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Development of the SiAlong Platform to Improve Digital Literacy on Landslide Disasters among Generation Z in Semarang City

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ABSTRACT

This study is a development research which proposes to create a digital platform to enhance digital literacy concerning landslide disasters for Generation Z. The findings indicate that in Semarang City, Generation Z frequently accesses information from the internet and finds it extremely helpful. However, their knowledge and literacy regarding preparedness for landslide disasters remain low, which highlights their need for a digital literacy platform on this topic. Based on this requirement, the researchers developed the SiAlong platform, short for "Landslide Preparedness Information System". This platform is a website accessible by users on various devices, including Android and iOS smartphones, as well as computers, laptops, PCs, and tablets. To date, the availability of digital platforms for information and education on landslide disasters is very limited. Digital technology is predominantly used for developing sensing systems, detection, prediction, or monitoring of landslide disasters. The SiAlong platform offers a range of features designed to improve disaster digital literacy, including: (1) Landslide Concepts, (2) Landslide Risk Reduction, (3) Safety Tips, (4) Do's and Don'ts, (5) Emergency Contact, (6) Survival Kit Checklist, (7) Video Content. Additionally, SiAlong includes a WEBGIS-based Landslide Disaster Risk Map feature that allows users to recognize and assess the level of danger and risk of landslides in their living areas. Thus, SiAlong presents integrated content on landslide disaster literacy, enhanced with a WEBGIS feature. The development of the SiAlong platform is expected to realize effective digital-based disaster education, thereby increasing the knowledge, awareness, literacy, and skills related to disasters among Generation Z. The widespread use of the SiAlong platform will enhance its utility. Besides dissemination, improving the quality and interactive features of the SiAlong platform is also essential. The SiAlong platform must not remain static but should continuously evolve its features to enhance effectiveness and utility.

1. INTRODUCTION

Disasters significantly threaten humanity, affecting countries and regions globally, regardless of their development status [1, 2]. Indonesia, with its abundant natural resources, is particularly vulnerable to major disasters that can endanger its population [3, 4]. This vulnerability is a consequence of Indonesia's geographical location at the convergence of three tectonic plates: the Eurasian, Pacific, and Indo-Australian plates. The country's entire territory is susceptible to active seismic zones, situated within the Pacific Ring of Fire and characterized by diverse morphologies [5-9].

One of the regions in Indonesia facing a high threat of disasters is Semarang City, which is frequently affected by floods, landslides, droughts, and erosion [10]. In the period from January to mid-November 2022, there were 110 landslide disasters reported in Semarang City, affecting areas such as Banyumanik, Tembalang, West Semarang, Ngaliyan, Gajah Mungkur, Candisari, and Gunungpati [11]. These locations are identified as high-risk zones for landslides, falling within the red zone of landslide-prone areas according to Semarang City BPBD [12]. The occurrence of several landslides in Semarang City is attributed to fault movements, causing the surrounding rocks to become fragile and resulting in landslides [11].

Landslides are considered the most catastrophic geo-hazard, causing numerous casualties and significant economic losses due to geological conditions, geomorphology, and climatic factors [13]. The occurrence of landslides is characterized by the movement of soil masses from higher to lower areas, particularly during periods of high rainfall intensity, rendering the soil movement unstable [14]. Landslide hazards have a profound impact on human survival and consistently threaten human safety [15]. Landslides, whether triggered by natural phenomena or human activities, result in geomorphological changes and cause physical, socioeconomic, and environmental losses, significantly affecting human life [16].

The frequent occurrences of landslides in Semarang City emphasize the pressing need to enhance the capacity and resilience of communities to reduce the risks associated with disasters, with disaster education emerging as a key strategy [17-20]. Disaster education programs hold the potential to elevate the knowledge, attitudes, and skills of local communities, contributing to improved disaster preparedness and response [21]. From the Yokohama Strategy and Plan of Action for a Safer World [22], the Hyogo Framework for Action [23], to the Sendai Framework for Disaster Risk Reduction [24], all prioritize risk reduction and disaster awareness, recognizing education as the most crucial element in enhancing public knowledge and fostering behavioural changes.

Disaster education plays a crucial role in enhancing disaster literacy within communities [25, 26]. Disaster literacy encompasses an individual's ability to read, comprehend, and utilize information to make decisions in the context of disaster mitigation, preparedness, response, and recovery [27]. It also involves communities' proficiency in interpreting natural signs, changes, and damage, translating into effective disaster mitigation efforts [28-30]. By equipping communities with the necessary skills, disaster literacy serves as a foundational element for effective preparedness, enabling communities to confront disasters. Currently, disaster literacy stands as the optimal starting point for engaging communities [31].

Insufficient levels of disaster literacy can render individuals unprepared to confront disasters [32], particularly considering that disasters often originate from various media publications [33]. Media reports, driven by technological advancements such as the internet and social media, serve as conduits for information dissemination to the public [34]. Disaster developments are one category of information conveyed in mass media reports. However, the swift progress in technology and information often results in misinformation, distorting the comprehension of disasters [35]. Advancements in technology and information across various domains bring about the emergence of irresponsible and negative information, sparking panic within communities [36]. Additionally, many communities still harbour traditional and pessimistic stigmas regarding disasters [37, 38].

