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Digital Pocket Book as Learning Medium for Disaster Preparedness in the Technological Era

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Abstract

This study develops a digital pocket book as an innovative learning medium to enhance disaster preparedness among high school students in disaster-prone Imogiri, Indonesia. Using a Research and Development (R&D) approach with a modified Borg & Gall model, the research involved needs analysis, expert validation, and three-stage field testing (preliminary, main, and operational) with 15-94 students and teachers. The digital media, designed with localized disaster content (floods, earthquakes, landslides) and interactive visual elements, was evaluated for practicality and effectiveness. Results showed high practicality scores from both students (average 71.60-76.67) and teachers (4.7-4.8/5), categorized as "very practical." Most significantly, the experimental group demonstrated a moderate improvement in disaster preparedness (gain score = 0.57), significantly higher than the control group's low improvement (gain score = 0.17), as confirmed by ANOVA ($F = 36.139$, $p < 0.05$). These findings prove that contextually designed digital media effectively bridges gaps in disaster education by aligning with digital-native learning preferences and transforming theoretical knowledge into operational readiness. The study offers a replicable model for technology-enhanced disaster education in vulnerable regions, contributing to global disaster risk reduction goals. This study presents a novel digital pocket book designed to enhance students' disaster preparedness. It significantly contributes to disaster education by demonstrating how interactive, locally-focused digital resources can translate theoretical knowledge into actionable readiness. Furthermore, the research offers a reproducible development framework, enabling the creation of similar tools in other high-risk regions and thus supporting global initiatives for disaster resilience through educational technology.

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INTRODUCTION

Education is a fundamental right and a basic necessity for all humankind, including Indonesian society. In Indonesia, education plays a strategic role in enhancing capacity and holistically developing students' potential, encompassing cognitive, psychomotor, and affective aspects, as well as character formation in social life. To support an optimal educational process, the availability of adequate and relevant learning resources, teaching materials, and educational tools is essential for facilitating teaching and learning activities (Arafik et al., 2021). According to Monica & Qurrotaini, (2019), education is an effort involving a learning process for students to enable them to understand, know, and experience through teaching and training activities.

Education serves as a foundational pillar in enhancing disaster preparedness, which encompasses coordinated efforts to mitigate disaster impacts through structured planning and efficient response systems (Sofyana et al., 2024). Disaster preparedness is defined as various efforts organized to mitigate the impact of disasters through structured planning and efficient actions BNPB, (2012). Indonesia has implemented various national policies to mainstream disaster education, driven by the country's high risk of natural threats such as earthquakes, tsunamis, floods, and volcanic eruptions (BNPB, 2020).

Statistical data show the high frequency of natural disasters in Indonesia over the past four years. According to records from the Central Statistics Agency (BPS), there were 2,952 cases in 2020, which then increased significantly to 5,402 incidents in 2021. This number briefly dropped to 3,454 cases in 2022 but surged again to 5,400 incidents in 2023 (bps.go.id). Facing this reality, the government, through the collaboration of BNPB and the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek), has launched the 'Disaster-Resilient Educational Institutions' (Satuan Pendidikan Aman Bencana/SPAB) initiative as a systematic response since 2018 (BNPB, 2018).

Schools play a critical role in disaster preparedness by integrating multifaceted strategies into their systems. Complementing this, schools develop tailored emergency protocols aligned with frameworks such as LIPI-UNESCO/ISDR to address region-specific risks (e.g., earthquakes, floods) (Guo et al., 2025). Regular evacuation drills are equally vital, with studies showing they improve response efficiency when designed realistically unannounced drills, for instance, provide more accurate preparedness assessments (Kalogiannidis et al., 2022). Together, these efforts curricular integration, protocol standardization, and participatory drills foster a culture of preparedness, further supported by technology-enhanced tools (e.g., digital simulations) and community engagement, as highlighted in global reviews (Fernandes et al., 2025). Equally important, regular evacuation drills are conducted to foster a culture of preparedness within the school environment. These systematic efforts aim to create a safer and more disaster-responsive educational setting (Kemendikbud, 2021).

The Indonesian government has integrated disaster-related content into the national education system through several core subjects, particularly Social Studies, Civics, and Geography, as part of systematic efforts to build disaster awareness from an early age (Kemendikbud, 2022). Intensive training programs have been implemented to enhance teachers' capacity in equipping students with a deep understanding of potential hazards in their surroundings while training them to respond quickly and appropriately during emergencies.

