Harnessing Digital Literacy for Disaster Risk Reduction: An Indonesian Review

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Abstract. Digital media now sit inside the ordinary routines through which Indonesians learn about hazards, exchange warnings, and decide what to do next. This matters in a country repeatedly affected by geological and hydrometeorological events. We reviewed 38 publications issued between 2013 and 2026 to examine what digital literacy contributes to disaster risk reduction (DRR), and where its contribution remains uncertain. The literature covers mobile applications and learning materials, education from early childhood through university, risk communication and early warning, misinformation, and community resilience. Read together, these studies do not support a simple technology-first account. A platform or application is useful only when people can access it, trust its source, understand the message, and connect that message to a feasible action. Teachers, public officials, community leaders, and local knowledge often make that connection possible. The review also reveals familiar but unresolved problems: unstable connectivity, unequal skills, inaccessible interfaces, overloaded information environments, weak coordination, and programmes that end when project funding does. Indonesia therefore needs more than additional digital products. It needs a coherent digital-DRR strategy, clearly defined educational competencies, tools that remain usable offline and by people with different abilities, credible arrangements for correcting false information, and research that follows interventions long enough to establish who benefits, under what conditions, and for how long.

Keywords: digital literacy; disaster risk reduction; disaster education; ICT; disaster communication; Indonesia

1 Introduction

For Indonesia, disaster risk is not an occasional interruption. It is part of the setting in which public institutions, schools, and communities operate. The country lies where the Eurasian, Pacific, and Indo-Australian tectonic plates meet and forms part of the Pacific Ring of Fire (Suharini et al., 2024; Suprapto et al., 2019; Syam et al., 2023). Indonesian policy commonly recognises at least 13 threats. These include earthquakes, tsunamis, volcanic eruptions, landslides, floods, flash floods, drought, extreme weather, forest

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fires, disease outbreaks, and technological failure (Novita et al., 2022; Saminan et al., 2024). In 2020 alone, BNPB recorded 4,886 natural disasters (Asshiddiqi et al., 2021). Floods, landslides, and strong winds have been particularly common over the past three decades (Novita et al., 2022). Less frequent events can nevertheless be devastating: the 2010 eruption of Mount Merapi caused 386 deaths and losses estimated at US$403 million (Saifudin, 2023).

At the same time, the channels through which Indonesians encounter risk information have changed. By 2023, more than 132.7 million people were using the internet and reported penetration had reached 78.19% (Andriani, 2023; Suprapto et al., 2019). That reach is promising for DRR, although it is easy to overstate what connectivity can accomplish. Receiving a message is not the same as recognising a credible warning, understanding its implications, or knowing which action is realistic. Digital literacy is therefore relevant to preparedness not simply as device competence, but as the practical ability to locate, assess, interpret, and responsibly circulate information when uncertainty is high (Suharini et al., 2024; Syam et al., 2023).

This review asks how that practical capacity appears in the Indonesian DRR literature. It examines 38 peer-reviewed articles, conference papers, book chapters, and preprints published between 2013 and 2026. Rather than treating every use of technology as equivalent, we trace how the studies connect digital literacy with education, mobile and web-based tools, disaster communication, community resilience, vulnerable groups, and misinformation. We then consider what the evidence can reasonably support, where it remains thin, and which questions should guide policy and subsequent research.

2 Research Method

2.1 Data Collection and Multi-Stage Processes

The review used a structured SLR process adapted from the multi-stage approach described by Djalante (2018). Four questions guided the reading: What topics have attracted research attention? How have authors defined or measured digital literacy in a DRR setting? Where is the available evidence concentrated? Which issues remain largely unexamined? The method was informed by PRISMA, but no meta-analysis was attempted because the included studies differed substantially in design, population, intervention, and outcome. Our purpose was to make the route from selection to interpretation visible and to synthesise patterns without implying a level of causal comparability that the source studies do not provide.

The supplied corpus contained 38 eligible publications issued between 2013 and 2026, including journal articles, conference papers, book chapters, and preprints. Some elements needed for a fully reproducible PRISMA record—database-level search yields, screening counts, and a duplicate-removal log—were not retained in the source draft. We have not attempted to recreate those figures from inference. Table 1 therefore reports the selection logic and identifies the documentation that should accompany a journal submission. The final supplementary file should include the search date and strings, database exports, exclusion decisions, duplicate record, and complete flow diagram.

Table 1. Multi-stage process for identifying, screening, and selecting materials.

Stage	Inclusion/screening logic	Evidentiary record
Identification	Search Scopus, Web of Science, Google Scholar, and institutional repositories using combinations of terms for digital literacy, ICT, mobile applications, disaster education, preparedness, resilience, DRR, and Indonesia.	The initial record count was not retained in the supplied corpus.
Screening	Remove records outside the scope of digital literacy, ICT, or technology-mediated DRR. Screen titles, abstracts, and source types; retain English- or Indonesian-language materials.	Database-specific screening counts were not retained.
Eligibility	Retain Indonesia-based studies and directly transferable comparative evidence. Include peer-reviewed articles, conference papers, book chapters, and preprints published from 2013 to 2026.	Full-text eligibility decisions should be retained in a submission audit trail.
Final selection	Synthesize eligible sources across digital tools, curricula, communication, resilience, vulnerable populations, and implementation constraints.	38 included sources were reported.

Note: The source draft identifies 38 included sources, but it does not retain numerical records for identification, screening, or eligibility. The table, therefore, distinguishes reported information from the documentation that should be preserved in a final audit trail.

2.2 **Data Analysis**

We coded each source by setting, study population, principal analytical concern, DRR phase, digital intervention, and reported outcome. For the descriptive overview, every study was assigned to one primary cluster so that the totals in Table 2 would not overlap. That decision is an accounting device rather than a claim that the themes are separate. In the narrative analysis, education, communication, resilience, and governance repeatedly intersect. We also chose not to reproduce the authorship and productivity analysis used by Djalante (2018), because the present corpus lacks sufficiently complete bibliometric metadata.

Table 2. Major research themes and primary coding of the reported review corpus.

Major thematic group	Coding focus	Reported sources and indicative evidence
Digital platforms, learning media and curricular integration	Mobile applications, e-books, digital materials, and school- or university-based learning.	14 (37%): DILIBA, SiAlong, mobile learning, disaster e-books, and curriculum integration.
ICT-enabled communication, information integrity and governance	Early warning, social media, digital leadership, information management, and misinformation response.	10 (26%): BMKG and BPBD communication, WhatsApp groups, television, and application usability.
Community resilience, inclusion and local knowledge	Preparedness, social capital, trusted intermediaries, local wisdom, and vulnerable populations.	9 (24%): resilience predictors, multistakeholder models, Babinsa, and locally grounded approaches.
Cross-cutting comparative and systems evidence	International comparisons, online DRR education, and system-level implementation constraints.	5 (13%): digital divide, inclusive online learning, and risk-management applications.
Total	Primary thematic allocation of the reported review corpus.	38 (100%): each source is assigned one principal theme for descriptive mapping.