In this digital era, digital literacy plays a pivotal role in fostering communication and interaction in everyday life [39]. Through disaster literacy, people can become aware that they reside in disaster-prone areas [40], thereby enhancing disaster literacy within the community [41]. Digital literacy is a scientific skill related to the ability to operate digital media, tools, and telecommunication networks to discover, evaluate, use, leverage, evaluate, and communicate information effectively from media in daily life [42, 43]. The ability of individuals to read, understand, and use information to make decisions based on information and to follow instructions in the context of mitigation, preparation, response, and recovery from disasters is reflected in digital disaster literacy [44]. Therefore, there is a need for facilities and the provision of disaster education for the community through disaster digital literacy [45].

These facilities can be specifically targeted towards Generation Z, the younger generation with a fundamental role and great potential in realizing disaster-resilient generations [46-48]. Although the majority of Generation Z already possesses good digital literacy [49], they still require technological stimuli [50] to enhance their responsiveness in facing disasters. This becomes more urgent because Generation Z's ability to obtain information from online sources is impressive. Nevertheless, they may need help to critique the validity of information, and they easily become frustrated if the answers they seek are not immediately clear [51, 52].

One of the facilities that can be provided to enhance digital disaster literacy for Generation Z is digital-based disaster learning media, either in the form of Android applications or websites. For Generation Z, technology and the internet are necessities, not innovations, as perceived by other generations [53]. Furthermore, the presence of digital technology in enhancing digital disaster literacy will also foster innovation in narratives [54], be more practical [55], more contextual, and effective in raising awareness and disaster preparedness [56-58]. Based on these considerations, this research aims to develop a digital platform to enhance digital literacy about landslide disasters among the Generation Z group.

2. RELATED WORKS

Literature on the use of digital technology in landslide disaster reduction primarily focuses on four main functions: (1) sensing, (2) communication, (3) processing, and (4) actuating. Sensing involves the identification and collection of various landslide-related information using sensors. Communication pertains to the efforts to relay landslide disaster information to the public. Processing relates to the engineering processes involved in reducing landslide disaster risks. Meanwhile, actuating involves robotics, virtual reality, 3D visualization, and 3D printing, providing technologies to reconstruct past conditions and simulate future developments [59].

A literature review by Bao et al. [60] indicates that among the four types of technology and their functions in reducing landslide disaster risks, the most publications were related to processing (55.23%). The second most frequent publications were on the use of digital technology for sensing efforts (35.91%). In contrast, publications on the use of digital technology for communication accounted for only 4.77%, indicating a significant lack. Similarly, publications on the use of digital technology for actuating were minimal at 3.94%.

Several studies highlight that researchers often discuss the use of digital technology for sensing functions. Among these studies, the first by Zhang et al. [61], which developed personalized virtual landslide disaster environments based on knowledge graphs and deep neural networks, focused more on providing information about disaster simulations, emergency response, and disaster analysis and assessment developed a web-based interactive 3D emergency response and visualization system using Cesium Digital Earth [62]. This technology focuses on providing emergency response information equipped with spatial visualizations in 3D and includes features such as mapping landslide-prone areas, monitoring landslides, managing contingency plans, and communication [62].

Further studies have explored mapping landslide susceptibility using Artificial Neural Networks [63] and spatial multi-criteria evaluation [64]. Another study by Puttinaovarat et al. [65] developed a real-time GIS digital platform for analyzing landslide disaster risks. Iadanza et al. [66] developed IdroGEO, a collaborative web mapping application based on REST API services and open data. Additionally, Meena et al. [67] designed a conceptual

framework for developing a web-based Nepalese landslide information system (NELIS). In their study, Meena et al. [67] only developed a conceptual framework for a landslide disaster information system, allowing platform users to share landslide locations for further collaboration. This system would use a web-based geographic information system (GIS) to support organizations responsible for managing and accommodating the varying needs of those dealing with landslide disasters, thus improving the current management conditions of landslides in Nepal.

Previous studies have largely focused on utilizing digital technology for the processes of sensing, assessment, and monitoring of landslide disasters. Many of these studies leverage GIS technology or other mapping platforms. Various previous research efforts have concentrated on the use of GIS and remote sensing technologies combined with other innovative technologies for assessing and predicting landslide disasters [68-73] and designing early warning systems for landslide disasters [74-76].

Artificial intelligence has also been widely used in sensing and assessment processes, as demonstrated in studies by Karantanellis et al. [77], Selamat et al. [78], and Sun et al. [79], and Wahba et al. [72]. Additional research by Pennington et al. [80] and Ofli et al. [81] has developed tools for reporting landslide incidents globally and in near real-time using social media and artificial intelligence. Tao et al. [82] also developed a landslide disaster monitoring system application that can capture the in-depth sliding force state of the slope in real time. This application focuses more on early warning functions. When ground movement on a slope reaches the early warning threshold, the system immediately sends a warning message to the user terminal, alerting users to initiate an appropriate risk avoidance plan.

While most studies presented focus on sensing, assessment, and monitoring functions related to landslide disasters, studies developing a digital literacy platform for landslide disaster containing materials, explanations, and educational content are still limited. Our previous studies only utilized Google Earth Pro for landslide disaster adaptation learning [83] or a pocket book to enhance students' knowledge in facing landslide disasters [4]. Therefore, the platform we are developing will be highly beneficial in enhancing the digital literacy of Generation Z regarding landslide disasters.

