

InaRISK Personal for Disaster Risk Literacy: A Content Analysis of Indonesia's Mobile Education Platform

Susilastuti¹

¹Disaster Management Study Program, Republic of Indonesia Defense University, Indonesia

Syamsul Maarif²

²Disaster Management Study Program, Republic of Indonesia Defense University, Indonesia

Kusuma³

³Disaster Management Study Program, Republic of Indonesia Defense University, Indonesia

Anwar Kurniadi⁴

³Disaster Management Study Program, Republic of Indonesia Defense University, Indonesia

Corresponding Author: susilastuti.sussi@gmail.com

Abstract

Digital innovation reshapes disaster preparedness education, with mobile platforms offering accessible learning opportunities. This study examines InaRISK Personal, Indonesia's government-developed mobile disaster education application, addressing the research gap in evaluating digital disaster preparedness tools in developing countries. Using descriptive qualitative content analysis combined with systematic literature review, we assessed the application against established disaster education frameworks (Petal et al., 2008; Paton & Johnston, 2017). Analysis reveals InaRISK Personal provides localized risk assessments, real-time hazard mapping, and personalized mitigation recommendations across four disaster phases. Despite 399,000 cumulative downloads by December 2024, active monthly users declined 18.85%, indicating critical retention challenges. Key barriers include limited digital literacy in Indonesia's context, weak curriculum integration, and absence of gamification features. This study contributes the first comprehensive content analysis of a government-developed disaster education app in Indonesia's high-risk context, providing empirical evidence of the retention paradox, where initial adoption does not guarantee sustained engagement. Findings suggest enhancing teacher training, embedding platforms within curricula, implementing engagement strategies, and strengthening digital literacy programs are critical for maximizing mobile-based disaster preparedness education



effectiveness in disaster-prone developing countries.

Keywords: Disaster Education; Digital Literacy; InaRISK Personal; Mobile Learning; Risk Communication

INTRODUCTION

Indonesia's exceptional vulnerability to natural disasters, ranked second globally in the 2024 World Risk Report (Bündnis Entwicklung Hilft & IFHV, 2024), necessitates innovative disaster preparedness strategies. The country's position within the Pacific Ring of Fire and at the convergence of major tectonic plates creates persistent exposure to earthquakes, tsunamis, volcanic eruptions, floods, and landslides. Recent catastrophic events, the 2004 Indian Ocean tsunami claiming over 230,000 Indonesian lives and the 2018 Central Sulawesi earthquake and tsunami with 4,400 fatalities (Global Facility for Disaster Reduction and Recovery [GFDR], 2025) underscore persistent gaps in public disaster awareness despite decades of traditional educational efforts. These recurring tragedies demonstrate that conventional disaster education approaches, while foundational, often fail to reach diverse populations effectively or engage younger demographics accustomed to digital interfaces.

The proliferation of mobile technology creates unprecedented opportunities for disaster education, with approximately 70% of the global population projected to access mobile services by 2025 (about 5.8 billion people). Mobile applications have become indispensable tools for disseminating immediate notifications, facilitating emergency communication, and coordinating response activities, representing a paradigm shift in disaster risk communication. However, Indonesia's inadequate digital literacy levels present significant challenges for technology-based disaster education initiatives, creating potential barriers between technological innovation and effective implementation. Furthermore, while disaster apps receive positive initial reception (22% positive user feedback), maintaining long-term engagement presents substantial difficulties, with users frequently citing technical issues including signup/signin problems, network connectivity challenges, and app configuration issues as major frustrations.

While extensive research examines disaster education effectiveness (Kamil et al., 2020; Rachmawan et al., 2024) and mobile learning applications (Kulemeke, 2015), limited empirical studies evaluate government-developed disaster education platforms in developing country contexts. Existing literature focuses predominantly on Western applications or theoretical



frameworks, leaving a critical gap in understanding how digital disaster preparedness tools function within Indonesia's unique socio-cultural and technological landscape. Rachmawan et al. (2024) demonstrated that virtual interactive media significantly improved flood disaster preparedness among Indonesian adolescents, with increased knowledge retention compared to conventional methods. Similarly, Kamil et al. (2020) reported that geospatial literacy interventions through digital platforms enhanced disaster comprehension by 91.6% among high school students. However, these studies primarily evaluate educational effectiveness without examining sustained user engagement patterns, retention challenges, or the translation of platform features into long-term behavioral changes.

Furthermore, no comprehensive content analysis exists examining user engagement patterns, retention challenges, and educational effectiveness of Indonesia's official disaster education applications. Sudrajad et al. (2023) noted underutilization of InaRISK Personal in educational settings, attributing this to limited teacher training and weak curriculum integration, yet provided limited empirical data on usage patterns or specific barriers. Amrand et al. (2022) identified digital literacy as a barrier to technology-based disaster education but did not quantify its impact on actual platform usage. This gap between technological availability and sustained educational impact remains critically underexplored in disaster education literature, particularly in high-risk developing country contexts where mobile technology could provide the most significant benefits.

