Journal of Advanced Science and Mathematics Education
Volume 3, Issue 2, 103 - 112
e_ISSN: 2798-1606
DOI : 10.58524/jasme.v3i2.320

Empowering young minds: An e-book intervention to boost earthquake disaster literacy

Ananda Pratiwi
Universitas Negeri Surabaya, INDONESIA

Heny Aryani
Universitas Negeri Surabaya, INDONESIA

Nia Wati
Universitas Negeri Surabaya, INDONESIA

Luthfiyaul Laila
Universitas Negeri Surabaya, INDONESIA

Antomi Saregar
Universitas Islam Negeri Raden Intan, Lampung, INDONESIA

Husni Mubarok
National Taiwan University of Science and Technology, TAIWAN

Utama Alan Deta*
Universitas Negeri Surabaya, INDONESIA

Article Info

Article history:

Received: Oct 12, 2023
Revision: Dec 02, 2023
Accepted: Dec 31, 2023

Keywords:

Disaster Mitigation;
E-book;
Literacy.

Abstract

Background: Education on disaster mitigation remains critically underemphasized, with existing pedagogical approaches often falling short in adequately preparing children for the realities of natural disasters. This gap underscores the urgent need for innovative educational tools that can effectively enhance disaster literacy among younger populations.
Aim: This study aims to develop and assess an Earthquake E-Book designed to elevate the disaster literacy levels among children, focusing on its validity, practicality, and effectiveness as educational media.
Method: Employing a Research and Development (R&D) framework, the study navigated through stages of problem identification, design formulation, and implementation, excluding the evaluation phase to concentrate on the developmental process. The implementation employed a One-Group Pretest-Posttest design, involving pretesting, intervention (treatment), and posttesting phases. The e-book's validity was appraised by three expert validators, while its practicality was gauged through student questionnaires, and its effectiveness was measured using the N-Gain test on student learning outcomes.
Results: The Earthquake E-Book garnered an average validation score of 85.4%, positioning it within the valid category. Practicality assessments reflected an 85.4% efficiency rating from student feedback. Furthermore, the effectiveness, as indicated by an N-Gain score of 0.74, was classified within the high category, signifying substantial improvements in children's disaster literacy post-intervention.
Conclusions: The findings affirm that the Earthquake E-Book stands as a valid, practical, and effective educational tool in bolstering disaster literacy among children. By integrating this digital resource into disaster mitigation education, it is anticipated to significantly contribute to enhancing children's understanding and preparedness for earthquake disasters.

To cite this article: Pratiwi, A., Aryani, H., Wati, N., Laila, L., Saregar, A., Mubarok, H., & Deta, U. A. (2023). Empowering young minds: An e-book intervention to boost earthquake disaster literacy. *Journal of Advanced Science and Mathematics Education, 3*(2), 103-112.

INTRODUCTION

Disaster mitigation is an essential component of comprehensive disaster risk management, emphasizing proactive measures to diminish the impacts of hazards and lessen vulnerabilities within communities. It involves a variety of strategies and actions designed to mitigate the negative effects of disasters on individuals, their livelihoods, and infrastructure (Sapountzaki, 2022). These efforts span structural and non-structural measures, including the enhancement of infrastructure resilience,

*** Corresponding author:**
Utama Alan Deta, Universitas Negeri Surabaya, INDONESIA. ✉ utamadeta@unesa.ac.id

land-use planning, the establishment of early warning systems, initiatives for community-based preparedness, and public awareness campaigns (Luthfin et al., 2022). Furthermore, mitigation initiatives are pivotal in disrupting the continuous cycle of disaster response and recovery by tackling fundamental risk elements. By weaving risk reduction strategies into the fabric of development planning, policies, and practices, communities can foster resilience and diminish their susceptibility to forthcoming disasters (Sarabia et al., 2020). Despite Indonesia ranking 60th among 61 countries, indicating a considerable distance from disaster resilience, there is a pressing need for enhanced education to impart insights and knowledge aimed at mitigating the adverse impacts of disasters, particularly through fostering disaster literacy among children.