3. METHODS

3.1 Research design

This study is development research aimed at creating a digital platform to improve digital literacy about landslide disasters among the Generation Z group. The research follows the development research stages outlined by Borg and Gall [84], consisting of 10 main stages. However, for this study, only the first three stages are adopted: (1) research and information collection, (2) planning, and (3) developing the preliminary form of the product.

3.2 Research location

This research is conducted in the city of Semarang, particularly in areas affected by landslide disasters, as an initiation project. Semarang City was chosen due to its high incidence of landslides, attributed to the geological and geomorphological conditions of the southern part of the city, which is hilly. Districts at risk of landslide disasters include Tembalang, Gajahmungkur, Candisari, Ngaliyan, Gunungpati, Banyumanik, and Mijen.

3.3 Participants

The population in this study comprises communities in the seven districts of the research location. Samples were selected using purposive sampling, based on the following criteria: 1) residing in the affected area for a minimum of 2 years, 2) willing to participate as respondents, and 3) born between 1997-2012. The study involved 78 respondents, predominantly high school students (SMA) in the Semarang City area. The majority of the respondents are under 18 years old, with 40 females and 38 males.

3.4 Data collection

3.4.1 Data sources

The data sources in this study include both primary and secondary data. Primary data are obtained directly from the field using interview and questionnaire techniques. Secondary data are collected through the documentation method. The interview technique is employed to gather data on the need for developing a digital platform for landslide disaster literacy. Semi-structured interviews are conducted to collect detailed data on disaster response capabilities among Generation Z and their information needs related to disasters. The interviews adhere to a predetermined list of questions.

The questionnaire technique was employed to collect data on the needs for developing the application, similar to the interview technique. This allowed for data collection on a large scale involving a significant number of respondents. The questionnaire technique utilized a needs analysis questionnaire. Secondary data were collected using the documentation technique, involving the retrieval of data from written documents, government policies, or regulations at both central and local levels. Literature data from previous journal articles also contributed to the secondary data. Additionally, online data searching via the internet or other network media offering online facilities was conducted to gather additional secondary data.

3.4.2 Data analysis

The data analysis techniques employed in this study encompass both quantitative and qualitative analysis methods. For quantitative analysis, the study utilized quantitative descriptive analysis, specifically applied to analyze the questionnaire on application development needs. This analysis technique was utilized to calculate the percentage of responses for each item in the collected questionnaire. The data analyzed using quantitative descriptive analysis consists of nominal data derived from a questionnaire with binary options ("Yes" or "No" and "Have taken the training" or "Have not yet taken the training"). This data was analyzed to determine the percentage obtained from each respondent's choice. Through this analysis, a description of the respondents' conditions and their needs for a digital literacy platform on landslide disasters could be obtained. The quantitative descriptive analysis was conducted using the SPSS computer program.

The analysis of this data was conducted using the SPSS computer program. On the other hand, qualitative data analysis focused on examining the needs for application development

based on interview results with respondents. The qualitative analysis followed the interactive analysis technique outlined by Miles and Huberman [85]. Throughout the interactive analysis process, researchers focused on three main components: data reduction, data display, and conclusion drawing or verification. Data obtained from interviews would be summarized and then undergo data reduction. Data reduction involved summarizing, selecting, and focusing on aspects relevant to the research objectives. This process also included selecting, categorizing, and abstracting from the interviews. Subsequently, data presentation incorporated displaying the reduced data in the form of interview notes, which were then coded to organize the data, allowing the researcher to analyze it easily. The final step, namely conclusion drawing or verification, was the process of making conclusions based on the analyzed data in accordance with the research problem statement. Activities in qualitative data analysis were conducted interactively and continuously until completion, ensuring data saturation.

4. RESULTS

4.1 Development needs analysis

The data analysis reveals that 73.1% of respondents who completed the questionnaire acknowledged having received disaster education, while 26.9% stated that they had not received such education. The analysis further indicates that the primary sources of disaster education for the majority of respondents are television, online news, and social media. These findings underscore the widespread use of digital technology among respondents, not limited to television but extending to devices commonly used for accessing online news and social media. The information obtained from various sources has positively impacted the respondents, fostering increased awareness of disasters and enabling them to draw valuable lessons. This information has made respondents more vigilant and prepared for disasters, prompting preventive efforts.

Moreover, the acquired information has contributed to the development of empathy and sympathy among respondents. Despite the majority having received disaster education, a small proportion of respondents reported participating in disaster simulations. Among the respondents who filled out the questionnaire, 82.1% admitted to never having taken part in disaster simulations, with only 17.9% having participated. Additionally, the few respondents who engaged in disaster simulations noted their involvement in activities related to earthquakes, volcanic eruptions, fires, and floods. The results of the analysis of respondents' participation in disaster education are shown in Figure 1.

The data analysis indicates that 57.7% of respondents who completed the questionnaire claimed to have an understanding of disaster emergency response, while 42.3% acknowledged needing to grasp disaster emergency response concepts. Moreover, the level of understanding regarding post-disaster rehabilitation is relatively low, with only 34.6% of respondents indicating comprehension, while 65.4% expressed a lack of understanding in this area.