Through the Ministry of Education, Culture, Research, and Technology, the Indonesian government has provided learning resources in the form of teacher and student textbooks published by the Center for Books. However, the materials in these guides remain limited to general knowledge, requiring teachers to be more creative in developing and integrating supplementary materials, especially for elementary school education (Sinaga & Setiawan, 2022). Teaching materials must also be adapted to students' socio-cultural conditions and environments (Suyitno et al., 2020), starting from the definition phase. When used in learning, well-developed teaching materials can increase student engagement and make learning more meaningful (Purwoko et al., 2019).

As the daily environment where students and other members spend 7–8 hours, schools play a strategic role in building disaster preparedness. Disaster preparedness materials must be integrated into the curriculum, and all school community members teachers, staff, and principals must understand mitigation steps for emergencies such as

earthquakes or floods. Thus, schools serve not only as formal learning spaces but also as disaster training centers covering prevention, emergency response, and post-disaster recovery (Kurniawati & Suwito, 2019). Globally, innovative approaches such as game-based learning and simulation drills have proven effective in engaging students. For instance, a study in Thailand and the Philippines found that interactive methods like virtual scenarios and evacuation mapping improved retention and practical application of disaster protocols among adolescents (Torani et al., 2019). Furthermore, schools in Japan and Canada have institutionalized regular, unannounced drills, which provide realistic assessments of preparedness and reduce evacuation times during actual emergencies (Bogdan et al., 2021).

Previous studies have shown that disaster preparedness among students and communities in Bantul Regency ranges from moderate to high. Setyaningrum & Nurhayati (2021) found that most students at SDN Jigudan Srandakan were in the "ready" category, with scores between 65 and 79. Similarly, Antari & Setyaningrum (2023) reported a significant increase in earthquake preparedness among students at SDN 1 Pundong after using educational videos. In the community context, Iwan (2019) revealed a positive correlation between knowledge levels and flood preparedness in Sriharjo Village, Imogiri. These findings emphasize the need for educational interventions and community-based efforts to strengthen disaster resilience in Bantul.

The researcher's observations on disaster preparedness among 10th and 11th-grade students at SMA Muhammadiyah Imogiri, using previously validated instruments, revealed that students' preparedness level was generally "Ready" at 69%. However, in specific indicators such as early warning systems (64%) and resource management (68%), preparedness was borderline, indicating the need for improvement. Given the students' conditions and disaster risks in Imogiri, enhancing preparedness is crucial to minimizing injuries or fatalities during disasters. Similarly, research by Calamba (2024) in the Philippines revealed that high school students possess high awareness of natural disasters but only moderate preparedness levels. The study also identified a significant correlation between awareness and preparedness, suggesting that increasing awareness could positively impact preparedness. In Bekasi, Indonesia, Sumarno & Setiadi (2023) conducted a study at a junior high school, concluding that students' knowledge, attitudes, and behaviors collectively influenced 9% of flood preparedness levels, indicating that other factors also play significant roles in disaster readiness. These studies underscore the importance of comprehensive disaster education programs that not only raise awareness but also enhance practical preparedness skills among students. Implementing regular drills, integrating disaster education into the curriculum, and providing resources for emergency planning can contribute to improved preparedness in schools, particularly in disaster-prone areas like Imogiri.

Challenges in disaster preparedness among high school students persist despite their high awareness of natural hazards. A study by Calamba (2024) reveals that while students recognize disaster risks, their actual preparedness for emergency situations remains moderate. Integrating disaster education into school curricula also faces multiple obstacles. Desilia et al., (2023) highlight that although efforts exist to include disaster topics, implementation is often limited and dependent on individual school initiatives, due in part to the lack of supportive policies and limited resources.

Teacher readiness presents another challenge. According to Aroyandini et al., (2024), many prospective science educators still lack 21st-century skills needed to effectively promote disaster literacy. Compounding the issue is the scarcity of context-specific learning media. Rachman et al., (2024) emphasize the importance of training

teachers to develop localized educational materials to enhance the effectiveness of disaster mitigation education. These findings underscore the urgent need for a more holistic approach to disaster education one that includes inclusive curriculum development, comprehensive teacher training, and the provision of locally relevant learning media to improve students' disaster preparedness.

Digital pocket books are an ideal medium practical, concise, and flexibly accessible in and outside classrooms. They serve not only as self-learning resources but also support project-based or group discussions. With engaging presentations, digital pocket books can boost student motivation in learning disaster preparedness (Md Jani et al., 2020), making them effective tools for facilitating students' understanding of disaster mitigation.