This study addresses these gaps by conducting the comprehensive content analysis of InaRISK Personal, Indonesia's official mobile disaster education platform launched by the National Disaster Management Authority (BNPB) in 2017. Specifically, this research examines: (1) the platform's features and functionalities within established disaster education frameworks (Petal et al., 2008; Paton & Johnston, 2017), evaluating how design elements align with effective disaster education principles; (2) user engagement patterns and retention challenges using empirical analytics data from December 2024, quantifying the gap between downloads and sustained usage; and (3) the platform's educational value and potential contributions to disaster risk literacy in Indonesia's disaster-prone context. This study contributes empirical evidence documenting the retention paradox in mobile disaster education, where initial adoption does not guarantee sustained engagement, and offers policy recommendations to enhance mobile-based disaster preparedness education effectiveness in high-risk developing countries.



THEORETICAL INSIGHT

Digital Technology in Disaster Education

The integration of digital technology into disaster risk reduction (DRR) education has accelerated significantly over the past decade, transforming traditional pedagogical approaches. Mobile applications have emerged as critical tools for enhancing disaster preparedness, particularly in disaster-prone regions where timely information access can save lives (Kulemeke, 2015). These platforms offer real-time information dissemination, personalized risk assessments, and interactive learning experiences that traditional educational methods, such as printed materials, classroom lectures, and community seminars, cannot provide with comparable immediacy and customization.

Recent empirical studies demonstrate the effectiveness of mobile-based disaster education in Indonesian contexts. Rachmawan et al. (2024) found that virtual interactive media, specifically the InaRISK Personal application, significantly improved flood disaster preparedness among adolescents, with increased knowledge retention rates compared to conventional teaching methods. The study employed pre-test and post-test designs, revealing statistically significant improvements in disaster knowledge scores among participants who engaged with the digital platform. Similarly, Kamil et al. (2020) reported that geospatial literacy interventions through digital platforms enhanced disaster comprehension by 91.6% among high school students in Indonesia, demonstrating the potential for technology-mediated learning to translate complex spatial risk information into accessible educational content. These findings underscore mobile applications' capacity to bridge the gap between scientific hazard data and public understanding, particularly among younger generations who demonstrate higher digital literacy and comfort with mobile interfaces.

However, the literature also reveals critical challenges that temper enthusiasm for technology-based disaster education. Amrand et al. (2022) noted that technology-based disaster education initiatives often face barriers related to limited digital literacy, particularly among vulnerable populations including elderly individuals, low-income communities, and rural residents with limited technology exposure. This digital divide creates inequitable access to potentially life-saving information, contradicting the inclusive principles of effective disaster risk communication. Furthermore, the literature demonstrates that while mobile applications show initial effectiveness in knowledge transfer, questions remain about long-term behavioral change and sustained engagement factors critical to disaster preparedness beyond mere awareness.

The gap between short-term knowledge gains and sustained preparedness behaviors



represents a critical deficiency in current disaster education research. Most studies evaluate immediate post-intervention knowledge improvements without longitudinal follow-up examining whether users maintain engagement with platforms, integrate risk reduction practices into daily routines, or demonstrate improved disaster response behaviors during actual emergencies. This research limitation is particularly problematic for mobile applications, where initial downloads may not translate into sustained usage or meaningful learning outcomes.

Mobile Learning Effectiveness and User Engagement

The theoretical foundations of mobile learning draw from connectivism and constructivism, which emphasize networked learning and active knowledge construction (Siemens, 2008; Driscoll, 2005). Connectivism posits that learning occurs through networks of information and social connections, facilitated by digital technologies that enable learners to access distributed knowledge sources. In disaster education contexts, mobile platforms enable learners to access information anytime and anywhere, facilitating continuous engagement with risk mitigation content beyond formal educational settings. The ubiquity of mobile devices, carried consistently by users throughout daily activities, creates opportunities for "learning in context," where individuals can assess personal risk exposure in real-time based on current location and circumstances.

Constructivist approaches suggest that learning occurs through active engagement and personal meaning-making rather than passive information reception (Gopnik & Wellman, 2012). Mobile disaster education platforms that incorporate interactive features, personalized content, and social sharing capabilities align with these pedagogical principles by positioning learners as active participants in knowledge construction. Features such as location-based risk assessment, customizable notification settings, and community sharing mechanisms transform users from passive information consumers to active risk analysts engaging with personalized data relevant to their specific circumstances.