The analysis of respondents' answers, particularly those who claimed to understand disaster emergency response and post-disaster rehabilitation, reveals responses that lack specificity and accuracy. There is a notable lack of understanding about the distinctions between rehabilitation and reconstruction efforts. Moreover, respondents need to grasp the necessary actions to take when disasters occur accurately. These findings suggest that respondents still need an adequate understanding of disasters and highlight the ongoing need for continuous disaster education. The analysis results of respondents' understanding of disaster emergency response are displayed in Figure 2.

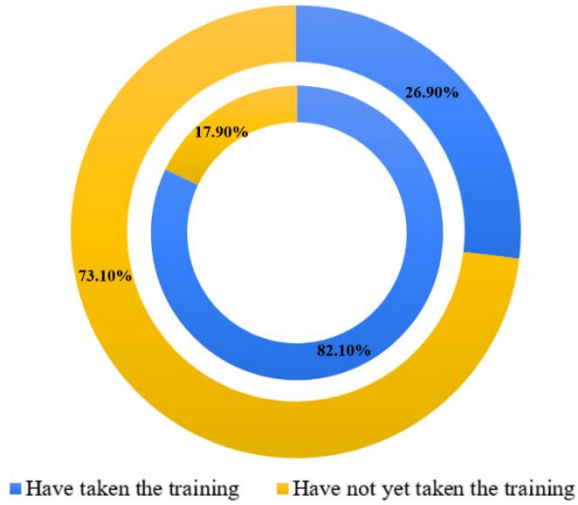

Figure 1. Diagram of respondents' participation in disaster education and disaster simulations

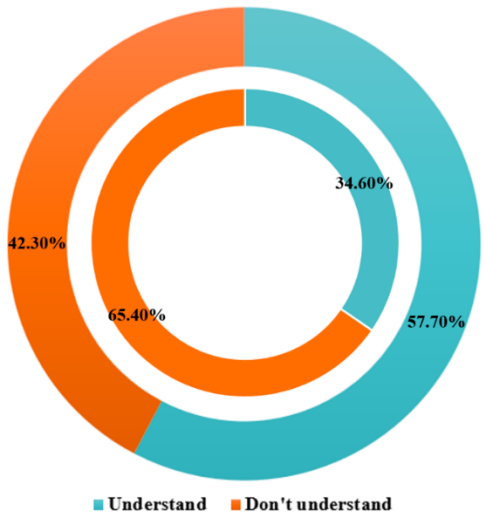

Figure 2. Diagram of respondents' understanding regarding disaster emergency response and rehabilitation

The data analysis also reveals that not all respondents comprehend the efforts to adapt to disasters. While 70.5% of respondents claim to understand disaster adaptation measures, the remaining 29.5% still need more understanding in this regard. Further analysis of respondents' answers indicates that the majority are aware that measures like terracing, tree planting, and avoiding sloping areas are necessary to prevent landslides. However, their responses remain general and need to reflect more specific details about landslide disaster prevention efforts.

Respondents also need a comprehensive understanding of disaster preparedness. Only 32.1% of respondents claim to comprehend disaster preparedness, while the majority, constituting 67.9%, acknowledge needing to understand disaster preparedness. Similar to the previous variable, the

analysis of respondents' answers regarding their understanding of landslide disaster preparedness indicates imprecise and nonspecific responses. This underscores the pressing need for disaster education for Generation Z. The results of the analysis of respondents' understanding of disaster adaptation and disaster preparedness are presented in Figure 3.

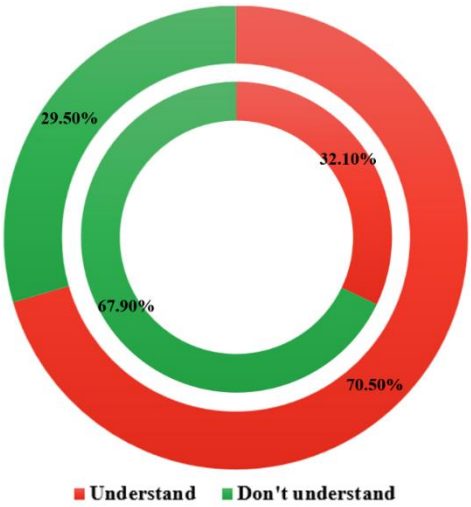

Figure 3. Diagram of respondents' understanding of disaster adaptation and disaster preparedness

Disaster education for Generation Z will be effective if conducted through a digital technology approach. A landslide disaster information platform is highly needed, given the still low knowledge and disaster preparedness among Generation Z. The results of data analysis also indicate that the majority of Generation Z consider digital-based disaster information platforms that can enhance disaster literacy as very important. Out of all respondents who filled out the questionnaire, 56.4% of respondents believe that developing digital-based disaster information applications or platforms is important. Additionally, 43.6% of respondents answered that developing such applications or platforms is not only important but also very important.

According to the respondents, the development of digital-based disaster information platforms is crucial because these platforms will greatly benefit the improvement of knowledge and disaster preparedness within the community. People will find it easier to access information and learn about prevention and strategies for dealing with disasters. The development of digital-based platforms is also very promising because, nowadays, everyone owns a gadget, making it more practical and effective for disaster information to be accessed through gadgets. People can access it anytime and anywhere with ease.