Note: The categories are mutually exclusive only for the descriptive totals in this table. In practice, many studies link education, communication, resilience, and governance.

3 Findings and Discussion

3.1 Conceptual and Policy Foundations

Disaster risk reduction: international and national frameworks. DRR is concerned with the conditions that turn hazards into losses: exposure, vulnerability, and inadequate preparedness for response (Sun et al., 2024; Winarni & Purwandari, 2018). The Sendai Framework for Disaster Risk Reduction 2015–2030 sets seven targets and four priorities for action: understanding disaster risk; strengthening disaster-risk governance; investing in resilience; and improving preparedness for response and "building back better" (Chan et al., 2021; Cuadra & Cotoron, 2025; Saifudin, 2023; Senanayake et al., 2023; Sun et al., 2024). Across the Yokohama, Hyogo, and Sendai frameworks, education is consistently positioned as a route for building knowledge and encouraging risk-reducing behaviour (Cuadra & Cotoron, 2025; Suharini et al., 2024).

Indonesia's institutional and legal foundations include Disaster Management Law No. 24 of 2007 and the establishment of the National Disaster Management Agency (BNPB) and Regional Disaster Management Agencies (BPBD) (Andung et al., 2021; Hutagalung & Indrajat, 2023; Prihantoro et al., 2024; Saifudin, 2023). BNPB coordinates activity before, during, and after disasters, while BPBD operates at provincial and district levels under mandates that include BNPB Regulation No. 3 of 2008 (Hutagalung & Indrajat, 2023). BNPB and the Meteorology, Climatology, and

Geophysics Agency (BMKG) have also developed digital services that provide public information and learning resources for disaster management (Meutia et al., 2024; Novita et al., 2022).

Digital literacy: definitions and dimensions. Paul Gilster's early formulation described digital literacy as literacy for the digital age: the ability to understand and use information from diverse digital sources (Suprapto et al., 2019). UNESCO extends the idea by stressing the capacity to find, use, evaluate, create, and communicate digital content through cognitive, ethical, social, emotional, and technical capabilities (Syam et al., 2023). Beetham, Littlejohn, and McGill (2009) identify seven related elements: information literacy, digital scholarship, learning skills, ICT literacy, career and identity management, communication and collaboration, and media literacy (Syam et al., 2023).

Digital literacy also develops unevenly. At a basic level, people can operate devices; at an intermediate level, they use digital media for purposes such as learning, work, trade, and social interaction; and at a more advanced level, they use those media to create innovations with wider social value (Syam et al., 2023). This progression is important for DRR because interventions need to begin with the capacities communities actually possess, rather than the capacities designers assume.

Disaster literacy: convergence with digital competencies. Disaster literacy refers to the ability to read, understand, and use disaster information to make informed decisions and follow guidance across mitigation, preparedness, response, and recovery (Damayani et al., 2022; Hasibuan et al., 2022; Logayah et al., 2023). It includes recognising hazards, understanding relevant information, appreciating local exposure, and preparing for possible impacts (Logayah et al., 2023; Saminan et al., 2024). Noviana et al. (2021) similarly describe it as a systematic means of reducing risk by analysing and addressing the factors that produce disasters (Logayah et al., 2023).

Bringing digital and disaster literacy together creates what may be termed digital disaster literacy (Suharini et al., 2024). It concerns not only receiving warnings, but also judging their credibility, understanding what action they require, and communicating useful information onward. Digital channels can extend disaster literacy through early warning systems, interactive learning platforms, social media, and the more rapid circulation of hazard information (Maulana & Sakir, 2024; Prihadi, 2025; Suharini et al., 2024a; Suprapto et al., 2019).

3.2 Digital Platforms and Mobile Applications for DRR

Indonesian-developed digital platforms. Indonesian studies document several platforms designed for disaster education and preparedness. Suprapto et al. (2019) developed the Android-based Natural Disaster Digital Literacy (DILIBA) application for primary teacher education students at Peradaban University. The application presented hydrometeorological disaster content through a digital-comic format that could be accessed on Android devices. The project aimed to produce understandable learning material, a workable digital-literacy media model, and an application that could be used through widely available phones (Suprapto et al., 2019). Its reliance on visual storytelling is consistent with earlier evidence that comic strips can help young learners understand earthquake concepts (Suprapto et al., 2019b).

Suharini et al. (2024) developed SiAlong, a platform intended to strengthen landslide-related digital literacy among Generation Z in Semarang. The platform functions as a digital information source on landslide risk and was designed to encourage faster, more informed responses to hazard information. The authors stress that technology cannot prevent disasters; its value lies in supporting preparedness, prediction, early warning, and post-disaster rescue (Suharini et al., 2024). The platform responds to the observation that Generation Z may be comfortable with technology while still needing prompts and guidance to translate that familiarity into disaster readiness (Suharini et al., 2024a).

Winarni and Purwandari (2018) tested a mobile-learning application for earthquake risk reduction in elementary schools in Bengkulu. In a one-group pre-test/post-test study, students' understanding of earthquake mitigation improved significantly ($t = -8.02$, $p < 0.05$, $df = 58$). The application covered what to do before, during, and after an earthquake and offered a more interactive way of presenting the material. The authors link this kind of learning to the development of a school "Safety Culture" (Winarni & Purwandari, 2018).

E-books and digital teaching materials. Asshiddiqi et al. (2021) developed a disaster-education e-book for junior high school students by connecting vibration and wave concepts with disaster topics through a webbed integration model. Two expert lecturers and three science teachers assessed the e-book, producing a validity score of 81% and judging it suitable for use. The design incorporated disaster-education indicators, including knowledge of risk reduction, emergency planning skills, and simulation activities, as well as disaster-literacy indicators covering hazards, warning signs, causes, impacts, and risk reduction (Asshiddiqi et al., 2021). The study shows how digital teaching materials can connect scientific concepts with practical preparedness skills.

Global perspectives on DRM mobile applications. International evidence offers a useful benchmark for Indonesian tools. Zavaleta (2026) analysed seven widely used disaster-risk-management (DRM) applications—AlertSwiss, Disaster Alert, FEMA, Info BMKG, NINA, NERV, and VicEmergency—and identified five recurring issues: everyday readiness, trust in the messenger, inclusion gaps, information overload, and technological fragility. The Indonesian BMKG application was included in the comparison. Preparedness improved when applications offered personalised tools and educational content, but institutional transparency remained central to user trust (Zavaleta, 2026). Language barriers, complex interfaces, and limited accessibility weakened usability, particularly for people with lower digital literacy. Large volumes of information could overwhelm users, and limited offline functionality reduced reliability during network disruption (Zavaleta, 2026).