Despite theoretical promise, empirical evidence on mobile learning effectiveness in disaster education remains mixed, particularly regarding sustained engagement. Research on disaster-related mobile applications reveals significant user retention challenges that undermine their potential educational impact. Studies indicate that while disaster apps receive positive initial reception, maintaining long-term user engagement presents substantial difficulties. App store analyses reveal that technical issues including signup/signin problems (creating friction at the critical entry point), network connectivity challenges (particularly problematic in disaster-prone



areas with unreliable infrastructure), and app configuration issues significantly impact user satisfaction and continued usage. These technical barriers, combined with the episodic nature of disaster preparedness, where motivation peaks following nearby disasters but wanes during calm periods, create substantial retention challenges.

Furthermore, the literature reveals a gap between user satisfaction with content quality and sustained engagement patterns. Users may rate disaster education apps positively for information quality and interface design yet discontinue usage after initial exploration. This paradox suggests that content quality alone is insufficient for sustained engagement; platforms must incorporate mechanisms that motivate repeated interactions, integrate into users' daily routines, or provide ongoing value beyond disaster events. The absence of gamification, social features, personalized learning paths, and achievement systems in many disaster education apps contributes to declining engagement after the novelty effect dissipates.

The gap between theoretical design principles and practical implementation outcomes remains a critical concern in the literature, with few studies examining why theoretically sound mobile learning platforms fail to maintain user engagement or produce sustained behavioral changes in disaster preparedness contexts.

Disaster Literacy and Community Preparedness

Disaster literacy encompasses the knowledge, skills, and attitudes necessary for effective disaster risk reduction (Triyanto et al., 2021). This multidimensional concept extends beyond factual knowledge about hazard types to include risk perception accuracy, protective action understanding, emergency response skills, and proactive preparedness behaviors. Contemporary frameworks emphasize that effective disaster education tools must be accessible (reaching diverse populations including vulnerable groups), interactive (promoting active learning rather than passive reception), localized (providing context-specific risk information relevant to users' geographic locations and circumstances), and integrated with existing curricula and community practices (Petal et al., 2008). Mobile platforms offer unique opportunities to address these requirements through location-based services that provide personalized risk assessments, multimedia content that accommodates diverse learning styles, and community engagement features that facilitate social learning and collective preparedness.

Research demonstrates positive correlations between public education and disaster response behaviors (Fu & Zhang, 2024). Community-based interventions that combine digital platforms with facilitator support show enhanced outcomes in building disaster resilience



compared to either digital-only or traditional-only approaches. This finding suggests that technology serves as an enabler rather than replacement for human-mediated learning, with optimal outcomes achieved through hybrid models integrating digital tools with community facilitators who can guide interpretation, address questions, and encourage application of knowledge to specific contexts. Paton and Johnston (2017) argue that disaster preparedness education must promote behavior change through participatory approaches that empower individuals and communities to take proactive mitigation actions rather than merely increasing awareness.

In Indonesia specifically, disaster literacy initiatives face unique contextual challenges shaped by geographic diversity, cultural heterogeneity, economic disparities, and varying levels of digital infrastructure and literacy. Ruswanto and Atmojo (2023) found that disaster learning programs incorporating Science, Environment, Technology, and Society (SETS) approaches enhanced both disaster literacy and resilience among elementary school students, demonstrating the effectiveness of integrated pedagogical frameworks that connect scientific knowledge to students' lived environments. However, Sudrajad et al. (2023) reported underutilization of digital disaster platforms like InaRISK Personal in educational settings, attributing this to limited teacher training, weak curriculum integration, and absence of systematic implementation strategies. Teachers reported feeling unprepared to effectively integrate mobile applications into lesson plans, uncertain about how to assess learning outcomes from digital platform usage, and concerned about technical challenges disrupting classroom activities.

This implementation gap, between available technological tools and effective educational integration, represents a critical barrier to realizing mobile disaster education's potential in Indonesia. While platforms like InaRISK Personal offer sophisticated features and comprehensive data, their educational impact depends on systematic integration into formal education systems, teacher capacity building, curriculum embedding, and sustained institutional support. The literature reveals that technological innovation alone is insufficient; effective disaster literacy development requires coordinated strategies addressing digital infrastructure, human capacity, institutional frameworks, and community engagement simultaneously.

METHODOLOGY

This study employed a descriptive qualitative approach with two primary sources of data. First, a content analysis was conducted on the InaRISK Personal mobile application to examine its features, user interface, and disaster education messages. Second, a literature review was carried



out, focusing on academic articles and official reports relevant to digital disaster literacy and the use of mobile applications in education. The literature was selected using three criteria: (1) it addresses digital technology in disaster education, (2) it was published between 2015 and 2025, and (3) it originates from reputable international or national journals, or from official documents issued by the government (BNPB). The findings from the content analysis and literature review were then compared with established disaster education principles (Petal et al., 2008; Paton & Johnston, 2017).

