



Development of an Augmented Reality-Based Booklet on Earth Structure Learning to Improve Scientific Literacy and Disaster Mitigation Literacy

Embun Khoerunnisa Maya Safitri, Bibin Rubini*, Surti Kurniasih

Science Education, Postgraduate School, Universitas Pakuan, Bogor, Indonesia

✉ * bibinrubini@gmail.com

Article Info	Abstract
Keywords: <i>augmented reality; booklet; disaster mitigation literacy; earth structure; scientific literacy</i> Received: 22/07/2026 Revised: 25/08/2026 Accepted: 07/09/2026	Background: Scientific literacy and disaster preparedness among students are currently low due to the limited availability of contextual teaching materials. Methods: This study utilized a Research and Development (R&D) approach based on the ADDIE model. The research employed a One-Group Pretest-Posttest design, involving 34 eighth-grade students at SMPS Al-Fikri. Results: The AR-based booklet achieved an Aiken's V index of 0.98 in the subject matter expert validation and 0.97 in the media expert validation, both with very high criteria. Furthermore, the implementation demonstrated a notable improvement in students' scientific literacy with an N-Gain score of 0.645, as well as an enhancement in disaster mitigation literacy with an N-Gain score of 0.490. Conclusion: Augmented reality-based media has a dual impact by effectively addressing students' academic needs while simultaneously building their disaster resilience.

INTRODUCTION

The development of the Industrial Revolution 4.0 and Society 5.0 eras demands mastery of capable scientific literacy so that individuals can use knowledge and scientific evidence in solving contextual problems (Vari & Bramastia, 2021). Nevertheless, the scientific literacy level of students in Indonesia is currently still considered low. Based on the 2022 PISA (Programme for International Student Assessment) assessment data, Indonesia's scientific literacy score decreased by 13 points, dropping from 379 in 2018 to 366 (OESD, 2022). This decline in achievement indicates that the Natural Sciences (IPA) learning process in schools has not effectively facilitated students' scientific reasoning abilities (Kartika et al., 2019). Scientific literacy remains a major concern for science teachers in Indonesia. According to the findings of (Rubini, Ardianto, & Pursitasari., 2019). The limited availability of contextual teaching materials and the lack of integration of natural phenomena in the surrounding environment are among the main factors hindering the development of such scientific literacy (Pursitasari et al., 2019).

Instructional materials used in the learning process play a crucial role in enhancing students' scientific literacy. According to the findings (Maliana et al., 2024), the development of booklet-based instructional materials, which present content in a concise and clear manner and are supported by contextual images from everyday life, can improve students' understanding of the subject matter. The use of booklets also enhances students' comprehension of the learning content while providing a more interactive and engaging learning experience that encourages active participation in the learning process (Raida & Immadudin, 2025). Furthermore, booklets facilitate teachers in assessing students' understanding of the learning materials, as well as monitoring the development of their attitudes and skills (Ningsih et al., 2023). Practical teaching materials, such as booklets, can facilitate students' understanding of science concepts while broadening their knowledge. (Hanifa et al., 2020) Booklets are designed to support independent learning by presenting concise content complemented by key terms, illustrations, and relevant references. Clear information presentation combined with an engaging visual design can stimulate students' curiosity, enhance their comprehension, and encourage active participation in the learning process (Diniyatushoaliha & Mahmudah, 2024). A booklet is a combination of a book and a leaflet, typically consisting of 5–48 pages that present information in a concise, clear, and engaging manner (Dewi et al., 2020). Through contextual presentation, booklets help students relate scientific concepts to phenomena in their surrounding environment, thereby promoting scientific literacy and supporting the application of scientific knowledge in everyday life (Paduwinata et al., 2024). Environmental issues should be a major concern for Generation Z, as these challenges have become increasingly critical at both the national and global levels (Rubini et al., 2024).