Situated within the Pacific Ring of Fire, Indonesia, an archipelagic nation, is confronted with a plethora of natural disasters, including earthquakes, tsunamis, volcanic eruptions, floods, and landslides. The country's geographical and geological features render it highly vulnerable to these disasters, underscoring the imperative for education in disaster mitigation (Suprapto et al., 2023). Such an educational framework is vital in promoting preparedness, reducing vulnerabilities, and bolstering resilience among the diverse populations scattered throughout this extensive and disaster-prone country (Andharia, 2020). The National Disaster Management Authority of Indonesia (BNPB, 2020) asserts the importance of disaster education in strengthening community resilience and preparedness against various prevalent hazards. The value of disaster mitigation education in Indonesia transcends traditional teaching methods by integrating local knowledge, cultural practices, and community participation in disaster risk reduction. This educational approach enables individuals and communities to effectively anticipate, respond to, and recover from disasters through a comprehensive strategy that marries scientific knowledge with indigenous wisdom (Suarmika et al., 2022).

The pervasive impact of natural disasters on global communities highlights the essential need to promote disaster mitigation awareness and preparedness from a young age. Teaching children and young people the knowledge, skills, and attitudes required to comprehend, react to, and lessen potential dangers plays a pivotal role in creating resilient communities (Tarricone et al., 2021). The importance of instilling disaster mitigation concepts early on is critical for protecting lives and enabling future generations to act as proactive contributors to disaster resilience. The United Nations Office for Disaster Risk Reduction (UNDRR, 2020) emphasizes the necessity of educating children and youth on disaster risks and preparedness to forge resilient communities and diminish vulnerabilities. Childhood is a vital phase for embedding values, behaviors, and habits that promote safety, resilience, and responsible citizenship. Initiating disaster mitigation education during these formative years helps in cultivating a culture of safety and resilience (Triastari et al., 2021). With the right knowledge and skills, children are better equipped to manage crises and advocate for disaster resilience in their families and communities.

Introducing disaster mitigation early encourages a forward-thinking approach, focusing on risk awareness, identifying hazards, and implementing preventative strategies. Through the inclusion of disaster education in school curriculums and community initiatives, young individuals develop a comprehensive understanding of potential threats. This knowledge empowers them to make informed choices and act effectively in emergency situations (Amri et al., 2022). Acknowledging the importance of improving disaster literacy among children, the creation of an earthquake e-book designed specifically for Indonesian youth stands out as a vital project. This digital innovation is intended to provide essential knowledge and skills, thus enhancing resilience and preparedness against the unique seismic challenges faced by Indonesia (Kamil, 2020).

Recent advancements in digital learning tools, specifically e-books, have significantly contributed to enhancing disaster literacy. Notably, Azmanita and Festiyed (2019) demonstrated that e-books integrating physics with disaster-related content meet criteria for validity, practicality, and effectiveness. Similarly, studies have illustrated the potential of incorporating coastal disaster mitigation content into physics education, further underscoring the educational value of e-books in disaster preparedness (Rifai, 2021). These e-books not only facilitate student comprehension of complex materials but also stimulate engagement and curiosity, essential for effective learning. The intersection of technology and education theory is evident in the application of CPA (Concrete-Pictorial-Abstract) strategies within e-books, aligning with constructivist, experiential, and

cybernetic learning theories (Nabila et al., 2021). This approach has proven particularly useful in creating engaging educational environments, even in the context of COVID-19, by offering feasible learning solutions through digital means. Moreover, research by Widi et al. (2022) validates the efficacy of e-books for fire disaster mitigation education, affirming their role in augmenting students' knowledge and preparedness. Despite these advancements, existing literature reveals gaps, particularly in the accessibility of educational apps and e-books across various devices, including mobile phones, which are increasingly preferred for their convenience. Additionally, there is a noted discrepancy in the integration of assistive technologies, which sometimes leads to access errors, limiting the effectiveness and reach of these digital resources. Addressing these challenges, this study focuses on the development of an Earthquake E-Book tailored for children. It aims to not only augment disaster literacy but also to enhance preparedness by evaluating the e-book's validity, practicality, and effectiveness. This initiative seeks to bridge the identified gaps by ensuring broader accessibility and engagement, thereby contributing to a more resilient and informed young generation in the face of disasters.