The developed digital pocket book presents disaster preparedness materials concisely, simply, and attractively through visuals and color combinations that stimulate student interest. As a technology-based medium, it delivers content more practically and efficiently than conventional books. Its compact and portable nature allows students to access learning materials anytime, anywhere (Pratiwi et al., 2021). Based on the above, this study aims to analyze the role of digital pocket books in enhancing disaster preparedness education in the digital era, particularly by exploring effective development procedures for high school students in Imogiri and examining their impact on improving disaster preparedness. Additionally, the research seeks to evaluate the usability and accessibility of digital pocket books as educational tools, assess their effectiveness in increasing students' knowledge and awareness of disaster risks, and identify potential challenges and opportunities in integrating digital learning resources into disaster education curricula. Through this comprehensive analysis, the study intends to provide actionable insights for educators and policymakers to optimize disaster preparedness strategies in schools.

METHOD

This study employs a Research and Development (R&D) approach, adapting the Borg & Gall (1983) model modified into four core stages (planning, development, testing, and revision) for efficiency and relevance to digital disaster education. This modification aligns with current trends in technology-based learning media development, emphasizing rapid iteration and practical validation (Bachri et al., 2024; Borg & Gall, 1984). The research involves three subject groups from SMA Imogiri, with different scopes for each testing phase. The preliminary trial included 15 students and 2 teachers, the main trial involved 30 students with the same 2 teachers, and the operational trial covered 94 students while still involving the 2 teachers as respondents.

The planning stage includes needs analysis, initial digital pocket book design, and research instrument preparation. The development stage involves prototype creation, validation by material and media experts, and revisions based on feedback. The testing phase is conducted in stages through preliminary, main, and operational trials to measure the practicality and effectiveness of the media.

This study uses data analysis techniques to evaluate the quality of the digital pocket book on disaster preparedness through two main aspects: feasibility and effectiveness. Product feasibility is assessed based on validation results from material and media experts, while effectiveness is measured through a series of field trials. To assess product feasibility, the researcher tabulates the validators' assessment data for each indicator, then calculates the average score for each component using the formula developed by Sugiyono, (2018).

To calculate scores for each component, the following formula was applied:

$$\bar{X} = \frac{\sum x}{n}$$

Descriptions:

$\bar{X}$: mean/ Average

$\sum x$: Total of all individual scores

n : Number of observations/participants

Enhancing natural disaster preparedness is measured by administering pretests and posttests. The data collected from students is analyzed to determine whether there is an improvement between the average pretest and posttest scores. This improvement is expressed using the Standardized Gain (Gain Score). The formula for calculating the Standardized Gain is as follows:

$$\text{gain } \langle g \rangle = \frac{xpost\ tets - x\ pretest}{x - xpretest}$$

$X_{posttest}$: Mean posttest score

$X_{pretest}$: Mean pretest score

X : Maximum possible score

Table 1. N-Gain Score Change Criteria

N-Gain Range	Criteria
0.7 ≤ g ≤ 1	High Improvement
0.3 ≤ g < 0.7	Moderate Improvement
0 < g < 0.3	Low Improvement
g = 0	No Change

An analysis was conducted to determine the influence of using the digital pocket book media on the disaster preparedness of high school students in Imogiri. A quasi-experimental approach with a pretest-posttest control group design was employed during the operational testing phase to measure the media's effectiveness. Test result data were analyzed using inferential statistics through ANOVA testing with the assistance of IBM SPSS Statistics version 25.0 for Windows. Prior to the ANOVA test, normality testing was performed using the Shapiro-Wilk formula, and homogeneity testing was conducted with the Levene Test. These two tests aimed to ensure that the data met parametric statistical assumptions namely, being normally distributed and homogeneous with the criterion of a significance value greater than 0.05.

RESULT AND DISCUSSION

This research and development study has produced a digital pocket book as a learning medium to enhance disaster preparedness among high school students in Imogiri. The primary objective of this product development was to validate the feasibility and effectiveness of the digital pocket book in improving students' disaster readiness. The development process consisted of three key stages: (1) research and data collection, (2) product planning, and (3) initial product development. The digital pocket book was designed as a supplementary learning resource that presents comprehensive disaster-related content through visually engaging materials aligned with disaster education curriculum requirements. The digital format enables students to independently study

mitigation techniques and emergency procedures while fostering disaster awareness and preparedness.

Product Development Outcomes

The development process of the digital pocket book for disaster preparedness began with a comprehensive planning phase, which included: (1) defining the product's objectives to enhance practical understanding among SMA Imogiri students regarding disaster mitigation (earthquakes, floods, landslides) through flexible and accessible media; (2) structuring content based on curriculum competencies (KI/KD) and contextualized materials from BPBD/BASARNAS tailored to local conditions; (3) identifying student characteristics that indicated a need for visually interactive media; (4) drafting the product by compiling materials from BNPB/BMKG, developing narrative-infographic content, and designing the presentation flow and visual elements; (5) preparing evaluation instruments such as knowledge tests, user response questionnaires, and expert validation sheets; and (6) designing trials at SMA Muhammadiyah Imogiri while considering administrative aspects and learning process efficiency.