The urgency of developing digital-based disaster information platforms is increasing, considering that the availability of information and materials regarding disasters in schools and communities still needs to be improved. Out of all respondents who filled out the questionnaire, 56.4% stated that disaster materials in schools are adequate. However, the remaining 43.6% stated that disaster materials in schools are still inadequate. Meanwhile, regarding the availability of disaster materials in the community, 56.4% of respondents stated that the availability of materials in the community still needs to be improved. On the other hand, 43.6% stated that the availability of disaster materials in the community is adequate. These results indicate the increasing importance of developing digital-based disaster information platforms to enhance disaster digital literacy.

The needs analysis conducted by the researchers also involved gathering aspirations and opinions through interviews with several respondents as informants. The interview results revealed that Generation Z prefers applications that are not overly text-heavy but rather emphasize attractive visual displays to make the information clearer. This preference is understandable given that Generation Z is accustomed to visual presentations, which they find easier to comprehend and less monotonous.

"One thing I believe is crucial is that the developed platform should not have too much text. Ideally, the platform should be filled with many illustrative images to make it easy to understand. Information that consists only of text without images tends to bore us quickly, making it uncomfortable for learning." (P1)

"A good platform, in my opinion, should have an appealing visual display. It should be equipped with images or videos to make it easier for the younger generation to digest. If it's just full of text and complicated, we tend to be lazy about reading the information. So, there should be more pictures and illustrations to make it more attractive, more readable, and not boring." (P2)

The presentation of images should also be packaged with good quality to be readable by users. The use of video illustrations is also highly desired to make the information clearer and reduce verbosity. Informants stated that often, educational information about disasters is displayed through images, but the quality of these images is poor. The illustrations provided are also not always easy to understand by readers. Thus, clearer and more practical images or videos are needed.

"Don't use poor-quality images or graphics in the app or website. Often, the images displayed are of low resolution. Sometimes, the images are also hard to understand or fail to fully convey the message, so readers have to guess." (P3)

"It would be better if there were videos too. So, the illustrations and simulations can be watched more clearly. With just images, it's sometimes still hard to understand. But with videos, there's usually a clearer explanation because the process is shown in sequence." (P4)

The use of language is also a very important element to consider in developing a digital literacy platform for disasters. As we know, each group or cohort with different characteristics and backgrounds, including age, will have different language abilities and habits. Therefore, the language used in the digital literacy platform for disasters should also be tailored to the characteristics of Generation Z.

Based on interviews with informants, Generation Z prefers the use of straightforward and simple language, without beating around the bush, and focuses on the core information to be conveyed. Another informant also expressed a preference for less formal language to make it easier for users to understand and remember. Casual language is considered to be more relatable for users, thereby being more engaging and persuasive. Casual language is also considered better by informants because it can be accepted by all age groups.

"I usually prefer casual language that isn't too stiff or theoretical. The main thing is to be to the point, concise, but informative. Often, too lengthy explanations just confuse us and don't get to the core of the information. Therefore, the language used in the app should be casual and not too theoretical." (P5)

"I think using contemporary language is actually good. It helps to attract the readers' interest. It makes it more interactive with readers, and readers will find it easier to understand the information. Light language will be more easily remembered by young people like us. If the language is too serious, we tend to forget it quickly." (P6)

"Just use casual language, not too theoretical, something that's easier to put into practice. Terms that are modern or typical of young people's daily lives will be easier to digest. Because if the language is too serious, it's uninteresting to read and less interactive with readers." (P7)

4.2 Development of digital disaster literacy platform for Gen Z

Based on the preliminary survey conducted, the researchers then proceeded to develop a digital disaster literacy platform that meets the needs of Generation Z. The development of the digital literacy platform design was also based on a review of literature from various previous studies. The researchers developed a digital disaster literacy platform called "SiAlong," which stands for "Landslide Preparedness Information System."

After determining the name of the digital platform, the researchers then developed the features within the application. The features mainly focus on landslide disaster education rather than disaster event warnings, as it is not an early warning system application. However, in the future, the platform can be equipped with early warning system features. The content within the application will be presented in the form of text, images, videos, and maps.

The SiAlong platform is accessible to all users through Android and iOS smartphones, as well as computers, laptops, PCs, and tablets. The website format offers flexibility for users to access it via various devices, and it eliminates the need for users to download and install the SiAlong platform. The features provided on the SiAlong platform include: (1) Landslide Concepts, (2) Disaster Risk Reduction, (3) Safety Tips, (4) Do's and Don'ts, (5) Emergency Contacts, (6) Survival Kit Checklist, (7) Video Content, and (8) Landslide Disaster Risk Map. The interface display of the SiAlong platform on a computer and smartphone can be seen in Figures 4 and 5.

Figure 4. Interface display of SiAlong platform on computer

The first feature is the Landslide Disaster Concept, which includes educational material about landslides. This section covers the concept of landslides, locations prone to landslides, signs or symptoms of landslides, and factors triggering landslides. The content in this menu is presented in text accompanied by illustrations. The text material is crafted in a clear manner to facilitate understanding for platform users. The second feature, namely Reducing Landslide Disaster Risk, encompasses material on how to reduce landslide disaster risk, covering pre-disaster, disaster response, and post-disaster stages. This feature also includes text presented in clear language and illustrations for clarification. The display of the Landslide Concept Feature and the Landslide Disaster Risk Reduction Feature is shown in Figure 6.