RESULT

Platform Features and Functionality

InaRISK Personal integrates authoritative hazard data from multiple Indonesian government agencies: PVMBG (Volcanology and Geological Disaster Mitigation Center), BMKG (Meteorology, Climatology, and Geophysics Agency), and BIG (Geospatial Information Agency). This integration provides comprehensive, officially validated risk information across multiple disaster types including earthquakes, tsunamis, volcanic eruptions, floods, landslides, droughts, and forest fires. Core functionalities include real-time location-based risk assessment utilizing GPS coordinates to provide personalized exposure analysis, multilayered hazard mapping displaying spatial distribution of multiple disaster risks simultaneously, and personalized mitigation recommendations tailored to users' specific locations across four disaster management phases: preparedness, response, recovery, and reconstruction.

The risk scoring system employs standardized color-coding (green indicating low risk, yellow indicating moderate risk, orange indicating high risk, red indicating very high risk) for immediate visual risk comprehension. This color scheme aligns with international risk communication standards and facilitates rapid assessment without requiring technical interpretation. Users can input specific addresses or use automatic geolocation to generate location-specific risk profiles showing exposure levels across all disaster types relevant to that area.

Advanced features include downloadable risk reports enabling users to save and share PDF documents containing comprehensive risk assessments for specific locations, facilitating family discussions and community planning. Social sharing capabilities allow users to distribute risk information via messaging apps, social media, and email, potentially expanding platform reach through peer networks. Integration with Dapodik (Indonesia's national school database) enables educational institution risk profiling, allowing schools to assess facility exposure and plan



appropriate preparedness measures. This feature particularly supports the government's School Safety from Disasters (Satuan Pendidikan Aman Bencana/SPAB) program.

The platform demonstrates strong usability principles with intuitive navigation structured around clear menu categories, visual hierarchy emphasizing critical information through size and color contrasts, and responsive design optimized for Android devices across various screen sizes. The interface employs familiar mobile design patterns reducing learning curves for users with basic smartphone experience. Educational content is presented through multiple modalities including text explanations, infographics, instructional videos, and interactive maps accommodating diverse learning preferences.

However, accessibility features for users with disabilities remain limited. The application lacks screen reader optimization for visually impaired users, does not offer text resizing options beyond device-level settings, provides limited audio alternatives to visual content, and includes insufficient color contrast in some interface elements potentially challenging users with color vision deficiencies. These limitations potentially exclude vulnerable populations from accessing critical disaster information, contradicting inclusive design principles essential for effective public education tools.

User Engagement and Adoption Patterns

Platform analytics reveal significant challenges in user retention despite download growth. As of December 2024, InaRISK Personal achieved 399,000 cumulative downloads representing a 12.5% increase from 2023's 355,000 downloads. This growth indicates expanding platform awareness and initial adoption, potentially driven by BNPB promotional efforts, media coverage of recent disasters, or educational institution recommendations.

However, active monthly users declined sharply to 50,300 devices, a concerning 18.85% decrease throughout 2024 compared to 62,000 active monthly users in 2023. This divergence between cumulative downloads and active user trends reveals a critical retention problem: while new users continue discovering and installing the application, existing users discontinue engagement at rates exceeding new adoption. The resulting net decline in active users suggests the platform struggles to maintain relevance or value proposition beyond initial exploration.

Figure 1 illustrates these contrasting trends, showing cumulative download growth alongside declining active user engagement throughout 2024.