A needs analysis was conducted to identify foundational requirements for the research through observations and interviews at SMA Muhammadiyah Imogiri. Initial data was collected by measuring students' preparedness levels via Google Forms, alongside interviews with teachers and students regarding the availability of learning media, disaster preparedness levels, and the need for a digital pocket book as a learning tool. The gathered data served as the basis for designing a product aligned with the school's needs.

Based on the needs analysis and preliminary studies, the draft of the digital pocket book was developed by aligning content with the school curriculum, high school student characteristics, current trends, and Imogiri's disaster context. Using design tools like Canva, the process involved seven key steps: (1) formulating basic competencies and learning indicators for disaster preparedness; (2) selecting main topics (floods, earthquakes, landslides) relevant to Imogiri; (3) creating visually based content (illustrations, infographics, narratives, emergency steps); (4) structuring content from introduction to evaluation; (5) designing an engaging and user-friendly visual interface; (6) integrating user-friendly graphic elements and colors; and (7) converting to digital formats (PDF/HTML) for distribution via digital platforms. The book was organized into thematic chapters, each addressing specific aspects of disaster preparedness.

Expert Validation

1) Material Expert Validation

This study did not conduct separate material validation because all learning content in the digital pocket book was sourced from standardized official documents, namely the Regional Disaster Management Agency (BPBD) and LIPI-UNESCO/ISDR scientific studies on earthquake and tsunami preparedness. This approach was based on three considerations: (1) BPBD materials underwent institutional curation and validation as official references for disaster education; (2) LIPI-UNESCO/ISDR studies met scientific criteria with rigorously tested methodologies; and (3) the content substantially aligned with the core competencies of Indonesia's disaster education curriculum. By integrating these authoritative sources, the product ensured material accuracy while fulfilling the principle of alignment between learning content and curricular goals. This method adheres to the recommendations of Permendikbud No. 8/2020 on validating teaching materials based on authoritative sources, optimizing media development efficiency without compromising content quality.

2) Media Expert Validation

Media experts validated the content of the digital pocket book, assessing 20 statements related to presentation and graphic aspects. The validation process utilized a 1-5 scale questionnaire, with evaluation criteria focusing on presentation quality and visual design. The validation results were presented in table format and served as the basis for product improvements. The digital pocket book on natural disaster preparedness received a total validation score of 74 (categorized as "Feasible"), consisting of 36 points for presentation aspects (10 items) and 38 points for graphic design aspects (10 items). These results indicate that the product is deemed feasible in terms of both content delivery and visual design, thus meeting the standards as a learning medium.

Field Trial Result

After being declared feasible through validation by content and media experts, the digital pocket book underwent a series of trials consisting of three stages: (1) initial field trial, (2) main field trial, and (3) operational trial. The following describes the results of the trials:

1) Initial Field Trial

The initial stage trial involved 15 students with varying academic abilities (high, medium, low) and one Geography teacher from a senior high school in Imogiri. It was conducted face-to-face on May 5, 2025, utilizing school facilities. The purpose was to gather initial feedback on the developed digital pocket book on disaster preparedness (floods, earthquakes, and landslides). After using the media, participants were asked to fill out a practicality questionnaire evaluating four main aspects: (1) attractiveness of presentation, (2) content organization, (3) graphic design, and (4) language usage. The evaluation results were used as a basis for product improvement before moving on to the next trial stage.

Based on the initial field trial results, the aspect of presentation attractiveness scored 14 from 4 items, content organization scored 10 from 2 items, graphic design scored 32 from 7 items, and language usage scored 10 from 2 items. The total score from all four aspects was 66, with an average score of 4.4. Based on these results, the digital pocket book was declared highly practical for further trial stages.

As an evaluation instrument, the student practicality questionnaire was designed to assess the responses of 15 high school students with varying academic abilities (high, medium, low) to the digital pocket book on disaster preparedness. This instrument contained 17 statements evaluating the practicality of the learning media, using a Likert scale of 1–5. The quantitative data obtained were then converted into specific interpretive categories based on a reference table 2 to determine the product's level of effectiveness. Complete data on students' responses to the digital pocket book are presented in the following table:

Tabel 2. Student Response Scale Results in the Initial Field Test

Score Total	1074
Average	71,60
Category	Very Practical

Based on the table above, the student response questionnaire in the initial field trial of the digital pocket book media obtained a total score of 1074 with an average score of 71.60, categorized as "very practical."