METHOD

The research employed a Research and Development (R&D) methodology, as delineated by Borg & Gall (1989), to design and assess educational products. R&D is a systematic approach aimed at creating new products or refining existing ones to address real-world problems or enhance learning experiences. The focal point of this study was the development of an earthquake e-book intended to augment earthquake disaster literacy among children. The research phases are outlined as follows, with reference to Sugiyono's framework:

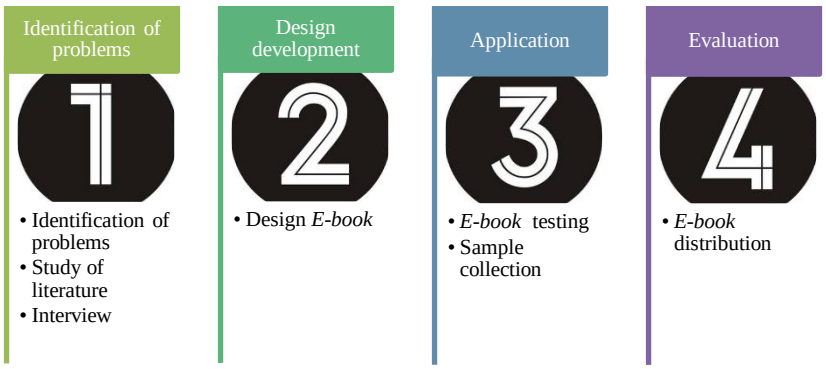

Figure 1. Research and Development (R&D) Stages
Source: Sugiyono, 2009

The initial phase of the research involved identifying the problem by examining literacy issues among children. This entailed conducting a literature review to explore existing research articles on literacy challenges and interviewing students in schools to understand the significance of disaster literacy. Subsequently, during the design development phase, an E-book focused on disaster literacy was created. This E-book's design drew upon the insights gained from literature reviews and interviews conducted in the preceding stage. At this juncture, the E-book's validity was assessed by three expert validators, providing valuable feedback for future enhancements of the E-book. The third phase entailed implementing the E-book with students serving as the research subjects, aiming to evaluate disaster literacy levels within the school setting. Sample selection occurred during the trial phase, utilizing various data collection methods to gather precise and pertinent information. These methods included direct interviews with students to gauge the importance of disaster literacy, observations of issues related to disaster literacy in schools, and questionnaires to assess students' response capabilities to disasters, with a focus on earthquakes. The instruments employed comprised pretest and posttest tools, along with questionnaires to measure student response satisfaction. In the final evaluation phase, the E-book was deemed appropriate for broader dissemination. This stage also included considerations for the future development of disaster literacy

E-books. The research employed a One-Group Pretest-Posttest design, concluding with a posttest following the intervention. This research design is outlined as follows:

$$O_1 \quad X \quad O_2$$

Figure 2. Research Design Scheme
Source: Sugiyono, 2016

Information :
O_1 = Pretest score (before treatment is given)
X = Treatment
O_2 = Posttest score (after being given treatment)

Meanwhile, to analyze the collected data, preliminary tests were conducted to select the appropriate statistical formulas. These included the normality and homogeneity tests. However, the results indicated that the data were neither normally distributed nor homogeneous. Consequently, a nonparametric approach, specifically the Wilcoxon signed-rank test, was employed. This decision allowed for the assessment of data without the assumption of normal distribution. Additionally, the effectiveness of the learning media (Earthquake E-Book) in the study was evaluated using the N-Gain test, which involves calculating the difference between pre-treatment and post-treatment scores.

RESULTS AND DISCUSSION

Results

1. Validity of E-Book

The validity of the earthquake e-book was assessed by three validating lecturers. Their collective evaluation across three distinct assessment aspects of the Earthquake E-book validation instrument yielded scores of 79.2% for material content, 83.3% for language quality, and 93.8% for literacy engagement. Consequently, an overall average score of 85.4% was achieved, classifying the e-book within the valid range, which spans from 76% to 100%. Upon scrutinizing the assessment aspects of the instrument, it was determined that the Earthquake E-book is apt for use, requiring only minor revisions as recommended by the validating lecturers.