Corcuera et al. (2021) assessed 73 mobile applications for disaster reduction worldwide. Most focused on a single DRM phase and a single hazard, leaving systemic risk insufficiently addressed and limiting their value for scaled humanitarian response. Their Digital Application Potential Index (DAPI) suggested an inverse pattern: countries with lower disaster risk had greater potential for mobile-app use. For high-risk countries such as Indonesia, this points to more difficult conditions for effective

digital deployment (Corcuera et al., 2021). The authors suggest that policy must account for internet costs, educational inequality, and the need for language translation when positioning mobile applications as viable DRM tools.

Digital leadership and geospatial tools. Prihadi (2025) examined digital leadership in flood-risk reduction for children living along the Bengawan Solo riverbank. In this study, digital leaders were individuals or groups using digital technologies and social media to guide, educate, and organise communities around disaster risk. The programme combined information-sharing, interactive education, and virtual simulations using Google Earth. It also worked with Karang Taruna to form study groups, introduce geospatial media, and run social-media campaigns (Prihadi, 2025). Game-based learning increased children's awareness and understanding of flood risk, although restricted internet access, uneven digital skills, and programme sustainability remained substantial challenges.

As'Ari (2026) presents an integrated model for disaster education in the Leuweung Sancang Nature Reserve. The programme combined GIS mapping, nature-based solutions, and local ecological knowledge (LEK), using maps as an early-warning resource alongside coastal and vegetation restoration. A quasi-experimental assessment reported significant improvements in community awareness, preparedness behaviours, and participation in DRR (As'ari, 2026). The case suggests that technology is more likely to be accepted and sustained when it is connected to locally grounded knowledge and ecological practice.

3.3 Digital Literacy in Disaster Education Curricula

Higher education integration. At university level, Saminan et al. (2024) examined the integration of disaster literacy into Earth and Space Sciences (ESS) teaching. Using the Borg and Gall development model, the study produced lesson plans, modules, and student worksheets that connected earth-and-space content with DRR education. The authors frame disaster literacy as a mitigation resource because it helps students understand risk, recognise local disaster potential, and prepare to act (Saminan et al., 2024). In the post-COVID-19 context, this also requires teachers to move flexibly across online, offline, blended, and hybrid learning modes.

Secondary and elementary school integration. At secondary level, Logayah et al. (2023) conducted a quasi-experimental study with 33 seventh-grade students in Lembang. Post-test scores differed significantly from pre-test scores ($p = 0.000$) after the disaster-literacy intervention, indicating gains across knowledge, attitudes, and skills. The authors nonetheless note that disaster literacy is still not yet routinely embedded in many schools and recommend turning it into a regular learning practice (Logayah et al., 2023).

Novita et al. (2022) outline options for disaster-mitigation learning in senior high schools under the Merdeka Belajar concept. Their proposal integrates disaster topics and digital disaster-literacy resources into the IPAS (Natural and Social Sciences) subject, using BNPB and BMKG digital services as accountable sources of information. They also develop planning tables to help educators connect disaster content with reliable digital platforms (Novita et al., 2022).

Andung et al. (2021) studied disaster-information literacy at Rehoboth Christian Elementary School in East Nusa Tenggara during the COVID-19 pandemic. Topics

such as floods and whirlwinds were incorporated into teachers' lesson plans. When conventional schooling was disrupted, teachers made home visits to deliver short lessons and distribute materials. The case shows how disaster education can be maintained even where digital access is limited, and how integrating risk topics into routine learning can benefit both students and their wider community (Andung et al., 2021).

Rahmawati and Rasidi (2023) reviewed 20 references on learning for elementary school students in disaster-prone areas. They identify five recurring approaches: preparedness education, disaster education for teachers, disaster education for students, disaster literacy, and learning media. Across the reviewed studies, disaster-education programmes were associated with improvements in public elementary-school teachers' knowledge and practice (Rahmawati & Rasidi, 2023).

Early childhood education. Oktaria et al. (2023) examined the design of information-literacy-based disaster-mitigation learning for early childhood education in flood- and tornado-prone East Lampung. Educators drew information from print sources—newspapers, magazines, and books—as well as television, YouTube, WhatsApp, Facebook, TikTok, and Google. Yet many still needed stronger skills for finding and evaluating information when preparing disaster-learning materials. The study argues that mitigation learning should begin early and that digital guidebooks can make preparation easier for educators (Oktaria et al., 2023).

International comparative perspectives on curricular integration. Sun et al. (2024) compared disaster-risk-reduction content in secondary-school geography textbooks in China and the United States through a Sendai Framework lens. Both sets of textbooks addressed DRR, but their coverage was uneven: understanding disaster risk and enhancing preparedness received more attention than risk governance and investment in risk management. For Indonesia, the comparison points to the value of curricular coverage that is balanced across all Sendai priorities.

3.4 ICT Applications in Disaster Management and Communication

ICT effectiveness in disaster response. Maulana and Sakir (2024) assessed ICT use in fire response and disaster management in Batam between 2018 and 2023 through surveys and case studies. They found that ICT-based early warning, stronger communication networks, and more efficient data management supported preparedness and response. However, equitable access, limited infrastructure in remote areas, and privacy concerns remained unresolved (Maulana & Sakir, 2024). Their recommendations include better ICT infrastructure, stronger digital skills, and clearer privacy and security safeguards.

Disaster communication models and digital literacy. Following the Cianjur earthquake, Prihantoro et al. (2024) examined innovations in mitigation communication, coordination, and digital literacy. Guided by Haddow's Disaster Communication theory—customer focus, leadership commitment, situational awareness, and media partnership—the study used observation, in-depth interviews, and focus groups. In Cianjur, digital-literacy activity included emergency call centres and WhatsApp groups used to circulate public information. BPBD also used social media to make activities and information more accessible. The analysis identifies an ABCGM model in which academics, business/administration, community/volunteers,

government, and media each contribute to public digital literacy (Prihantoro et al., 2024b).

Andriani (2023) considers digital literacy as a medium for da'wah communication in efforts to counter disaster hoaxes in Cianjur Regency. Four initiatives are described: Cianjur Saber Hoaks, which clarifies suspected online hoaxes; Tanjeur Cianjur, an online and offline disaster-management and digital-literacy movement; psychosocial support by UNPI and Jayabaya University, including volunteer guidebooks; and the ASEAN Digital Literacy Program, which socialises the dangers of hoaxes and the ITE Law. Together, these initiatives show how grassroots and institutional actors responded to misinformation after a disaster (Andriani, 2023).

Television and traditional media in disaster literacy. Hasibuan et al. (2022) examine how television reporting can strengthen community disaster literacy. They identify cognitive, affective, and conative dimensions that may be developed through coverage before, during, and after disasters. Television remains close to everyday family life and can provide warnings and timely updates during crisis situations. The authors caution, however, that reporting should avoid excessive dramatisation and instead encourage empathy and active public involvement in risk reduction (Hasibuan et al., 2022).