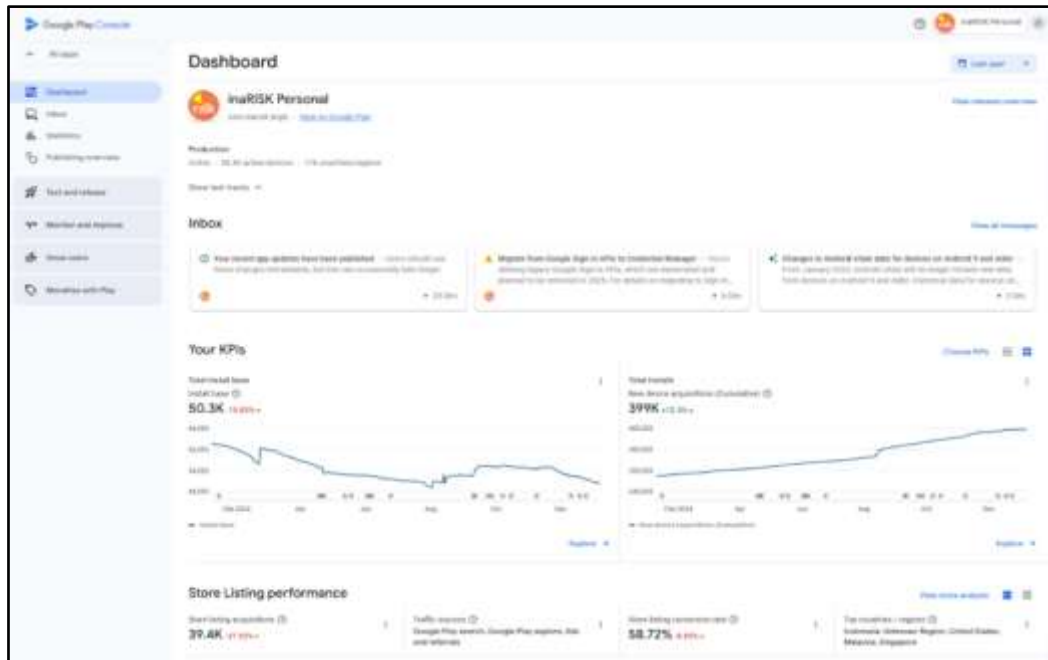


Figure. 1. User Trend Analysis of the InaRISK Personal Application Based on Google Analytics as of December 2024 (source: BNPB, 2024)

Table 1 summarizes key engagement metrics demonstrating the retention challenge pattern across multiple indicators.

Table 1. InaRISK Personal User Engagement Metrics (2024)

Metric	Value	Change from 2023
Total Downloads	399,000	+12.5%
Active Monthly Users	50,300	-18.85%
Google Play Rating	3.5/5	-0.2
Installation Conversion Rate	58.73%	-8.83%

The installation conversion rate of 58.73% indicates that among users who view the app listing on Google Play Store, approximately 59% proceed to install—a moderate conversion

suggesting the app description and presentation generate sufficient interest for trial. However, the 8.83% decline in conversion rate from 2023 suggests weakening appeal or growing competition from alternative disaster information sources.

The Google Play rating of 3.5/5 represents moderate user satisfaction, declining 0.2 points from 2023's 3.7/5 rating. This mid-range rating suggests mixed user experiences: some users find value while others encounter frustrations or disappointments. Review analysis reveals common complaints including technical glitches, slow loading times, outdated information in some regions, and desires for additional features such as real-time disaster notifications and community forums.

This declining engagement pattern aligns with broader disaster app retention challenges documented in recent literature, where technical issues including signup/signin problems creating entry friction, network connectivity issues particularly problematic in areas with unreliable infrastructure, and app configuration challenges significantly impact user satisfaction and continued usage. The absence of engaging features such as gamification, achievement systems, personalized learning paths, or social interaction mechanisms contributes to declining motivation for repeated interactions after initial exploration satisfies curiosity.

User Satisfaction Assessment

Despite declining active user numbers, satisfaction surveys reveal that users who do engage with the platform express positive evaluations of core features. Figure 2 presents respondent satisfaction with InaRISK Personal's content and visual presentation of disaster mitigation information, based on surveys administered to active users.

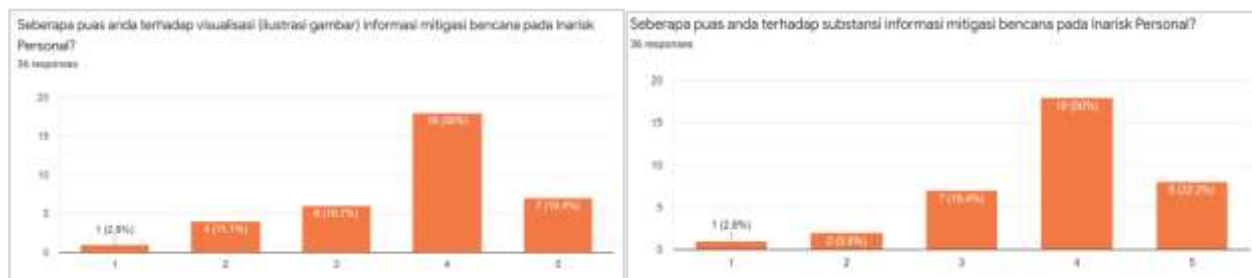


Figure 2. Respondents' Satisfaction with the Content and Visual Presentation of Disaster Mitigation Information on Inarisk Personal (Source: BNPB, 2024)

Survey results indicate majority satisfaction with both informational content substance and

graphical illustrations. Specifically, users rated the accuracy and comprehensiveness of disaster risk information positively, appreciated the color-coded risk maps for visual clarity, found mitigation recommendations practical and actionable, and valued the integration of multiple government data sources providing authoritative information.

These qualitative findings create a paradox: users who engage with the platform find educational value and express satisfaction with content quality, yet overall engagement declines substantially. This suggests that content quality alone is insufficient for sustained engagement. Users may appreciate the information during active usage but lack motivations for repeated interactions. The episodic nature of disaster preparedness, where concern peaks following nearby disasters but wanes during calm periods combined with absence of features promoting habitual usage patterns, contributes to declining engagement despite content satisfaction.