2. Practicality of E-Books

The practicality test is carried out by filling out response questionnaires for students. Based on the instrument results, the response to the Earthquake E-book is in the very practical category with an average percentage of 90.78% in the value range of 75% - 100%.

3. Effectiveness of E-Books

After getting a very practical value, the E-book also needs to be assessed for effectiveness through pretest and posttest instruments which are distributed to students. The effectiveness value can be shown in the results below:

a. Normality test

The normality test is included in the requirements for the use of parametric statistics. The normality test used is the chi-square test. Based on the chi-square test that has been carried out, the results obtained are as in Table 1.

Table 1. Data Normality Test Results

	PRETEST	POSTTEST
Chi-Square	19,368[a]	12,316[b]
df	8	6
Asymp. Sig.	,013	,055

Based on Table 4 above, the normality test uses the chi-square test to obtain a test result on the pretest data of 0.013, wherein the pretest data can be seen that the data is not normally distributed, this is because the test value is smaller than the alpha value. However, it is different in the post-test data, where the test value obtained is 0.055, which can be said that the post-test data is normally distributed because the test value is more than the alpha value (0.050).

b. Homogeneity Test

The homogeneity test is carried out to determine the homogeneity of the data. The test used to determine whether the data is homogeneous or not is the marginal homogeneity test. So the results in Table 2 can be produced.

Table 2. Data Homogeneity Test Results

	PRETEST & POSTTEST
Distinct Values	15
Off-Diagonal Cases	19
Observed MH Statistic	777,000
Mean MH Statistic	1168,000
Std. Deviation of MH Statistic	94,048
Std. MH Statistic	-4,157
Asymp. Sig. (2-tailed)	,000

Based on the data above, it can be concluded that the pretest and posttest data that have been carried out are not homogeneous, this can be seen in the test results which have a value smaller than the alpha value.

c. Nonparametric Test

After testing the data using the normality test and homogeneity test, it was stated that the data was not normally distributed and not homogeneous, therefore a nonparametric test was carried out using the Wilcoxon test. It can be seen in Table 3, as follows.

Table 3. Nonparametric Test Results Pretest-Posttest Data

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The median of differences between Pretest and Posttest equals 0.	Related-Samples Wilcoxon Signed Rank Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .050.

From the data above it can be said that the initial hypothesis (H_0) is rejected with the initial hypothesis stating that the difference between the pretest and posttest scores is 0. The final hypothesis (H_1) is accepted, namely that there is a difference between the pretest and posttest scores that is not equal to 0.

d. N-Gain test

The N-Gain test is a test carried out to determine the effect of using media in the form of the Earthquake e-book on student learning outcomes based on the level of effectiveness through

pretest and posttest questionnaires. The results obtained before and after treatment or use of the Earthquake E-book based on the N-Gain score test can be seen in the table below.