BMKG digital services and social capital. Meutia et al. (2024) explore how BMKG in Lampung uses digital media to build weather literacy, support mitigation, and foster social capital. Instagram, the BMKG website, and mobile applications give the public fast access to disaster information. Yet participation remains mostly one-way: people receive information but are not always involved in assessing or contributing to it. The study recommends more active participation, trust-building through two-way communication, and wider community networks grounded in social capital.

Disaster information management. Mutasa (2013) highlights the importance of managing disaster information systematically across the full disaster cycle. The study criticises the tendency to collect, manage, and distribute information mainly during emergencies, which can sideline recovery as a source of knowledge for future mitigation. Integrating disaster-information management into DRM curricula is therefore relevant to Indonesia's effort to build more comprehensive digital literacy for DRR (Mutasa, 2013).

3.5 Community Resilience and Digital Disaster Preparedness

Quantitative evidence on disaster literacy and resilience. Saifudin (2023) surveyed 258 people living in hazard zone III near Mount Merapi in Yogyakarta using proportional cluster sampling. The study applied Indonesian versions of the Communities Advancing Resilience Toolkit (CART-AS), Disaster Health Literacy Mitigation and Preparedness Questionnaire (DHLQ), Disaster Risk Perception Questionnaire (DRPQ), and Disaster Preparedness Questionnaire (DPQ). Disaster health literacy ($\beta = 0.22$, $p < 0.001$), risk perception ($\beta = 0.26$, $p < 0.001$), and preparedness ($\beta = 0.38$, $p < 0.001$) were all significant predictors of resilience. Higher disaster health literacy was also associated with stronger scores in the information-and-communication domain ($\beta = 0.21$, $p = 0.00$) and the disaster-management domain ($\beta = 0.12$, $p = 0.04$) (Saifudin, 2023b). These findings provide quantitative support for the connection between disaster literacy and measurable resilience.

Multistakeholder education models. Hutagalung and Indrajat (2023) propose a multistakeholder model for building disaster literacy and awareness in Lampung Province, drawing on mixed-method case studies in Bandar Lampung City and South Lampung Regency. Preparedness, they argue, can be supported through early warning carried by local media such as kentongan as well as phone-based applications. Their disaster-safe-school model includes safe facilities and infrastructure, disaster-management organisations, and risk-education activities. The recommended Disaster Resilient Family (Katana) programme covers recognising risk, building safer homes, preparing household plans and early-warning information, and conducting evacuation simulations. It also highlights the need for BPBD to give greater attention to people experiencing economic disadvantage, older adults, women, children, and people with disabilities (Hutagalung & Indrajat, 2023b).

Military and community-level digital literacy. Syam et al. (2023) analyse how Babinsa (Village Development Non-Commissioned Officers) in the Kodim 0705/Magelang area use digital literacy to improve preparedness. Babinsa can act as local connectors and information disseminators, helping communities communicate and coordinate around hazard information. The study suggests that such capacity is especially valuable when digital technologies are used to complement established military–community relationships (Syam et al., 2023).

Local wisdom and digital integration. Damayani et al. (2022) examine disaster-mitigation literacy rooted in the local wisdom of indigenous communities in Pangandaran, West Java. Traditions such as seni badud and hajat laut carry moral, social, and spiritual messages relevant to disaster mitigation. Local wisdom can therefore serve as a culturally resonant communication resource alongside digital approaches. This finding aligns with As'Ari's (2026) integration of local ecological knowledge and digital tools, suggesting that digital innovation is strongest when it works with—not against—embedded knowledge systems.

Urban resilience and nature-based solutions. Ginting (2026) examines multihazard risk management in Medan City, where 28% of the city is assessed as highly exposed to flooding and community readiness is reported to be below 30%. The study proposes four strategic pillars: spatial action through risk-informed urban design; social action through preparedness and literacy; ecological action through nature-based solutions; and governance action through coordination between development and DRR policies. Digital literacy belongs centrally within the social pillar because it helps residents interpret risk information and act on it.

3.6 Vulnerable Populations and Digital Literacy for DRR

Children and young people. Children are among the groups most exposed to disaster impacts, but they are also central to the longer-term development of community resilience. UNICEF research from 2018 reported that roughly 45% of Indonesia's population still lacked adequate disaster knowledge and attitudes, with children and older adults especially affected (Logayah et al., 2023). Suharini et al. (2024) argue that Generation Z has particular potential to shape disaster-resilient communities because digital technology and internet access are routine parts of their lives.

Prihadi (2025) shows that children living along the Bengawan Solo riverbank can be engaged through digital leadership, game-based learning, social-media campaigns, and

introductions to geospatial media. Familiarity with technology does not, however, automatically mean that young people can judge or use disaster information well. Digital-literacy workshops therefore remain important, even for digital-native learners (Prihadi, 2025).

Rowland et al. (2020) and Mort et al. (2020) explore participatory DRM tools with children and young people through the CUIDAR project in Europe. Teenagers chose digital technologies to share their work, leading to child-friendly digital emergency plans and video messages directed at adults about disaster risk (Rowland et al., 2020). Although these studies were conducted in Europe, their participatory methods provide useful starting points for Indonesian initiatives that place young people in an active, rather than passive, role in digital DRR.

Elderly populations. Sawangnate (n.d.) investigated digital literacy and flood preparedness among older adults in Bangkok, Thailand. Many participants had limited ICT experience and low levels of digital and media literacy; approximately 75% had neither communicated nor shared flood information through social-network platforms. About 13% obtained pre-flood information through Facebook and Line, and fewer than 2% accessed national or provincial web platforms (Sawangnate, n.d.-a, n.d.-b). Education and income significantly shaped flood literacy and preparedness. Within a Protection Motivation Theory framework, risk perception, understanding of preparedness measures, self-efficacy, and capacity to act were positively correlated ($p < 0.01$) (Sawangnate, n.d.-b). Although the study is Thai, its findings speak to comparable access and literacy challenges among older people in Indonesia.

Socioeconomically disadvantaged communities. Abedin et al. (2022) studied ICT use in flash-flood risk management in north-eastern Bangladesh. Illiteracy, low quality of life, weak social capital, poor infrastructure, and limited institutional communication constrained the effective use of ICT. Mobile phones were commonly used for communication during disasters, but computer and internet use was absent in the remote communities studied. Comparable barriers may affect disadvantaged and remote Indonesian communities, particularly in rural and eastern regions (Abedin et al., 2022).

3.7 COVID-19 Pandemic and Digital Transformation

The COVID-19 pandemic accelerated the digital turn in DRR education, while also making its weaknesses more visible. Saminan et al. (2024) describe how the post-pandemic period required disaster-literacy education to make use of online, offline, and blended or hybrid learning. The pandemic itself also underscored the need to include biological hazards within DRR frameworks (Chan et al., 2021; Saminan et al., 2024a).