Figure 5. Interface display of SiAlong platform on smartphone

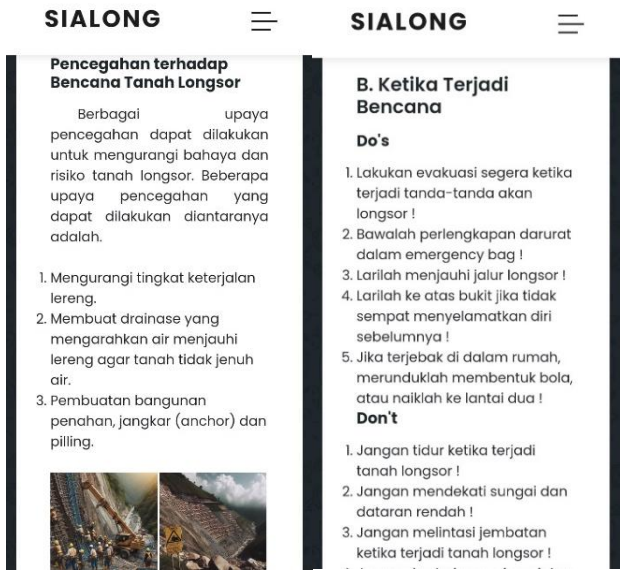

Figure 6. Display of the landslide concept feature and the landslide disaster risk reduction feature

The Safety Tips feature contains various tips that Generation Z can implement to ensure safety during a landslide disaster. These tips offer practical advice for protecting oneself from landslides, covering preparations for landslide hazards, survival during a landslide, and ensuring safety after a landslide. The next feature is the Do's and Don'ts Feature, providing guidelines on recommended actions and actions to avoid in order to reduce the risk of landslides. Similar to other features, this section includes do's and don'ts for the pre-disaster phase, emergency response phase, and recovery phase. The display of the Safety Tips feature and the Do's and Don'ts feature can be seen in Figure 7.

The fifth feature on the SiAlong platform is the emergency contact feature, which includes various contacts of

stakeholders that can be reached in the event of a landslide. This feature provides contacts from the Provincial and City Disaster Management Agency, Natural Disaster Posts, Police, Fire Department, Ambulance, National Search and Rescue Agency (BASARNAS), and several other emergency contacts.

Figure 7. Display of safety tips feature and do's and don'ts feature

Furthermore, the sixth feature is the survival kits checklist feature, which contains various items that Generation Z must prepare before a landslide occurs, enabling them to be prepared when a disaster strikes. The survival kits checklist feature helps Generation Z to prepare and manage various necessities required for survival and self-preservation during landslides. Some essential items displayed include emergency response supplies, first aid kit, water and food, blankets and clothing, among others. In the next stage, this feature can be further developed to be more practical, allowing Generation Z to create a checklist of fulfilled and unfulfilled needs. The appearance of the emergency contact feature and the survival kits checklist feature can be seen in Figure 8.

The next feature provided on the SiAlong platform is the content feature, which contains various supplementary materials that Generation Z can learn to enhance their knowledge, awareness, and digital literacy of landslide disasters. The supplementary materials provided include text and video connected to the YouTube platform. This feature can be continuously developed by adding supplementary materials for Generation Z so that their knowledge and digital literacy of landslide disasters can continue to improve and stay updated.

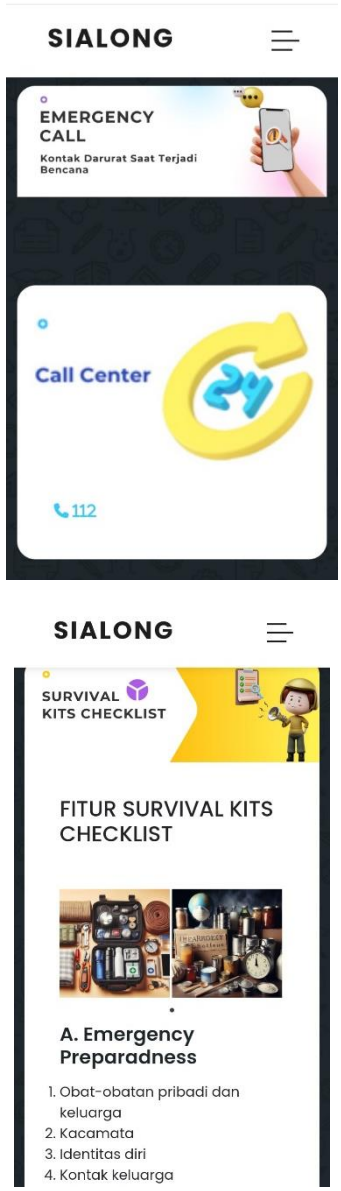

Figure 8. Display of emergency contact feature and survival kit checklist feature

The last feature provided on the SiAlong platform is the hazard map feature of landslides in Semarang City. This map is developed in the form of a WEBGIS that allows users to use the map flexibly, as it can be zoomed in and out to view landslide hazards in various areas of Semarang City specifically. In the displayed map, landslide hazard levels are classified into three categories: low hazard level, moderate hazard level, and high hazard level. This map enables Generation Z to determine the level of landslide hazard in their residential areas and various other places in Semarang City that they commonly visit. Thus, Generation Z can implement landslide disaster reduction actions in their residential areas according to the landslide disaster digital literacy they have learned through the SiAlong platform. The display of the content feature and the WEBGIS hazard map feature can be seen in Figure 9.