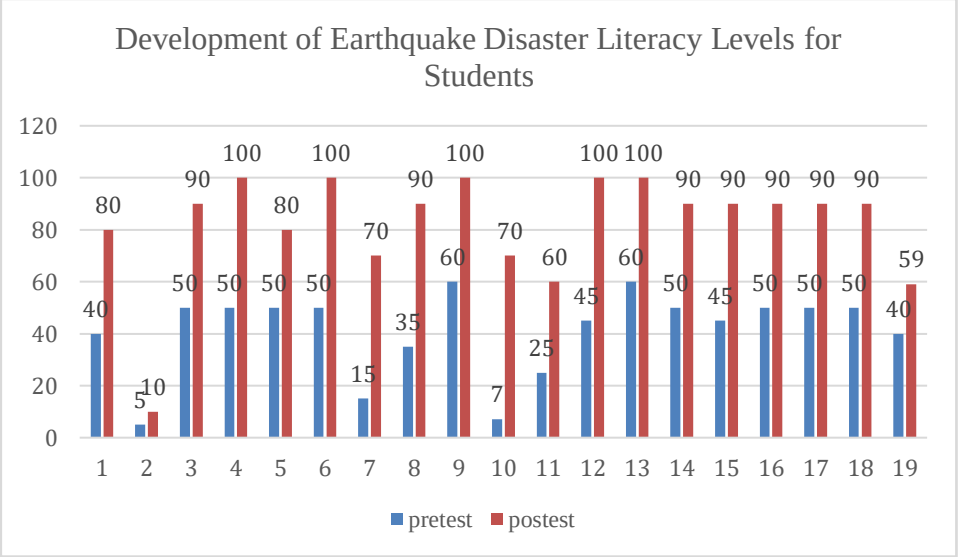

Figure 3. The difference in scores before (Pretest) and after (Posttest) using the *Earthquake E-book*.

The value of students' learning outcomes before using the Earthquake E-book (pretest) was obtained with an average value of 40.89. Meanwhile, the learning outcomes of students after using the Earthquake E-book (posttest) were with an average score of 82.05. It is based on the results of data analysis using the N-Gain score test with an average value of 0.74, where the score is included in the high criteria as seen in Table 1. Next, a paired t-test is carried out which aims to determine the comparison of the average scores of the previous and previous values. after being treated using the Earthquake E-book it was 0.001, based on the testing hypothesis there was a difference between the average score before using the Earthquake E-book and after using the Earthquake E-book in the learning process. Based on the results of data analysis, it can be shown that the use of the Earthquake E-book in learning can improve students' abilities and children's earthquake disaster literacy levels. This is in line with Asshiddiqi et al (2021) that the use of learning media in the form of E-books can increase students' knowledge and abilities regarding natural disaster mitigation.

Table 4. N-Gain Score Test Results

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Ngain_score	19	,05	1,00	,7417	,25136
Ngain_persen	19	5,26	100,00	74,1655	25,13584
Valid N (listwise)	19				

Based on the N-Gain Score test results in Table 4, it can be concluded that the average N-Gain Score value is 0.74, where the score is included in the high criteria.

Discussion

This study is driven by the concern over the low level of disaster literacy among Indonesian children. Data from the World's Most Literate Nation (2006) reveal that Indonesia ranks 60th out of 61 countries surveyed, indicating a significant gap in disaster resilience. This issue is often overlooked by parents and educators, leading to children becoming victims of disasters due to a lack of understanding and preparedness. Desfandi (2014) highlights the critical need to enhance disaster

literacy, particularly among elementary school-aged children who generally lack knowledge of appropriate responses to disasters. Suharwoto et al. (2015) argue for the early introduction of disaster mitigation education within communities and formal education settings, starting from elementary school, to reduce child fatalities caused by ignorance. This research aims to elevate disaster literacy levels among children, particularly in response to earthquakes. It aligns with the Pisa 2025 framework on scientific literacy, emphasizing the "Explanation of Scientific Phenomena," which involves understanding scientific, technological, and environmental phenomena through scientific and cultural theories (Ramli et al., 2021). Adequate media are necessary to improve children's disaster literacy.

Addressing the current challenges, a viable solution is the development of educational media on disaster mitigation, specifically earthquake preparedness, through the creation of valid, practical, and effective e-books for children. E-books as a medium for enhancing earthquake disaster mitigation literacy offer considerable benefits by educating children and young individuals on preparedness and safety. Digital tools like e-books are increasingly recognized for their potential to improve engagement, accessibility, and the effectiveness of educational content delivery. Morgan (2013) notes that interactive digital media, including e-books, can captivate and sustain children's interest more efficiently than traditional materials. The incorporation of multimedia elements, quizzes, animations, and simulations within e-books makes learning about earthquake safety interactive and engaging, thus accommodating various learning preferences (Sejati & Budiningsih, 2019). Furthermore, e-books offer a flexible and accessible means of information dissemination. Accessible via digital devices such as tablets, computers, and smartphones, e-books allow for anytime, anywhere learning, facilitating a personalized and self-directed learning experience (Korat, 2009). The portability of e-books also supports their broad distribution, reaching children in both urban and remote locations, an aspect particularly pertinent in geographically diverse nations like Indonesia.