Chan et al. (2021) reflect on how the COVID-19 pandemic opened both challenges and opportunities for including biological hazards in DRR planning. They identify digital literacy as a priority alongside resilient health systems, data management, and risk communication. Their analysis stresses the importance of inclusive digital literacy and continuing education on multifaceted risk governance. The Health Emergency Disaster Risk Management (Health-EDRM) paradigm is presented as a WHO framework for integrating DRR across intra-, inter-, and multidisciplinary levels (Chan et al., 2021).

Senanayake et al. (2023) examine online DRR education through the INCLUsive Disaster Education (INCLUDE) project in Lithuania, Japan, Sweden, and the United

Kingdom. Learning-management systems, synchronous sessions, and flipped classrooms were the dominant approaches. Yet inadequate ICT infrastructure and digital literacy, health disruptions, and participants' work and personal commitments interrupted learning. The authors conclude that inclusive online disaster education must take account of learners' wider social circumstances and vulnerabilities (Senanayake et al., 2023).

Andung et al. (2021) offer a practical example from a Christian school in disaster-prone East Nusa Tenggara. During the pandemic, home visits helped sustain disaster-information literacy when digital access was limited. The case shows that continuity in disaster education does not depend on digital delivery alone.

3.8 Challenges, Barriers, and Misinformation

Infrastructure and the digital divide. Across the literature, infrastructure constraints in remote and disadvantaged areas remain the most persistent obstacle to digital DRR. Maulana and Sakir (2024) identify remote-area infrastructure as a challenge in Batam, while Prihadi (2025) reports limited internet access in Nusupan Village along the Bengawan Solo riverbank. Abedin et al. (2022) found that computer and internet use was absent in remote Bangladeshi communities, a pattern that is relevant to parts of eastern Indonesia. Corcuera et al. (2021) add a difficult paradox: countries with higher disaster risk often have lower potential for mobile-app deployment, meaning that communities with the greatest need may be least able to use digital tools.

The digital divide is geographic, socioeconomic, demographic, and institutional. It separates urban from rural communities, people with different levels of income and education, age and gender groups, and institutions with unequal capacity (Abedin et al., 2022; Corcuera et al., 2021; Maulana & Sakir, 2024; Sawangnate, n.d.-a). Sawangnate (n.d.) found that education and income significantly affected digital literacy and preparedness actions, while older women recorded higher flood literacy than older men. These overlapping inequalities make targeted support essential if digital DRR resources are to be genuinely equitable.

Teacher and educator capacity. Several studies identify professional gaps in both disaster content and the use of digital tools. Suprapto et al. (2019a) note limits in pedagogical, social, and personal competencies relevant to disaster education. Oktaria et al. (2023) report that early-childhood educators in East Lampung needed stronger information-literacy skills to prepare disaster-mitigation materials. Rahmawati and Rasidi (2023) similarly call for programmes that build teacher capacity alongside student knowledge. This task became more demanding after the pandemic, as teachers were expected to work across online, offline, and blended formats at the same time (Saminan et al., 2024).

Misinformation and false information. Misinformation circulated through digital channels can undermine DRR by generating anxiety, fear, and poor decisions. Cuadra and Cotoron (2025), in an integrative review of community-based DRM, find that social media can accelerate information-sharing but can also spread false claims that weaken preparedness and resilience. Reported responses include digital and media literacy education, community training, local communication networks such as community radio and messaging groups, trusted local leaders, and simulated drills that teach verification practices.

Suharini et al. (2024) observe that rapid technological and information change can distort public understanding of disasters when misinformation is not checked. Andriani (2023) documents four digital-literacy initiatives in Cianjur aimed at responding to disaster hoaxes. Niekerk (2025) likewise argues that misinformation can weaken community-based DRM, reinforcing the importance of credible leadership, local communication networks, and practical digital literacy.

Zavaleta (2026) finds that institutional affiliation and transparency are central to trust in DRM mobile applications. Weyrich et al. (2021), using serious games to assess social-media information for early warning, also note public agencies' concerns about harmful or inaccurate online content. These concerns should not preclude social-media use; they underline the need for verification protocols and accountable communication practices.

Institutional coordination. Ginting (2026) identifies weak institutional coordination as a factor that can increase urban disaster vulnerability. Meutia et al. (2024) similarly find that BMKG's digital outreach has not yet generated substantial active community involvement. The Sendai Framework emphasises collaboration between government and stakeholders to identify risk, manage it, and build resilience (Cuadra & Cotoron, 2025). Translating that principle into sustained practice remains difficult within Indonesia's decentralised governance environment.

Sustainability and scalability. Sustainability is a recurring concern across the evidence. Prihadi (2025) identifies it as a challenge for digital-leadership initiatives, and Corcuera et al. (2021) argue that current mobile-app use falls well short of ensuring reliable DRM communication in high-risk settings. Programmes that depend on short project cycles or remain weakly embedded in public institutions are unlikely to have durable effects.

4 Synthesis and Discussion

4.1 Emerging Patterns

Across this uneven body of work, five observations recur.

The first is a change in the material form of disaster education. Conventional instruction has not disappeared, but it now operates alongside DILIBA, SiAlong, disaster e-books (Asshiddiqi et al., 2021), geospatial exercises (As'ari, 2026; Prihadi, 2025), social-media communication (Meutia et al., 2024; Prihantoro et al., 2024), and school resources linked to public digital services (Novita et al., 2022). Their attraction is understandable: a phone can carry warnings, maps, explanations, and exercises across several stages of a disaster. Yet reach depends on connectivity, language, interface design, and the credibility of the institution behind the screen.

The second observation concerns education over the life course. Relevant studies appear in early-childhood settings (Oktaria et al., 2023), elementary schools (Andung et al., 2021; Winarni & Purwandari, 2018), secondary schools (Asshiddiqi et al., 2021; Logayah et al., 2023; Novita et al., 2022), and universities (Saminan et al., 2024). This spread creates an opportunity to build capacity cumulatively rather than through occasional awareness campaigns. Merdeka Belajar may provide the curricular space for doing so, provided that schools are given competencies, teaching support, and

dependable sources rather than an additional list of loosely specified activities (Novita et al., 2022).

Third, the more convincing cases are hybrid rather than purely digital. In Leuweung Sancang, GIS mapping was connected to local ecological knowledge (As'ari, 2026). After the Cianjur earthquake, WhatsApp groups functioned within existing official and community relationships (Prihantoro et al., 2024). Elsewhere, kentongan, local traditions, and phone-based communication were treated as complementary resources (Damayani et al., 2022; Hutagalung & Indrajat, 2023). These examples matter because communities do not suspend their histories and relationships when a new application arrives.