2) Main Field Trial

Teacher Practicality Questionnaire

At the main stage of the study, the practicality questionnaire was completed by two high school teachers who evaluated four key aspects: (1) attractiveness, (2) content organization, (3) graphic design, and (4) language usage. The evaluation instrument consisted of 15 statements using a 5-point Likert scale to measure the practicality level of the digital pocket book as an instructional medium.

Table 3. Teacher Response Scale Results in the Main Field Test

No.	Aspect	Teacher's Score	Category
1	Attractiveness	20	Very Practical
2	Content Organization	10	Very Practical
3	Graphic Design	33	Very Practical
4	Language Usage	10	Very Practical

Based on the assessment data, both teachers gave high scores across all evaluation aspects. The attractiveness aspect received scores of 20 and 18 (from 4 items), content organization 10 and 9 (from 2 items), graphic design 33 and 34 (from 7 items), and language usage 10 (from 2 items). The total scores were 73 (Teacher 1) and 71 (Teacher 2), corresponding to average scores of 4.8 and 4.7 on a 1–5 scale. These results indicate that the digital pocket book on disaster preparedness is highly practical and feasible to proceed to the next stage of testing.

Student Practicality Questionnaire

The practicality questionnaire was also administered to 30 students with varying academic abilities (high, medium, low) during the main field trial to measure their responses to the web-based digital pocket book. This evaluation instrument consisted of 17 statements covering various aspects of practicality, using a 5-point Likert scale. It was designed to assess the appropriateness of the media as a learning tool for disaster preparedness from the perspective of the end users.

Tabel 4. Student Response Scale Results in the Main Field Test

Score Total	2300
Average	76,67
Category	Very Practical

Based on the table above, the results of the student response questionnaire during the main field trial of the digital pocket book media showed a total score of 2300 with an average score of 76.67, which falls into the "very practical" category. Therefore, the digital pocket book on disaster preparedness is considered highly practical and feasible to proceed to the next trial stage.

3) Operational Trial

The level of student preparedness was measured using an objective test instrument consisting of 30 multiple-choice questions. The assessment involved three groups of students: one control class and two experimental classes, aiming to compare the level of preparedness before (pre-test) and after (post-test) the use of the digital pocket book. The comparative results of both measurements are presented in detail in the following table:

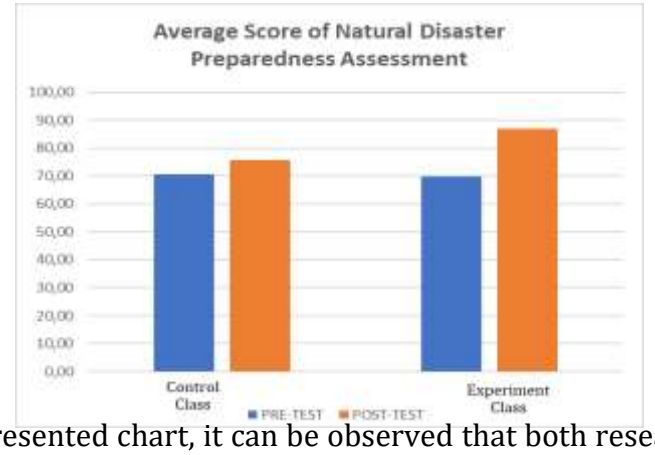
Tabel 5. Natural Disaster Preparedness Test Results

Class	Average Score		Gain	Category
	Pre-test	Post-test		
Control	70.77	75.63	0.17	
Experimental	69.88	86.98	0.57	

The evaluation results of high school students' disaster preparedness show that in the control class, the average pre-test score was 70.77. After participating in conventional learning without the use of the digital pocket book, the average post-test score increased to 75.63. This reflects an improvement of 4.86 points with a gain score of 0.17, which falls into the "low" category.

In contrast, the experimental class had an average pre-test score of 69.88. After receiving instruction using the digital pocket book, the average post-test score significantly increased to 86.98. The difference between the pre-test and post-test scores was 17.10 points, with a gain score of 0.57, which is categorized as "moderate." A comparative chart illustrating the pre-test and post-test scores of both the control and experimental classes is presented in the following figure:

Figure 1. Comparison Chart of Students' Disaster Preparedness Pre-Test and Post-Test Scores



Based on the presented chart, it can be observed that both research groups showed an increase in scores from pre-test to post-test. However, the experimental group that utilized the digital pocket book demonstrated a significantly greater improvement compared to the control group.