The e-book developed in this study has been endorsed as valid by three expert validators, achieving a validation score of 85.4%. This score categorizes the Earthquake E-book as a valid educational tool for teaching children about earthquake disaster mitigation. The validation process assessed the e-book based on its content accuracy, language clarity, and literacy relevance, aligning with criteria established by Rohdiani and Rakhmawati (2017), who emphasize the necessity of validating educational media before their application in learning environments. The Earthquake E-book covers eight key topics, including the definition of earthquakes, their types, causes, symptoms, preparatory actions, immediate responses, post-event actions, and the effects of earthquakes of varying magnitudes (Yuliatmoko & Kurniawan, 2019).

Following the validity assessment, a limited practicality test was conducted through student questionnaires, revealing a practicality rating of 90.78%, placing it in the efficient category. The e-book's advantages include ease of access via smartphones, hosting on a blog with direct links to Google Drive, minimizing storage requirements, and the inclusion of engaging, colorful animations. These features not only facilitate student engagement but also allow for flexible learning opportunities regarding earthquake disaster mitigation—a subject of critical importance yet challenging to convey within constrained time frames. The use of the Earthquake E-book as a supplementary learning resource in science education is supported by Sahronih et al. (2020), who assert that technology-enhanced learning media can significantly boost learning motivation, engagement, and outcomes.

An evaluation of student learning outcomes before and after the introduction of the Earthquake E-book revealed a substantial improvement, with average scores increasing from 40.89 (pretest) to 82.05 (posttest). The analysis utilized an N-Gain score test, yielding an average increase of 0.74, indicating a significant enhancement in students' understanding and literacy regarding earthquake disaster mitigation. This finding corroborates the views of Alkadri and Fauzi (2021), who argue for the effectiveness of e-books in elevating students' knowledge and skills in natural disaster preparedness.

The integration of the Earthquake E-book into educational settings underscores the importance of the TPACK framework, which combines technological, pedagogical, and content knowledge to enrich learning experiences. As Santos & Castro (2021) suggest, there is a critical need

to expand educators' proficiency in applying technology in teaching, ensuring the effective incorporation of TPACK in educational practices. This study's data analysis demonstrates the potential for improved learning outcomes through the use of the Earthquake E-book, highlighting the transformative impact of digital resources in modern education. The convenience and accessibility of e-books, enabling learning anytime and anywhere, significantly contribute to the dissemination of vital, valid, practical, and substantial knowledge in the digital era.

CONCLUSION

Drawing from the findings of this study, the Earthquake E-book designed for children has successfully fulfilled the criteria for validity, practicality, and effectiveness. This research has demonstrated an improvement in learning outcomes among children before and after the introduction of the Earthquake E-book. Such results signify that employing the Earthquake E-book as an educational tool can effectively enhance disaster literacy among young learners. Moreover, the Earthquake E-book serves as a valuable resource in the educational journey of children, aiding in their understanding of disaster mitigation. This study not only underscores the significance of the Earthquake E-book in fostering disaster preparedness among children but also lays the groundwork for future research on its development and application in educational settings.

ACKNOWLEDGMENT

We offer thanks to the presence of Allah SWT. Thanks to the abundance of grace, Taufik, and guidance, we were able to complete this scientific article entitled "Development of an E-Book to Improve Earthquake Disaster Literacy for Students" well and on time. This progress report was completed successfully thanks to the assistance of several parties. Therefore, on this occasion, please allow us to thank Mrs. Siti Aminah, M.Pi., and the MIS teachers of Darul Fikri Sidoarjo for completing this research.

This research was funded by the Institute for Research and Community Service, Universitas Negeri Surabaya. We hope that the activities that have been carried out can be useful for developing earthquake disaster literacy among children in all regions, especially Sidoarjo and Surabaya.

AUTHOR CONTRIBUTION STATEMENT

AP: Conceptualization, Data retrieval, Writing - Original Draft;
HA & NW: Data retrieval, Writing - Original Draft;
LL: Writing to the final version of the manuscript;
AS: provided critical feedback and helped shape the research, analysis and manuscript.
HM: provided critical feedback and helped shape the research, analysis and manuscript.
UD: Project Administration, supervised the project.