Fourth, the small quantitative literature points in a positive direction, but it should be read with restraint. Saifudin (2023) found that disaster health literacy predicted several dimensions of resilience in Yogyakarta, while Logayah et al. (2023) reported improved student preparedness following an educational intervention. These findings are more informative than broad claims about the promise of technology. They do not, however, establish that every digital intervention will work in another population, hazard setting, or institutional environment.

Finally, digital systems rarely act on their own. Babinsa (Syam et al., 2023), teachers (Oktaria et al., 2023; Suprapto et al., 2019a), BPBD personnel (Prihantoro et al., 2024), BMKG services and staff (Meutia et al., 2024; Novita et al., 2022), digital leaders (Prihadi, 2025), and trusted community figures (Cuadra & Cotoron, 2025) interpret information and connect it with local action. Where networks are weak or trust is contested, the same technical system may have a very different effect.

4.2 **Theoretical Implications**

No single theory adequately captures this field. Disaster Communication theory helps to examine the movement of messages during and after an event (Prihantoro et al., 2024). Protection Motivation Theory directs attention to threat appraisal, self-efficacy, and perceived ability to prepare (Sawangnate, n.d.-a, n.d.-b). Social capital theory explains why networks, trust, and participation can alter the reception of a digital intervention (Meutia et al., 2024). The Health-EDRM paradigm adds a multihazard and multisector perspective, particularly where public health and disaster governance meet (Chan et al., 2021).

The conceptual problem is that these perspectives are usually applied side by side. The literature still lacks an account of how access to a device becomes—or fails to become—judgment, trust, communication, and action under pressure. An integrated model of digital disaster literacy should make those transitions explicit. It should also allow for breakdowns: a credible message may arrive too late, an accessible tool may not be trusted, or a well-understood warning may recommend an action that a household cannot afford to take.

4.3 **Research Gaps**

The evidence is substantial enough to identify recurring omissions, but not yet mature enough to answer them. Eight gaps deserve priority:

1. Longitudinal evidence: Most studies are cross-sectional or short-term experiments. Research is needed to determine whether digital-literacy interventions produce lasting changes in preparedness and resilience.
2. Stronger impact evaluation: A small number of studies use quasi-experimental designs (As'ari, 2026; Logayah et al., 2023; Winarni & Purwandari, 2018), but descriptive and qualitative studies still dominate. Randomised trials and other rigorous impact evaluations would strengthen causal inference.
3. Disability inclusion: Although vulnerable groups are mentioned (Hutagalung & Indrajat, 2023b), research on digital literacy for DRR among persons with disabilities in Indonesia is almost absent.
4. Gender analysis: Sawangnate (n.d.) identifies gender differences in flood literacy in Thailand, yet Indonesian studies rarely report digital-DRR outcomes by gender.
5. Cost-effectiveness: The literature does not compare the costs and outcomes of digital and conventional DRR education, leaving policymakers with limited evidence for allocation decisions.
6. Rural and eastern Indonesia: Most documented studies are located in Java and Sumatra. High-risk provinces in eastern Indonesia remain substantially underrepresented.
7. Offline functionality: Zavaleta (2026) identifies weak offline capacity as a major flaw in DRM applications, but Indonesian research has not systematically assessed how tools work in low-connectivity settings.
8. Scalability: Individual platforms are promising, but there is little evidence on how they can be adapted and sustained across Indonesia's diverse geographic, linguistic, and cultural contexts.

5 Recommendations

5.1 Policy Recommendations

The review suggests several policy priorities. They are best understood as connected decisions rather than a menu of independent projects:

1. National digital-DRR strategy: Develop a coherent national strategy that embeds digital literacy throughout the disaster-management cycle and builds on existing BNPB and BMKG services (Maulana & Sakir, 2024; Meutia et al., 2024; Novita et al., 2022).
2. Curriculum competencies: Embed disaster digital literacy at every level of education within the Merdeka Belajar framework, using clear competency indicators rather than ad hoc activities (Logayah et al., 2023; Novita et al., 2022; Saminan et al., 2024a).
3. Infrastructure investment: Prioritise resilient ICT infrastructure in remote, disaster-prone areas to narrow the digital divide (Abedin et al., 2022; Maulana & Sakir, 2024; Prihadi, 2025).

4. Misinformation safeguards: Strengthen institutional systems for monitoring, correcting, and preventing disaster misinformation, learning from local initiatives such as Cianjur Saber Hoaks (Andriani, 2023; Cuadra & Cotoron, 2025).
5. Inclusive design: Require digital DRR tools to include accessibility features for older adults, persons with disabilities, and people with limited literacy (Sawangnate, n.d.-a, n.d.-b; Zavaleta, 2026).

5.2 Practice Recommendations

1. Hybrid delivery: Combine digital channels with television, radio, SMS, and locally trusted traditions so that risk communication reaches people across levels of connectivity (Corcuera et al., 2021; Damayani et al., 2022; Hasibuan et al., 2022; Hutagalung & Indrajat, 2023a).
2. Teacher development: Provide sustained professional development that builds both disaster-content knowledge and the ability to integrate digital tools into learning (Oktaria et al., 2023; Rahmawati & Rasidi, 2023; Suprapto et al., 2019a).
3. Active community participation: Move beyond one-way information delivery by involving communities in evaluating, adapting, and sharing digital DRR information through trusted local networks (Cuadra & Cotoron, 2025; Meutia et al., 2024).
4. Multilingual and offline tools: Ensure DRM applications offer relevant languages and robust offline functions (Corcuera et al., 2021; Zavaleta, 2026).

5.3 Research Recommendations

1. Conduct longitudinal studies of digital-DRR interventions across multiple years.
2. Use rigorous experimental and quasi-experimental designs, including randomised controlled trials where feasible.
3. Develop integrated theoretical models of digital disaster literacy.
4. Prioritise underrepresented regions, especially eastern Indonesia.
5. Include gender-disaggregated and disability-inclusive analyses.
6. Compare the cost-effectiveness of digital and conventional DRR approaches.

6 Conclusion

Indonesia is already experimenting with many forms of digitally supported DRR: mobile applications, e-books, school platforms, geospatial tools, social media, early-warning services, and curriculum resources. Taken together, the studies reviewed here associate these approaches with improved knowledge, preparedness, communication, and resilience. The strongest quantitative findings come from a limited number of settings, while qualitative studies provide a richer account of the institutional and social conditions that shape use. The evidence is encouraging, but it is not a licence to assume that any digital product will produce resilience.

What matters is the chain between information and action. That chain can break because a signal is unavailable, an interface excludes its intended user, a source is not

trusted, a teacher has received little support, or an institution has not planned what happens after a pilot ends. Conversely, digital tools become more useful when they are joined to local knowledge, familiar communication practices, credible intermediaries, and accessible design. Technology is one component of preparedness; it cannot substitute for the relationships and public capacity on which preparedness depends.