The need for teaching materials that feature local contexts has become highly urgent, especially considering Indonesia's geographical position stretching across the Pacific Ring of Fire (Yulianto et al., 2021). This geological position makes the entire archipelago highly vulnerable to natural disaster threats such as earthquakes, volcanic eruptions, and tsunamis. In line with the international mandate of the Sendai Framework for Disaster Risk Reduction 2015-2030, disaster risk reduction must be integrated into formal education pathways to build sustainable community resilience. Therefore, science learning should not merely be a medium for transferring theory but must be transformed into comprehensive life skills through disaster mitigation literacy education (Çalışkan & Üner, 2021). Promoting disaster preparedness in schools is consistent with the Sendai Framework for Disaster Risk Reduction 2015–2030, adopted by the United Nations and promoted by the United Nations Office for Disaster Risk Reduction (UNDRR), which advocates integrating disaster risk reduction into formal education to build resilient communities. In science education, understanding natural phenomena should be transformed into disaster literacy, enabling students to develop the knowledge, skills, and decision-making abilities necessary to respond effectively to disasters (Sakurai & Sato, 2016; Shiwaku et al., 2020; Amri et al., 2022).

In the junior high school curriculum, the understanding of geophysical disaster phenomena has a close connection with the mastery of the "Earth Structure and Its Development" material. However, the concepts within this material, such as the anatomy of the Earth's interior layers, tectonic processes, and volcanism, are highly abstract,

thereby complicating students' cognitive processes (Ahmad, 2024). On the other hand, the establishment of an ideal disaster-responsive culture requires students to comprehensively master competencies based on the KAS framework proposed by Chung and Yen (2016), which includes the domains of Knowledge, Attitude toward preparedness, and evacuation operational Skill. The fulfillment of these three dimensions is reasoning abilities (Kartika et al., 2019). Scientific literacy remains a major concern for science teachers in Indonesia. According to the findings of (Rubini, Ardianto, & Pursitasari, 2019). The limited availability of contextual teaching materials and the lack of integration of natural phenomena in the surrounding environment are among the main factors hindering the development of such scientific literacy (Pursitasari et al., 2019).

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In response to the challenge of concretizing abstract materials while simultaneously equipping multidimensional disaster competencies, the utilization of Augmented Reality (AR) technology becomes the most ideal instructional solution (Yilmaz, 2021). The integration of AR instruments into the learning booklet allows students to interactively explore 3D visualizations of the Earth's structural layers (Lino Padang et al., 2022). Previous studies have demonstrated that the integration of AR into science education facilitates students' visualization of geoscientific phenomena that are not directly observable, promotes greater learning engagement, and enhances concept retention through interactive and inquiry-based learning experiences (Mondro et al., 2026; Cabello et al., 2025). Through this innovative dual-output approach, the development of the AR-based booklet is expected to provide an integrated double impact, namely improving students' academic achievement in scientific literacy while simultaneously strengthening disaster mitigation resilience skills in the surrounding environment.

METHODS

This study utilized a Research and Development (R&D) approach by adopting the ADDIE development model, which consists of five systematic stages: Analyze, Design, Development, Implement, and Evaluate (Branch, 2009). This research was conducted in the odd semester of the 2025/2026 academic year, spanning from April to December 2025. The trial subjects in this study were 34 eighth-grade students from SMPS AlFikri, Cibunian Village, Pamijahan District, Bogor Regency. The product effectiveness trial on the research subjects used a One-Group Pretest-Posttest design, where the measurement of students' abilities was carried out before and after the use of the media. Comprehensively, the framework of this development and research flow can be seen in Figure 1