The divergence between content satisfaction and usage patterns underscores the importance of continuously enhancing both functionality addressing user needs and user experience creating engaging, habit-forming interactions to improve sustained usage. Educational effectiveness requires not only quality information but also delivery mechanisms that maintain user attention and encourage repeated engagement sufficient for knowledge retention and behavioral integration.

DISCUSSION

Consistent with findings from Rahmawan et al. (2024), the use of digital platforms like InaRISK Personal enhances knowledge retention and risk perception. Fu & Zhang (2024) evidence of positive correlations between public education and disaster response behaviors further underscores the platform's potential as an educational tool.

However, the underutilization of InaRISK Personal reported here echoes challenges noted in ICT-based disaster education literature, including the need for broader programmatic integration and sustained community engagement (Amrand et al., 2022). This study highlights the necessity of coupling technological innovation with educational policies and grassroots involvement to realize meaningful impact.

Disaster information that is easier to obtain and more rapid is one of the beneficial effects of disaster literacy. Applications from BNPB, BMKG, and BPPTKG as well as social media platforms like Facebook, Instagram, and Twitter can offer quick and precise information. Anxiety, lack of preparation, losses, and other disaster risks can be decreased by using technology as disaster



literacy. The community will benefit from a wealth of freely accessible literacy resources for disaster mitigation information. According to a study by Kamil et al. (2020), geospatial literacy can improve people's comprehension and knowledge of catastrophes by 91.6%. Disaster literacy for children may be a good starting point for helping students develop their understanding and personal skills related to disaster care in their surrounding environment (Ruswanto, 2023).

CONCLUSION

This study examined InaRISK Personal's features, user engagement patterns, and educational value within established disaster education frameworks, addressing critical gaps in understanding government-developed disaster education platforms in developing countries. The research provides comprehensive empirical analysis of Indonesia's official mobile disaster preparedness education application, evaluating its potential contributions to disaster risk literacy and identifying barriers limiting effectiveness.

The analysis reveals that InaRISK Personal demonstrates strong educational potential through its integration of authoritative hazard data from multiple government agencies (PVMBG, BMKG, BIG), real-time location-based risk assessment enabling personalized exposure analysis, multilayered hazard mapping displaying comprehensive risk profiles, and actionable mitigation recommendations organized across four disaster phases (preparedness, response, recovery, reconstruction). These features align with established disaster education effectiveness principles (Petal et al., 2008; Paton & Johnston, 2017), providing accessible, localized, and actionable disaster risk information to Indonesian communities in a highly disaster-prone context. User satisfaction surveys confirm that engaged users perceive educational value, appreciating content quality and visual presentation.

However, the study identifies a critical retention paradox central to understanding mobile disaster education effectiveness: while cumulative downloads reached 399,000 (+12.5% in 2024), active monthly users declined 18.85% during the same period to 50,300 devices. This finding reveals that initial adoption does not guarantee sustained engagement, a distinction often overlooked in disaster education effectiveness research focusing on immediate knowledge gains without examining long-term usage patterns. The 12.6% active user rate (50,300 / 399,000) indicates that nearly 87% of users who downloaded the application no longer engage regularly, suggesting that download statistics dramatically overestimate actual educational impact.

Key barriers explaining the retention paradox include: limited digital literacy particularly among vulnerable populations, rural communities, and older demographics lacking smartphone



proficiency for comfortable app navigation; weak formal education integration stemming from inadequate teacher training, absence of systematic curriculum embedding, and lack of assessment frameworks linking platform usage to learning outcomes; absence of engagement-enhancing features such as gamification, social interaction mechanisms, personalized learning paths, or achievement systems creating ongoing usage motivations; technical usability challenges including connectivity issues, slow loading times, and configuration difficulties generating user frustration; and the episodic nature of disaster concern where preparedness motivation peaks following disasters but wanes during calm periods absent features creating habitual usage patterns.

The research contributes three key insights to disaster education scholarship. First, it provides the first comprehensive content analysis of Indonesia's government-developed disaster education app, filling geographical and institutional gaps in mobile disaster education literature dominated by Western contexts and non-governmental platforms. Second, it empirically documents the retention challenge paradox in mobile disaster learning, demonstrating that effectiveness frameworks must account for sustained engagement alongside content quality, accessibility, and localization. Petal et al. (2008) disaster education criteria provide valuable design guidelines but insufficient attention to engagement mechanisms maintaining user interest beyond initial exposure. Third, it reveals critical implementation gaps between technological availability and effective educational integration in developing country contexts, emphasizing that technology transfer requires capacity building and institutional development alongside technical tools.