Climate change, urban growth, and persistent inequality are likely to make this question more urgent. Indonesia now needs evidence that follows digital-DRR interventions beyond their launch and asks who actually uses them, who changes behaviour, who remains excluded, what the gains cost, and whether they endure. The most important next step is therefore not simply to produce more platforms. It is to learn, with greater methodological discipline, whether digital innovation reaches people facing the greatest exposure and the fewest practical options.

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7 References

1. Abedin, Md. A., Parvin, G. A., Habiba, U., Kibria, M. G., Ahsan, R., Onitsuka, K., Rahman, Md. M., Kobeasy, M. I., & Gaber, A. (2022). ICT Uses, Constraints, and Challenges in Flash Flood Risk Management: A Case Study in North-Eastern Haor Areas of Bangladesh. Sustainability, 14(13), 8018. https://doi.org/10.3390/su14138018
2. Andriani, A. D. (2023). Digital Literacy as a Media for Da'wah Communication in Overcoming Disaster Hoaxes in Cianjur Regency. Ilmu Dakwah Academic Journal for Homiletic Studies, 17(2), 373-396. https://doi.org/10.15575/idajhs.v17i2.29298
3. Andung, P. A., Lobo, L. J., & Mandaru, S. S. E. (2021). Disaster Information Literacy During Covid-19 Pandemic at a Christian School in Disaster-Prone Area. https://doi.org/10.2991/assehr.k.210101.002
4. Asshiddiqi, M. R., Vitasari, M., & Biru, L. T. (2021). VALIDITY OF DISASTER E-BOOK TO IMPROVE DISASTER LITERACY SKILLS AT JUNIOR HIGH SCHOOL. Jurnal Pena Sains, 8(2), 79-87. https://doi.org/10.21107/jps.v8i2.12204
5. As'ari, R. (2026). Empowering communities with technology and nature-based solutions for effective disaster education. Iop Conference Series Earth and Environmental Science, 1586(1), 012087. https://doi.org/10.1088/1755-1315/1586/1/012087
6. Chan, E. Y. Y., Dubois, C., Fong, A. H. Y., Shaw, R., Chatterjee, R., Dabral, A., Loyzaga, A. Y., Kim, Y., Hung, K. K. C., & Wong, C. S. (2021). Reflection of Challenges and Opportunities within the COVID-19 Pandemic to Include Biological Hazards into DRR Planning. International Journal of Environmental Research and Public Health, 18(4), 1614. https://doi.org/10.3390/ijerph18041614
7. Corcuera, L. N. de, Barbero-Barrera, M. del M., Hidalgo, A. C., & Martínez, J. R. (2021). Assessment of the adequacy of mobile applications for disaster reduction. Environment

Development and Sustainability, 24(5), 6197-6223. https://doi.org/10.1007/s10668-021-01697-2

8. Cuadra, J. M., & Cotoron, V. N. (2025). Addressing false information through local capacity building in community-based disaster risk management. Jàmbá Journal of Disaster Risk Studies, 17(1). https://doi.org/10.4102/jamba.v17i1.1836
9. Damayani, N. A., Saepudin, E., Rusmana, A., Rizal, E., & McArthur, J. M. B. (2022). The local wisdom-based disaster mitigation literacy of the indigenous Pangandaran community. Jurnal Studi Komunikasi (Indonesian Journal of Communications Studies), 6(2), 424-439. https://doi.org/10.25139/jsk.v6i2.4862
10. Djalante, R.: Review article: A systematic literature review of research trends and authorships on natural hazards, disasters, risk reduction and climate change in Indonesia, Nat. Hazards Earth Syst. Sci., 18, 1785-1810, https://doi.org/10.5194/nhess-18-1785-2018, 2018.
11. Ginting, W. O. (2026). Strategic management of multihazard risk in Medan City: Integrating risk analysis with nature-based solutions for urban climate resilience. Iop Conference Series Earth and Environmental Science, 1586(1), 012091. https://doi.org/10.1088/1755-1315/1586/1/012091
12. Hasibuan, E. J., Sahputra, D., & Mazdalifah, M. (2022). The Presence of Television Media in Disaster Reporting to Increase the Community's Disaster Literacy Skills. Jurnal Komunikasi Ikatan Sarjana Komunikasi Indonesia, 7(1), 75-82. https://doi.org/10.25008/jkiski.v7i1.640
13. Hutagalung, S. S., & Indrajat, H. (2023a). Multistakeholder Education Model in Strengthening Literacy and Disaster Awareness in Lampung Province. Kne Social Sciences. https://doi.org/10.18502/kss.v8i5.13006
14. Hutagalung, S. S., & Indrajat, H. (2023b). Multistakeholder Education Model in Strengthening Literacy and Disaster Awareness in Lampung Province. Kne Social Sciences. https://doi.org/10.18502/kss.v8i5.13006
15. Logayah, D. S., Maryani, E., Ruhimat, M., & Wiyanarti, E. (2023). Understanding Disaster Literacy Level in Indonesia: How can students understand natural disasters? Al-Ishlah Jurnal Pendidikan, 15(4), 4962-4971. https://doi.org/10.35445/alishlah.v15i4.3648
16. Maulana, S. F., & Sakir, S. (2024). Evaluating The Effectiveness of Information and Communication Technologies (Icts) in Fire Response in Disaster Management in Batam, Indonesia. International Journal of Social Service and Research, 4(02), 573-584. https://doi.org/10.46799/ijssr.v4i02.700
17. Meutia, I. F., Yulianto, Y., Indriyati, S., Hermawan, D., Kasmad, R., & Assalam, M. S. (2024). Disaster Management Strategy Through Social Capital Development. IJAMRS, 4(6), 45-50. https://doi.org/10.62225/2583049x.2024.4.6.3393
18. Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., and PRISMA Group: Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement, PLoS Med., 6, e1000097, https://doi.org/10.1371/journal.pmed.1000097, 2009.
19. Mort, M., Rodriguez-Giralt, I., & Delicado, A. (2020). Children and Young People's Participation in Disaster Risk Reduction. https://doi.org/10.51952/9781447354437
20. Mutasa, M. (2013). Investigating the significance of disaster information management. Jàmbá Journal of Disaster Risk Studies, 5(2). https://doi.org/10.4102/jamba.v5i2.73
21. Niekerk, D. van. (2025). Resilience through the integration of governance, lived experience, and knowledge. Jàmbá Journal of Disaster Risk Studies, 17(1). https://doi.org/10.4102/jamba.v17i1.1988
22. Novita, M., Nurohmah, A., Maarif, S., Nguyen, T. A. H., Kusumo, H., Marlina, D., & Anwar, M. (2022). Analysis of Disaster Mitigation in IPAS Subject of High School Phases under Merdeka Belajar Concepts. Kne Social Sciences. https://doi.org/10.18502/kss.v7i19.12463
23. Oktaria, R., Putra, P., Windah, A., & Haerudin, N. (2023). Needs Analysis of Disaster Mitigation Learning Design Based on Information Literacy in Efforts to Increase Disaster Self-awareness of Early Childhood. 816-826. https://doi.org/10.2991/978-2-38476-046-6_78