Statistical Analysis

1) Normality Test

The results of the normality test for the differences between post-test and pre-test scores indicate that both the control and experimental groups have normally distributed data. This is supported by the significance (Sig.) values from the Kolmogorov-Smirnov and Shapiro-Wilk tests, all of which are greater than 0.05 (control group: Kolmogorov-Smirnov = 0.200, Shapiro-Wilk = 0.254; experimental group: Kolmogorov-Smirnov = 0.200, Shapiro-Wilk = 0.563).

Therefore, the null hypothesis (H_0), which states that the data are normally distributed, is accepted, while the alternative hypothesis (H_1) is rejected. This indicates that the differences in students' learning outcomes in both groups meet the normality assumption and the analysis can proceed to the homogeneity test. The normality test results for both the control and experimental groups are presented in Table 6 below.

Table 6. Test of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	KELOMPOK	Statistic	df	Sig.	Statistic	df	Sig.
SELISIH POST-PRE TEST	Kontrol	.122	30	.200*	.957	30	.254
	Eksperimen	.073	64	.200*	.984	64	.563

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The normality test analysis of the gain scores (the difference between post-test and pre-test scores) confirmed that the data from both groups were normally distributed. This is evidenced by the significance values from the Kolmogorov-Smirnov test (0.200 for both control and experimental groups) and the Shapiro-Wilk test (0.254 for the control group; 0.563 for the experimental group), all of which exceed the threshold of $\alpha = 0.05$. Consequently, the null hypothesis (H_0) is accepted and the alternative hypothesis (H_1) is rejected, indicating that the normality assumption is met and the data are suitable for further analysis using a homogeneity test.

2) Homogeneity Test

The homogeneity analysis of the gain scores (the difference between post-test and pre-test scores) related to disaster preparedness was conducted using IBM SPSS Statistics 25 with the one-way ANOVA technique. The statistical hypotheses used were: H_0 – the data variances are homogeneous; H_a – the data variances are not homogeneous.

The decision criterion was based on the significance (sig.) value: if sig. ≥ 0.05, then H_0 is accepted (indicating homogeneous data); if sig. < 0.05, then H_0 is rejected (indicating non-homogeneous data). The complete results of the test are presented in the following table.

Table 7. Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
SELISIH POST-PRE TEST	Based on Mean	.010	1	92	.920
	Based on Median	.023	1	92	.879
	Based on Median and with adjusted df	.023	1	90.279	.879
	Based on trimmed mean	.013	1	92	.908

Based on the results of the prerequisite tests, the data on the difference between post-test and pre-test scores for both the control and experimental groups met the assumptions of normality and homogeneity of variance. The homogeneity test using Levene's Test yielded a significance value based on the mean of 0.920. Additionally, the significance values based on alternative approaches such as the median and trimmed mean were also above 0.05. Therefore, the null hypothesis (H_0) is accepted and the alternative hypothesis (H_a) is rejected, indicating that the variances between the two groups can be considered homogeneous. Since both assumptions are satisfied, the data are suitable for further analysis using a parametric statistical test, namely ANOVA.

3) ANOVA Test

The statistical analysis in this study employed a one-way ANOVA using IBM SPSS Statistics 25 to test the significance of the effect of using the digital pocket

book on students' disaster preparedness. The formulated statistical hypotheses were as follows:

- H_0: There is no significant difference in disaster preparedness between the experimental group (using the digital pocket book) and the control group (not using the digital pocket book).
- H_a: There is a significant difference in disaster preparedness between the two groups.

The decision criterion was set at a significance level of $\alpha = 0.05$. If the p-value is greater than or equal to 0.05, H_0 is accepted (no significant effect); if the p-value is less than 0.05, H_0 is rejected (significant effect is present). The complete ANOVA test results, including the F-value, degrees of freedom (df), and significance level, are presented in the following table.

Table 8. ANOVA Test

SELISIH POST-PRE TEST

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3061.459	1	3061.459	36.139	.000
Within Groups	7793.701	92	84.714		
Total	10855.160	93			

The ANOVA test on the gain score (difference between post-test and pre-test) showed a significant difference between the experimental and control groups, with F = 36.139 and p-value = 0.000 ($p < 0.05$). The rejection of H_0 proves that there is a significant difference in the mean improvement of disaster preparedness between the two groups. Specifically, the experimental group using the digital pocketbook showed a statistically higher improvement in learning outcomes compared to the control group. This finding clearly confirms the effectiveness of the digital pocketbook media in enhancing students' disaster preparedness compared to learning without using this media.