The SiAlong platform, which has been developed, is expected to fulfil the needs of digital disaster literacy regarding landslides for Generation Z. The features provided on the SiAlong platform can serve as crucial assets for

Generation Z to be responsive and resilient in facing landslide disasters. The development of the SiAlong platform has also been tailored to the characteristics of Generation Z, who prefer the use of simple and straightforward language, clear and engaging visual media, and videos that clarify the presented information further.

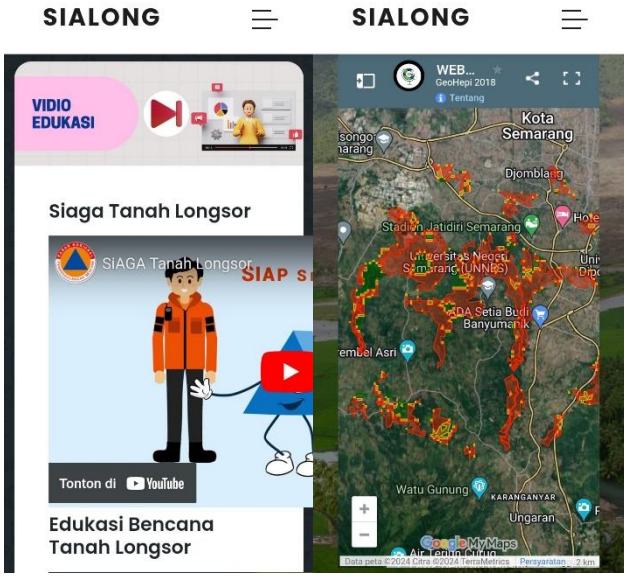

Figure 9. Display of the content feature and the WEBGIS hazard map feature of landslide disaster hazard

Generation Z can utilize the SiAlong platform across various educational levels and pathways. In both formal and non-formal education pathways, SiAlong can serve as a beneficial digital literacy medium for Generation Z from junior high school to university levels. Educators in formal and informal educational institutions can benefit from the SiAlong platform, as they will be able to find suitable digital learning media easily. Within the family and community settings, the SiAlong platform can also be beneficial for Generation Z, as they can use it independently or with the assistance of their families and support from the surrounding community.

5. CONCLUSION

The development of the SiAlong platform represents a strategic step in meeting the information and digital disaster literacy needs regarding landslides for Generation Z in Semarang City. This is crucial as Generation Z has indicated their heavy reliance on the internet for information and considers it highly beneficial. However, the knowledge and literacy of landslide disaster preparedness among Generation Z in Semarang City still need to improve. They emphasize the significance of a digital platform for landslide disaster literacy, stating that it is crucial and would greatly benefit them.

Hence, the development of the SiAlong platform is a commendable initiative to harness the potential of Generation Z and tackle the challenges they encounter. Creating platforms tailored for Generation Z is essential to facilitate effective disaster education, promoting preparedness, and enhancing resilience among them. Drzewiecki et al. [86] emphasized that education has been a pivotal strategy in mitigating disaster risks globally. Disaster mitigation education plays a critical role in shaping an informed and vigilant society about effective disaster mitigation processes [87].

Rouhban [88] asserts that the degree of disaster preparedness and education in communities exposed to disasters directly influences the level of danger and the outcomes of such disasters. Therefore, disaster education holds significant importance as it equips individuals with the knowledge and skills necessary to confront disasters [29]. Moreover, disaster education is regarded as a practical, operational, and cost-effective measure of disaster risk management [89]. It is not surprising, then, that there exists international consensus on the effectiveness of disaster education programs for children in enhancing disaster preparedness and resilience within both children and families [90].

As a digital disaster information system, the SiAlong platform stands as an apt source of information for Generation Z, facilitating the enhancement of digital disaster literacy related to landslides. The dissemination of information, knowledge, awareness, disaster literacy, and education is deemed crucial [91, 92]. Education provides individuals and communities with access to knowledge and information concerning threats and strategies to address these disaster risks. Comprehensive information is pivotal in effectively confronting disasters [93]. Prananingrum et al. [94] also assert that effective communication and information management are critical in disaster management, emphasizing the need for efficiency and efficacy in the information required for disaster management.

The development of digital literacy platforms to prepare students for disasters and make them disaster-ready is crucial [69]. Disseminating information about hazards, risks, and necessary actions to the general public is a vital aspect of disaster education. Disaster knowledge significantly influences the process and outcomes of disaster management, both directly and indirectly [95]. The transfer of disaster knowledge stands as the most effective preventive measure to enhance community preparedness in confronting disasters [96]. This perspective is also underscored in the Sendai Framework for Disaster Risk Reduction, particularly Priority 1, which addresses knowledge issues and includes 23 requirements directly or indirectly related to information and knowledge [97].

Disaster information is a key resource that must be managed effectively to enable easy access by those who need it, ensuring it is available at the right time and in the right format. It is crucial to verify that the provided information is accurate to support the development of appropriate disaster risk management strategies [98]. IFRC [99] underscores that information is one of the primary forms of assistance to communities. Communities require information as they do water, food, medicines, and shelter. Information has the potential to save lives, livelihoods, and resources. Indeed, information stands as the only form of disaster preparedness accessible to vulnerable groups, yet it is often overlooked.