To realize InaRISK Personal's full educational potential and maximize mobile-based disaster preparedness education effectiveness, comprehensive strategies addressing multiple barriers simultaneously are essential. Policy recommendations include: enhancing user engagement through gamification elements (points, badges, challenges), social features enabling community formation and peer learning, personalized learning paths adapting to individual progress, and progress tracking creating habitual usage patterns; strengthening formal education integration through systematic teacher professional development programs, explicit curriculum standards incorporating digital disaster education, structured learning activities guiding student exploration, and assessment frameworks measuring platform-based learning outcomes; investing in digital literacy programs targeting vulnerable populations with limited smartphone proficiency, providing community training sessions, and developing simplified interface options for users with basic digital skills; developing community facilitator networks positioning mobile platforms within guided learning contexts rather than standalone tools, training disaster volunteers and local



leaders to facilitate group discussions, and creating hybrid implementation models combining technology scalability with human guidance; addressing technical usability issues through infrastructure improvements ensuring reliable connectivity, interface optimization reducing loading times and configuration complexity, and accessibility enhancements accommodating users with disabilities; and evaluating programs using active engagement and behavioral outcome metrics rather than download statistics, measuring sustained usage patterns, feature utilization depth, and actual preparedness behavior improvements.

These recommendations apply beyond Indonesia to disaster-prone developing countries worldwide seeking to leverage mobile technology for disaster preparedness education. The study demonstrates that effective mobile disaster education requires coordinated strategies addressing digital infrastructure, human capacity, institutional frameworks, and community engagement simultaneously, technology alone is insufficient.

Study limitations include the content analysis approach's inability to directly measure learning outcomes or behavioral changes, reliance on secondary analytics data limiting demographic and contextual understanding, focus on Indonesian and English-language literature potentially missing relevant international research, and examination of a single platform at one time point limiting generalizability and longitudinal perspective.

Future research should employ experimental designs measuring actual behavioral changes among users compared to control groups, conduct longitudinal studies tracking engagement patterns and preparedness behaviors over extended periods, utilize mixed-methods approaches exploring user experiences and motivations through qualitative interviews complementing quantitative analytics, perform comparative analyses across multiple countries' disaster education applications identifying universal versus context-specific success factors, and evaluate specific intervention strategies (gamification implementations, teacher training models, community facilitator programs) through controlled trials providing actionable evidence for platform improvement and implementation strategy development.

FUTURE DIRECTION

InaRISK Personal's adaptability enables integration into various educational and community contexts, offering multiple pathways for enhancing disaster risk literacy beyond current implementation. The platform's potential applications extend across formal education, community outreach, organizational preparedness, and personal empowerment initiatives.

In formal education settings, InaRISK Personal can enrich geography curricula through



practical risk mapping exercises where students assess hazard exposure for their schools, homes, and communities, translating abstract geographic concepts into personally relevant spatial analysis. Science education can utilize the platform to explore geological and meteorological disaster mechanisms, examining why specific locations face particular hazards and how natural processes generate risk patterns. Civic education can incorporate the platform into lessons on community responsibility, emergency management systems, and individual preparedness obligations, connecting civic participation concepts to tangible disaster preparedness actions. Environmental education can examine human-environment interactions creating or mitigating disaster risks, exploring how land use decisions, infrastructure development, and climate change influence exposure patterns.

In community outreach contexts, the platform's use during focus group discussions can ground risk concepts in local realities, increasing relevance and retention. Community facilitators can guide groups through collective risk assessments for neighborhoods, villages, or organizations, fostering shared understanding and collaborative planning. Disaster simulation exercises can integrate platform data, with participants using real hazard information to develop emergency response scenarios, evacuation plans, and resource allocation strategies. Religious institutions, community centers, and local government offices can host platform training sessions, reaching populations beyond formal education systems.

As a mobile learning tool, InaRISK Personal democratizes access to disaster information for youth and vulnerable populations traditionally excluded from formal disaster education programs. Young people can independently assess personal risk exposure, empowering them as active participants in family preparedness planning rather than passive dependents. Vulnerable populations including persons with disabilities, elderly individuals, and marginalized communities can access authoritative information without requiring literacy in technical disaster terminology, though accessibility improvements are necessary to fully realize this potential.

Importantly, the platform's effectiveness is amplified when paired with facilitators or community champions who can guide interpretation, address questions, encourage proactive behaviors, and maintain engagement motivation. Hybrid implementation models combining technology scalability with human facilitation represent the most promising pathway for maximizing educational impact. Future development should prioritize features supporting facilitated usage: group assessment tools enabling collective risk analysis, discussion guides providing structure for facilitator-led sessions, implementation checklists tracking community



preparedness progress, and communication features connecting facilitators with users for ongoing support.