Product Revision

This study implemented a media development method through three stages of tiered evaluation to validate the feasibility of the digital pocketbook as a disaster education tool for high school students. The first phase involved an expert review by instructional media specialists from UNY who conducted a comprehensive assessment of interface design and technical presentation aspects. Content validation was not carried out because the learning materials were sourced from standardized documents by BPBD and scientific publications from LIPI-UNESCO/ISDR, which substantially meet academic feasibility criteria.

The second phase consisted of limited trials and main field testing involving teachers and students as end-users. In the limited trial, a formative evaluation was conducted on a small heterogeneous student group, resulting in recommendations for improvements such as: (1) condensing textual materials into essential bullet points, and (2) optimizing visual elements to increase appeal. The main field test involving a larger sample yielded valuable feedback on the need for: (1) contextualizing content with location-specific information (school evacuation maps), and (2) refining layout for optimized readability.

The third phase was an operational test in actual classroom settings. This summative evaluation revealed findings on the practicality and effectiveness of the media, while also identifying further development opportunities such as integrating multimedia components (video/audio) to enhance interactivity. This iterative

development process ensured the final product aligns with students' cognitive characteristics and contextual learning needs for disaster preparedness.

DISCUSSION

This study aimed to develop a digital pocketbook learning media as an educational tool for disaster preparedness among high school students in the Imogiri area. The development process was conducted systematically through stages of needs analysis, planning, initial product development, expert validation, field testing, and operational testing. Results from each testing phase indicated that this media is very practical and effective in improving students' disaster preparedness.

The study evaluated the feasibility of the digital pocketbook as a media for improving natural disaster preparedness through validations involving two experts: content material experts and media design experts. According to Wahyuni, (2022), a pocketbook essentially serves as an additional learning resource intended to enrich students' understanding of the learning material. In digital form, this product is developed on a mobile-based platform, making it easy to use, as explained by Jannah & Hasanah (2021).

The development of a digital pocketbook for disaster education, based on standardized materials from BPBD and the LIPI-UNESCO/ISDR framework, offers a concise and accessible alternative to conventional textbooks, enhancing student comprehension and engagement (Arıkan et al., 2024). Its concise format facilitates student understanding compared to conventional textbooks (Setiyaningrum & Suratman, 2020). Media expert validation confirmed the product's technical feasibility with an intuitive interface, ergonomic color palette, and structured navigation compatible with digital devices (Rosdiana et al., 2022). For instance, gamified applications and virtual simulations have been shown to increase retention rates and practical application of disaster response skills, as evidenced by studies on the 3E learning model (e.g., virtual reality and digital games) in middle schools (Kankanamge et al., 2022).

The revised product is specially designed for disaster-prone areas like Imogiri, presenting curricular content through an interactive multimedia approach. According to Nuritha & Tsurayya, (2021), this digital format effectively builds preparedness through self-directed learning. Graphic visualization in the pocketbook aids knowledge construction (Rosdiana et al., 2022), while its cognitive aspects develop awareness, understanding, and disaster mindset (Nurdiyanto et al., 2023; T. Wahyuni et al., 2023), consistent with constructivist learning theory that emphasizes mental processes (Budiningsih, 2015).

Practicality tests from both students and teachers showed that the digital pocketbook scored high in all evaluated aspects, including presentation attractiveness, content systematics, graphics, and language use. Initial field trials showed an average score of 71.60 from 15 students, while the main field test with 30 students obtained an average of 76.67, both categorized as "very practical." Meanwhile, teachers involved in the main trial gave average ratings of 4.7–4.8 on a 1–5 scale, also confirming ease of use in a learning context. These findings align with research by Anggraini & Sartono, (2019), which states that digital media with attractive and interactive visualizations tends to increase active student participation and facilitates comprehension of abstract concepts, including disaster topics. Media designed considering digital native student characteristics also supports flexible technology-based learning (Prastowo, 2019).

Effectiveness assessment focused on increasing students' disaster preparedness capacity through a comparative pretest-posttest method. As a learning medium, the

digital pocketbook serves as a learning stimulus that motivates learners (Adam, 2015), while also building individual and collective rescue capabilities (Pambudi & Masruroh, 2023). This study adopted the LIPI-UNESCO/ISDR (2006) evaluation framework emphasizing the development of competencies for quick and appropriate response in emergency situations. This approach highlights practical preparedness where students not only understand the theory but are also able to apply the knowledge operationally when facing disasters. Research supports this approach, demonstrating that structured training programs significantly enhance functional skills, knowledge retention, and attitudinal shifts toward disaster readiness (Amini et al., 2024). For instance, a quasi-experimental study on health sciences students revealed that targeted educational interventions led to marked improvements in disaster physical protection, planning, and assistance capabilities (Aslanoğlu et al., 2024). Similarly, evidence from Iran showed that sustained training programs resulted in long-term retention of disaster management skills among volunteers