Digital disaster literacy is crucial as one of the efforts to reduce disaster risk in society involves increasing disaster literacy capacity among the people [41, 100-102]. Disaster literacy is the key that must be possessed by the community to fully understand the geographical location of their area, especially in a disaster-prone area [103], and be capable of reducing the impact of existing disaster threats [104]. Given this urgency, the opportunity to enhance disaster literacy is now wide open in the digital era due to the rapid advancement of digital technology [105]. In line with this, Triyanto et al.

[105] emphasize that the use of information technology can also serve as a means to provide disaster literacy learning experiences to participants, equipping them with skills to face disasters. The utilization of information technology can be integrated with the need for information literacy, including disasters. Therefore, the presence of the SiAlong platform is highly urgent for Generation Z.

The SiAlong platform was developed because Generation Z greatly needs digital technology to enhance disaster literacy. Generation Z is considered the first digital native [106, 107] because they were born and raised in a technological and digitalized environment [108]. Due to the rapid development of technology, digital literacy is no longer just recommended but has become an essential element that must be possessed and mastered by Generation Z [109]. New technology is a natural environment for Generation Z [110]. Therefore, the provision of disaster literacy facilities also needs to be packaged digitally, aligning with the characteristics of Generation Z.

The SiAlong platform developed by researchers has been adapted to the characteristics and needs of Generation Z. The language used has been adjusted to the characteristics of Generation Z, and the information displayed is also supplemented with images and videos. According to Berkup [111], Patch [112], and Tejedor et al. [113], the brains of Generation Z have different characteristics from various previous generations. The brains of Generation Z are surrounded by complex visual imagery, and the part of their brain responsible for visual abilities is more developed, making them more reactive to "visual learning" but with a shorter attention span. They are capable of reacting quickly, consider themselves digital experts, have high expectations of technology, prefer self-directed learning, and feel comfortable in digital and visual environments, but may not necessarily be able to evaluate information on the internet and cross-check accurately [114, 115].

The SiAlong platform is also equipped with a map of landslide hazard levels in Semarang City developed using WEBGIS technology. GIS technology combined with the SiAlong platform has great potential to enhance digital disaster literacy and spatial literacy for Generation Z, making them more resilient to disasters. A study by Li et al. [116] stated that WEBGIS is one of the appropriate and effective technologies for implementing disaster education. GIS can be useful for creating and presenting spatial processes and analyses, which can then be beneficial for better decision-making [117]. GIS has also been widely used for analyzing and mapping hazards, risks, and vulnerabilities, thus facilitating and effectively enhancing understanding and risk management in various areas [118-120].

Thomas [121] also added that GIS can be very beneficial in disaster management for damage assessment processes, risk prediction and situational analysis, vulnerability and resilience assessments, and determining alternative mitigation priorities. In the SiAlong platform, the landslide hazard level map will be an important asset for Generation Z to understand the characteristics of disasters in their area. This is a tangible manifestation of the GIS function in disaster management, namely as situation awareness that forms the basis of emergency and disaster management [122, 123].

The development of the SiAlong platform is anticipated to serve as a valuable tool in improving digital disaster literacy for Generation Z. The SiAlong platform represents a strategic initiative in disaster risk reduction, fortifying disaster preparedness and resilience among Generation Z by advancing digital disaster literacy, aligning with the contemporary era's progress and the swift evolution of digital technology. While technology cannot prevent disasters, it proves highly beneficial in disaster preparedness, particularly in prediction, early warning, and post-disaster rescue processes [124].

Based on this research, the SiAlong platform must be widely usable across communities, especially among Generation Z. Expanding the use of the SiAlong platform will enhance its usefulness. Engaging various stakeholders, including educational institutions, communities, government bodies, NGOs, and academics, is crucial for the widespread adoption of the SiAlong platform. Their roles in promoting and supporting the platform will facilitate effective information and literacy transfer to Generation Z. Constructive feedback and criticism from users are also vital to enhance the innovation and utility of the SiAlong platform.

In addition to broadening the platform's usage, enhancing the quality and incorporating various interactive features into the SiAlong platform are crucial. The platform should not remain static but must continuously evolve to improve its effectiveness and utility. For instance, integrating an interactive forum, linking with other technologies such as early warning systems, and enabling data sharing among users can enhance the timeliness and informativeness of the information provided.

The next phase of research is anticipated to delve into the implementation of the SiAlong platform among Generation Z, evaluating its effectiveness, usability, and practicality. This analysis aims to gather new insights to enhance the platform further. Future research endeavours also focus on creating a more comprehensive and integrated platform to facilitate more effective disaster information and communication. Furthermore, extending the development of such platforms to areas beyond Semarang City is deemed highly necessary.

This research has yet to fully implement the Research and Development (R&D) method, as it has only reached the development stage. The SiAlong platform developed has yet to enter the implementation stage to assess its effectiveness, usability, and user acceptance. The researchers plan to conduct the implementation phase in the next stage to evaluate these aspects. Additionally, it is important to note that this study was exclusively conducted on Generation Z in Semarang City residing in landslide-prone areas. The survey and preliminary stages were conducted only among high school students aged 16-18 years, and do not represent the entire Generation Z age group. Moreover, the number of respondents used was also below 100 people. Therefore, in the next trial phase, it would be beneficial to involve a larger and more diverse group of subjects or participants to obtain more credible results and receive feedback that represents various segments of Generation Z.

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