REFERENCES

Alkadri, R., & Fauzi, A. (2021). Practicality of high school physics e-book integrated materials of meteor fall disaster mitigation based on guided inquiry model assisted google classroom. *Journal of Physics: Conference Series*, 1876(1), 012061. https://doi.org/10.1088/1742-6596/1876/1/012061

Amri, A., Lassa, J. A., Tebe, Y., Hanifa, N. R., Kumar, J., & Sagala, S. (2022). Pathways to Disaster Risk Reduction Education integration in schools: Insights from SPAB evaluation in Indonesia. *International Journal of Disaster Risk Reduction*, *73*, 102860. https://doi.org/10.1016/j.ijdrr.2022.102860

Andharia, J. (2020). Thinking about disasters: A call for intersectionality and transdisciplinarity in disaster studies. *Disaster studies: Exploring intersectionalities in disaster discourse*, 3-32. https://doi.org/10.1007/978-981-32-9339-7_1

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 Vol, 8*(2), 79-87. https://doi.org/10.21107/jps.v8i2.12204/

Azmanita, Y., & Festiyed, F. (2019). Analisis Kebutuhan Media untuk Pengembangan E-Book Tema Abrasi pada Pembelajaran Fisika Era 4.0. *Jurnal Penelitian Pembelajaran Fisika*, *5*(1), 09-16. https://doi.org/10.24036/jppf.v5i1.107416

BNPB. (2020) Retrived from https://www.bnpb.go.id/storage/app/media/uploads/migration/pubs/445.pdf

Desfandi, M. (2014). Urgensi kurikulum pendidikan kebencanaan berbasis kearifan lokal di Indonesia. *SOSIO-DIDAKTIKA: Social Science Education Journal*, *1*(2), 191-198. https://doi.org/10.15408/sd.v1i2.1261

Gall, M. D., & Borg, W. R. (1989). *Educational research. A guide for preparing a thesis or dissertation proposal in education*. Longman, Inc., Order Dept., 95 Church Street, White Plains, NY 10601 Stock No. 78164-6

Kamil, P. A., Utaya, S., & Utomo, D. H. (2020). Improving disaster knowledge within high school students through geographic literacy. *International journal of disaster risk reduction*, 43, 101411. https://doi.org/10.1016/j.ijdrr.2019.101411

Korat, O. (2010). Reading electronic books as a support for vocabulary, story comprehension and word reading in kindergarten and first grade. *Computers & Education*, *55*(1), 24-31. https://doi.org/10.1016/j.compedu.2009.11.014

Luthfin, A., Irjan, I., & Hidayati, S. N. (2022). Mapping of destructive tectonic earthquakes in the West Nusa Tenggara (NTB) region based on the Zhao attenuation function. *Jurnal Penelitian Fisika dan Aplikasinya (JPFA)*, *12*(2), 156-166. https://doi.org/10.26740/jpfa.v12n2.p156-166

Morgan, H. (2013). Multimodal children's e-books help young learners in reading. *Early Childhood Education Journal*, *41*, 477-483. https://doi.org/10.1007/s10643-013-0575-8

Nabila, A., Wahyuningtyas, N., & Wiradimadja, A. (2021). Pengembangan aplikasi "CPA" (Covid-19 prevention application) sebagai literasi mitigasi bencana covid-19 bagi siswa SMP. *JINoP (Jurnal Inovasi Pembelajaran)*, *7*(2), 129–140. https://doi.org/10.22219/jinop.v7i2.16761

Ramli, M., Saridewi, N., & Rifki, A. (2021). Analysing Traditional Islamic Boarding School Students' Scientific Literacy Using Pisa Framework. *Jurnal Penelitian Pendidikan IPA*, *6*(1). https://doi.org/10.26740/jppipa.v6n1.p31-39

Rifai, H. (2021, April). Validity of physics edupark e-book with scientific approach based on tourism destinations of Rumah Gadang. In *Journal of Physics: Conference Series* (Vol. 1876, No. 1, p. 012057). IOP Publishing. https://doi.org/10.1088/1742-6596/1876/1/012057

Rohdiani, F., & Rakhmawati, L. 2017. Pengembangan Media Pembelajaran Berbasis Web pada Mata Pelajaran Dasar Elektronika di SMK Negeri 3 Jombang. *Jurnal Pendidikan Teknik Elektro*, *6* (1) 105-110. https://doi.org/10.26740/jpte.v6n1.p%25p

Sahronih, S., Purwanto, A., & Sumantri, M. S. (2020). The effect of use interactive learning media environment-based and learning motivation on science learning outcomes. *International Journal for Educational and Vocational Studies*, *2*(3), 1-5.