The effectiveness of the digital pocketbook as a learning medium was quantitatively assessed by comparing pre-test and post-test scores between experimental and control groups. The experimental group demonstrated a significant improvement, with average scores rising from 69.88 to 86.98, yielding a moderate gain score of 0.57. In contrast, the control group showed minimal progress, with a low gain score of 0.17. ANOVA analysis confirmed a statistically significant difference between the groups ($F = 36.139$; *p* < 0.05), underscoring the digital pocketbook's positive impact on disaster preparedness outcomes. These findings align with global studies on technology-enhanced learning tools, such as the structured digital-based education (SDE) intervention for nursing students, which similarly reported significant improvements in disaster literacy and preparedness beliefs post-intervention (Genç et al., 2025). The results also resonate with smartphone-based disaster training for nurses, where digital interventions outperformed traditional methods in knowledge acquisition and operational readiness (Mirlohi et al., 2025). Collectively, these studies validate the efficacy of digital tools in disaster education, emphasizing their role in bridging theoretical knowledge and practical application.

These findings align with recent research by Juhadi et al., (2021), which demonstrates that disaster education models integrating local wisdom such as the traditional "lamban langgakh" stilt houses significantly enhance students' disaster mitigation literacy. By embedding disaster education within school curricula and contextualizing it with culturally relevant practices, students develop a deeper understanding and preparedness for disaster scenarios. Furthermore, strengthening through visual approaches and concise presentation in the digital pocketbook supports the "mitigative education" principle advocated by BNPB and UNESCO (Unisco, 2023). This achievement is not only evident in students' cognitive ability to identify disaster types and handling procedures but also reflected in changes in attitudes and awareness of disaster risks in their environment. The advantage of the digital pocketbook as a learning aid lies in its ability to attract learning interest and facilitate independent learning. Its concise format allows students to more easily understand and remember learning materials, as revealed by Setiyaningrum & Suratman, (2020).

This study's findings have important implications for both disaster education and digital learning innovation. The successful creation and use of the digital pocketbook clearly show its potential to boost disaster preparedness in high school students. By combining credible disaster information with engaging multimedia, this research offers a valuable framework for educators and policymakers to implement technology-based

learning solutions in areas prone to disasters. The study also underscores the need to tailor educational content to local disaster risks, ensuring students acquire practical, relevant knowledge. Moreover, the positive feedback from both students and teachers indicates that these digital pocketbooks can be smoothly integrated into school curricula, promoting independent learning and increasing student involvement in disaster preparedness.

Despite its promising outcomes, this study has several limitations. Firstly, since the research was carried out in a specific location (Imogiri), the findings might not be fully generalizable to other regions with different disaster risks or educational systems. Secondly, the field testing involved a relatively small sample size, which could impact the reliability of the statistical conclusions. Additionally, the digital pocketbook's effectiveness was mainly assessed through cognitive measures (pre-test and post-test), and the study did not evaluate long-term changes in disaster preparedness behaviors. Another limitation is the potential digital divide, as unequal access to mobile devices or stable internet connections among students could impede the widespread adoption of this learning tool.

Future research should build upon this study by investigating the long-term effects of digital pocketbooks on students' actual disaster response behaviors, not just their knowledge retention. Comparative studies across different regions with varying disaster risks would also offer valuable insights into the adaptability of this learning tool. Furthermore, more research is needed to determine how digital pocketbooks can be optimized for students with limited technological access, potentially through offline versions or community-based digital learning centers. Another promising avenue is the incorporation of augmented reality (AR) or gamification features to enhance interactivity and engagement. Lastly, research could explore collaborative models involving local disaster management agencies (BPBD), schools, and communities to strengthen disaster education programs through digital innovations.

CONCLUSION

The digital pocketbook proved effective in improving disaster preparedness among high school students in disaster-prone areas like Imogiri. This media has undergone expert validation and systematic testing, showing a significant improvement (gain score 0.57) compared to traditional methods. Key findings include: (1) learning technology overcomes limitations in disaster education through interactive content, (2) the digital format fits the characteristics of the younger generation, and (3) contextual design enhances understanding and practical preparedness. The implication of this research offers an affordable digital learning model for schools in risk areas. Transforming disaster education from theory into practice is crucial for disaster-prone Indonesia. Future development should include studies on long-term impacts and real behavioral changes among students. These findings support global efforts in disaster risk reduction through youth-based digital solutions.

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