micro:bit devices has proven to be an effective medium for enhancing disaster awareness and technological literacy among students. Through an experiential learning approach, participants not only acquired fundamental knowledge about earthquake preparedness but also developed essential skills in coding, problem-solving, and teamwork. The project facilitated active student engagement, fostered critical thinking, and cultivated a sense of responsibility towards disaster risk reduction. Moreover, the integration of simple, low-cost technology in a real-world context encouraged creativity and inspired continued interest in science and technology. This community service initiative underscores the potential of educational technology as a transformative tool for community empowerment, particularly in cultivating preparedness and resilience in disaster-prone regions. Ultimately, the project demonstrates that practical, student-centered interventions can generate lasting educational and social impacts, contributing meaningfully to both individual growth and collective awareness.

Figure 5. Project Light Detection

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