24. Prihadi, S. (2025). Digital leadership in flood disaster risk reduction for children in Bengawan Solo. Iop Conference Series Earth and Environmental Science, 1462(1), 012077. https://doi.org/10.1088/1755-1315/1462/1/012077
25. Prihantoro, E., Yusufina, A. R., & Ohorella, N. R. (2024a). Innovation in Disaster Mitigation Communication Model, Coordination, and Digital Literacy after the Cianjur Earthquake Disaster. Jurnal Komunikasi Ikatan Sarjana Komunikasi Indonesia, 9(1), 168-178. https://doi.org/10.25008/jkiski.v9i1.979
26. Prihantoro, E., Yusufina, A. R., & Ohorella, N. R. (2024b). Innovation in Disaster Mitigation Communication Model, Coordination, and Digital Literacy after the Cianjur Earthquake Disaster. Jurnal Komunikasi Ikatan Sarjana Komunikasi Indonesia, 9(1), 168-178. https://doi.org/10.25008/jkiski.v9i1.979
27. Rahmawati, P., & Rasidi, R. (2023). How to Manage Student Elementary School Learning in Disaster Areas? 495-502. https://doi.org/10.2991/978-2-494069-49-7_82
28. Rowland, J., Arenas, M., Cordani, F., Grisi, A., Nikolaraizi, M., Papazafiri, M., Williams, A. L., Goto, A., & Bingley, A. (2020). Participatory tools for disaster risk management with children and young people. 117-150. https://doi.org/10.51952/9781447354437.ch005
29. Saifudin, I. M. Moh. Y. (2023a). Disaster Health Literacy, Risk Perception, and Preparedness towards Resilience in a Volcano-Prone Community: A Cross-sectional Study in Yogyakarta, Indonesia. Journal of Community Empowerment for Health, 6(3), 154. https://doi.org/10.22146/jcoemph.86343
30. Saifudin, I. M. Moh. Y. (2023b). Disaster Health Literacy, Risk Perception, and Preparedness towards Resilience in a Volcano-Prone Community: A Cross-sectional Study in Yogyakarta, Indonesia. Journal of Community Empowerment for Health, 6(3), 154. https://doi.org/10.22146/jcoemph.86343
31. Saminan, N. F., Suhandi, A., Riandi, R., Kaniawati, I., Khairul, M., Syafrizal, S., & Saminan, S. (2024a). Disaster Literacy Inventory at Earth and Space Sciences (ESS) Lectures as Education in the Post-Covid-19 Pandemic. Kne Social Sciences. https://doi.org/10.18502/kss.v9i13.16019
32. Saminan, N. F., Suhandi, A., Riandi, R., Kaniawati, I., Khairul, M., Syafrizal, S., & Saminan, S. (2024b). Disaster Literacy Inventory at Earth and Space Sciences (ESS) Lectures as Education in the Post-Covid-19 Pandemic. Kne Social Sciences. https://doi.org/10.18502/kss.v9i13.16019
33. Sawangnate, C. (n.d.-a). Digital literacy for enhancing preparedness capacity to climate related risks among ageing population in Bankgok, Thailand. https://doi.org/10.58837/chula.the.2021.166
34. Sawangnate, C. (n.d.-b). Digital literacy for enhancing preparedness capacity to climate related risks among ageing population in Bankgok, Thailand. https://doi.org/10.58837/chula.the.2021.166
35. Senanayake, A., Samarakkody, A., Malalgoda, C., Amaratunga, D., Haigh, R., Liyanage, C., Hamza, M., Kaklauskas, A., & Shaw, R. (2023). Towards an Inclusive Disaster Education: The State of Online Disaster Education from the Learner's Perspective. Sustainability, 15(14), 11042. https://doi.org/10.3390/su151411042
36. Suharini, E., Kurniawan, E., Al-Hanif, E. T., Syifauddin, M., Nafi'ah, K., & Mahat, H. (2024a). Development of the SiAlong Platform to Improve Digital Literacy on Landslide Disasters among Generation Z in Semarang City. International Journal of Safety and Security Engineering, 14(3), 729-742. https://doi.org/10.18280/ijsse.140306
37. Suharini, E., Kurniawan, E., Al-Hanif, E. T., Syifauddin, M., Nafi'ah, K., & Mahat, H. (2024b). Development of the SiAlong Platform to Improve Digital Literacy on Landslide Disasters among Generation Z in Semarang City. International Journal of Safety and Security Engineering, 14(3), 729-742. https://doi.org/10.18280/ijsse.140306
38. Sun, H., Ai, X., & Duan, Y. (2024). Content Analysis of Disaster Risk Reduction in Secondary School Geography Textbooks in China and the United States: Promoting Disaster Resilience

through Geography Education. Sustainability, 16(21), 9321. https://doi.org/10.3390/su16219321

39. Suprapto, Y., Fasha, E. F., Liesnoor, D., & Suharini, E. (2019a). The Development of Natural Disaster Digital Literacy (DILIBA) Android Based of Students' Understanding at Primary Teacher Education Study Program, Peradaban University. https://doi.org/10.4108/eai.19-10-2018.2281720
40. Suprapto, Y., Fasha, E. F., Liesnoor, D., & Suharini, E. (2019b). The Development of Natural Disaster Digital Literacy (DILIBA) Android Based of Students' Understanding at Primary Teacher Education Study Program, Peradaban University. https://doi.org/10.4108/eai.19-10-2018.2281720
41. Syam, B. M., Sutisna, S., Kurniadi, A., & Kusuma. (2023). The role of digital literacy capability of Babinsa Kodim 0705/Magelang to improve community preparedness for natural disasters. E3s Web of Conferences, 464, 04001. https://doi.org/10.1051/e3sconf/202346404001
42. Weyrich, P., Ruin, I., Terti, G., & Scolobig, A. (2021). Using serious games to evaluate the potential of social media information in early warning disaster management. International Journal of Disaster Risk Reduction, 56, 102053. https://doi.org/10.1016/j.ijdrr.2021.102053
43. Winarni, E. W., & Purwandari, E. P. (2018). Disaster Risk Reduction for Earthquake Using Mobile Learning Application to Improve the Students Understanding in Elementary School. Mediterranean Journal of Social Sciences, 9(2), 205-214. https://doi.org/10.2478/mjss-2018-0040
44. Zavaleta, G. (2026). The world in the palm of our hands: a thematic analysis on key factors for effective disaster risk management mobile applications. https://doi.org/10.21203/rs.3.rs-8253919/v1

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