Santos, J. M., & Castro, R. D. (2021). Technological Pedagogical content knowledge (TPACK) in action: Application of learning in the classroom by pre-service teachers (PST). *Social Sciences & Humanities Open*, *3*(1), 100110. https://doi.org/10.1016/j.ssaho.2021.100110

Sapountzaki, K. (2022). Risk Mitigation, Vulnerability Management, and Resilience under Disasters. *Sustainability*, 14(6), 3589. https://doi.org/10.3390/su14063589

Sarabia, M. M., Kägi, A., Davison, A. C., Banwell, N., Montes, C., Aebischer, C., & Hostettler, S. (2020). The challenges of impact evaluation: Attempting to measure the effectiveness of community-based disaster risk management. International journal of disaster risk reduction, 49, 101732. https://doi.org/10.1016/j.ijdrr.2020.101732

Sejati, P. M., & Budiningsih, C. A. (2019). Multimedia in Disaster Risk Reduction. *Journal of Physics: Conference Series* 1233(1), 012090. https://doi.org/10.1088/1742-6596/1233/1/012090

Suarmika, P. E., Arnyana, I. B. P., Suastra, I. W., & Margunayasa, I. G. (2022). Reconstruction of disaster education: The role of indigenous disaster mitigation for learning in Indonesian elementary schools. *International Journal of Disaster Risk Reduction*, *72*, 102874. https://doi.org/10.1016/j.ijdrr.2022.102874

Sugiyono. (2016). *Metode Penelitian Kuantitatif, kualitatif, dan R&D.* Bandung : Alfabeta

Sugiyono. (2009). *Metode Penelitian Pendidikan Pendekatan Kuantitatif,. Kualitatif, dan R&D.* Bandung : Alfabeta.

Suharwoto, dkk. 2015. *Modul 3 Pilar 3 – Pendidikan Pencegahan dan Pengurangan Resiko Bencana*. Jakarta: Biro Perencanaan dan Kerjasama Luar Negeri Sekretariat Jenderal Kemendikbud.

Suprapto, N., Zamroni, A., Faustino-Eslava, D. V., Calzeta, E. C., Tiburan Jr, C. L., Rachmawati, Y., & Nolos, R. C. (2023). Global Overview on The Recent Studies of Geohazards: A Dynamic Population Approach. *Science of Tsunami Hazards*, 42(3).

Tarricone, P., Mestan, K., & Teo, I. (2021). Building resilient education systems: A rapid review of the education in emergencies literature. https://doi.org/10.37517/978-1-74286-639-0

Triastari, I., Dwiningrum, S. I. A., & Rahmia, S. H. (2021). Developing disaster mitigation education with local wisdom: Exemplified in Indonesia schools. *IOP Conference Series: Earth and Environmental Science*. 884(1), 012004). https://doi.org/10.1088/1755-1315/884/1/012004

UNDRR. (2020). Retrived from https://www.undrr.org/words-into-action/engaging-children-and-youth-disaster-risk-reduction-and-resilience-building

Widi, H., Nur., Adhitio K., & L.M. Rasdi R. (2022). Machine Learning Methods for Predicting Manure Management Emissions. *Jurnal Nasional Teknik Elektro Dan Teknologi Informasi*, *11*(2), 131-139. https://doi.org/10.22146/jnteti.v11i2.2586

Yuliatmoko, R. S. and Kurniawan, T. (2019).Analysis of Stress Drop Variations in Fault and Subduction Zones of Maluku and Halmahera Earthquakes in 2019. *Jurnal Penelitian Fisika dan Aplikasinya (JPFA)*, 9(2), 152–162. https://doi.org/10.26740/jpfa.v9n2.p152-162