The platform's evolution should respond to identified retention challenges through engagement-enhancing features, accessibility improvements, and integration mechanisms supporting systematic implementation. By addressing current limitations while leveraging existing strengths, authoritative data integration, comprehensive hazard coverage, localized risk assessment, actionable recommendations. InaRISK Personal can realize its substantial potential as a cornerstone of Indonesia's disaster preparedness education infrastructure and model for disaster-prone developing countries worldwide.

REFERENCES

- Amrand, D., Syahbuddin, F., Siam, F., Sapan, Y. T., Pradjono, R., & Safiuddin, S. (2022). Edukasi, Sosialisasi, dan Simulasi Bencana Alam Pada Masyarakat Melalui Pendekatan Berbasis Teknologi Dengan Memanfaatkan Sosial Media. *Educate*~. <https://doi.org/10.32585/educate.v2i2.2802>
- Badan Nasional Penanggulangan Bencana. (2024). *Laporan kinerja: Direktorat Sistem Penanggulangan Bencana*. Kedeputan Bidang Sistem dan Strategi.
- Bündnis Entwicklung Hilft & IFHV. (2024). *WorldRiskReport 2024: Focus – Multiple Crises*. Ruhr University Bochum – Institute for International Law of Peace and Armed Conflict (IFHV). <https://www.weltrisikobericht.de>
- Creswell, J. W. (2021). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage Publications.
- Direktorat Sistem Penanggulangan Bencana, BNPB. (n.d.). *Panduan penggunaan InaRISK*. <https://inarisk.bnpb.go.id/>
- Fu, Q., & Zhang, X. (2024). Promoting community resilience through disaster education: Review of community-based interventions with a focus on teacher resilience and well-being. *PLOS ONE*, 19(1), e0296393. <https://doi.org/10.1371/journal.pone.0296393>
- Global Facility for Disaster Reduction and Recovery. (2025, January). *On the road to resilience: Indonesia's disaster risk management journey*. The World Bank. <https://www.gfdr.org/en/feature-story/road-resilience-indonesias-disaster-risk-management-journey-1>
- Kamil, P. A., Utaya, S., Sumarmi, & Utomo, D. H. (2020). Improving disaster knowledge within high school students through geographic literacy. *International Journal of Disaster Risk*



- Reduction*, 44, 101411. <https://doi.org/10.1016/j.ijdr. 2019.101411>
- Kulemeke, O. (2015). Teaching disaster preparedness via a mobile device: A study of Auckland Civil Defence's smartphone application. *Natural Hazards and Earth System Sciences Discussions*, 3(6), 4555–4583. <https://doi.org/10.5194/nhessd -3-4555-2015>
- Paton, D., & Johnston, D. (2017). *Disaster resilience: An integrated approach* (2nd ed.). Charles C Thomas Publisher.
- Petal, M., Green, R., Kelman, I., Shaw, R., & Dixit, A. (2008). Community-based construction for disaster risk reduction. In I. Kelman & T. Mather (Eds.), *Living with environmental change* (pp. 191-217). Routledge.
- Rachmawan, I., Hidayat, W. S., Prasetyawan, R. D., & Iswahyudi, U. A. (2024). The effectiveness of the virtual interactive media InaRISK Personal on flood disaster preparedness among adolescents. *Nusantara Journal of Disaster and Emergency Studies*, 5(1), 45–54. <https://doi.org/10.54832/nij.v5i1.1258>
- Ruswanto, & Atmojo, S. E. (2023). SETS (Science, Environment, Technology, and Society) based disaster learning on elementary school students' disaster literacy and resilience. *International Journal of Elementary Education*, 7(4), 576–585. <https://doi.org/10.23887/ijee.v7i4.67651>
- Sudrajad, B., Napitupulu, D., & Rhofiq, A. (2023). Sosialisasi penggunaan aplikasi InaRISK Personal kepada siswa sekolah menengah atas dalam upaya mewujudkan Satuan Pendidikan Aman Bencana (SPAB) di Kota Jayapura. *Jurnal Altifani Penelitian dan Pengabdian Kepada Masyarakat*, 3(3), 423–430. <https://doi.org/10.59395/altifani. v3i3.423>
- Sunzuma, G., & Umbara, U. (2025). Ethnomathematics-based technology in Indonesia: A systematic review. *Asian Journal for Mathematics Education*, 4(1), 129-153. <https://doi.org/10.1177/27527263241305812>
- Triyanto, T., Agustinova, D. A., & Syamsi, K. (2021). Strengthening disaster literacy as an effort to reduce the risk of disaster in D.I. Yogyakarta society. *IOP Conference Series: Earth and Environmental Science*, 884(1), 012032. <https://doi.org/10.1088/1755-1315/ 884/1/ 012032>