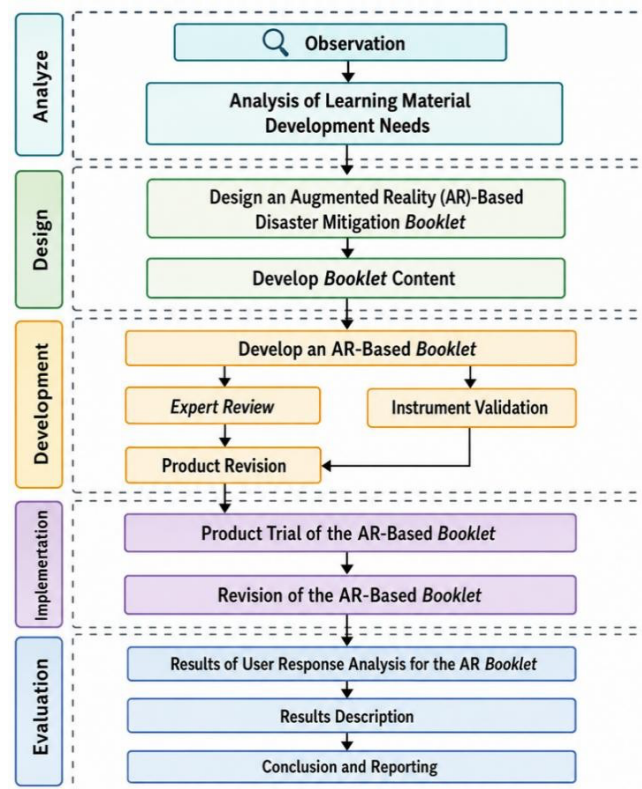


Figure 1. Research Design

Based on the flow in Figure 1, data collection was carried out through a series of testing stages using various structured instruments. The research instruments used included: expert validation sheets (material and media) to assess product feasibility; a cloze test to examine the booklet's readability level in a limited trial; written tests in the form of pre-test and post-test questions to measure scientific literacy and cognitive disaster mitigation achievements; as well as non-test instruments in the form of a preparedness questionnaire based on the KAS (Knowledge, Attitude, Skill) framework and a practicality response questionnaire from both teachers and students.

Quantitative data analysis techniques were applied to process the results from these instruments. The feasibility and validity levels of the AR booklet from expert validators were statistically analyzed using Aiken's V index formula. To measure the significance of the improvement in scientific literacy and disaster mitigation literacy between before and after the intervention, researchers used the non-parametric Wilcoxon Signed-Rank Test, considering the normality prerequisite test results (Shapiro-Wilk) indicated that the data were not normally distributed. Furthermore, the magnitude or effectiveness level of the increase in students' understanding was specifically evaluated using the N-Gain Score index calculation.

The implementation stage was carried out systematically, beginning with the selection of research subjects using a purposive sampling technique. A total of 34 eighth-grade students from SMPS Al-Fikri in Cibunian Village, Pamijahan District, Bogor Regency, were selected as the primary subjects. This specific demographic was chosen because the "Earth Structure and Its Development" topic is structurally embedded in the eighth-grade curriculum, and the school's geographical location provides a highly relevant context for integrating disaster mitigation literacy. The implementation process consisted of three

consecutive steps: administering a pre-test to assess students' initial competencies, conducting the learning intervention utilizing the AR-based booklet, and concluding with a post-test alongside the distribution of practicality and preparedness questionnaires.

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RESULT AND DISCUSSION

Media Development and Feasibility

Prior to the product development phase, this study commenced with the Analyze and Design stages in accordance with the ADDIE framework. During the Analyze stage, a preliminary needs assessment and field observation revealed that students experienced difficulties in comprehending the "Earth Structure and Its Development" material due to its abstract nature. Furthermore, the analysis highlighted a significant scarcity of contextually relevant teaching materials capable of bridging theoretical science with practical disaster preparedness in vulnerable geographical areas.

Based on these empirical findings, the Design stage was systematically executed to formulate the pedagogical blueprint of the teaching materials. This stage involved structuring the content layout, drafting the integration of the KAS (Knowledge, Attitude, Skill) disaster mitigation framework, and designing the conceptual storyboard for the 3D visual projections. The output of this design process was subsequently translated into the Development stage of the Augmented Reality (AR)-based disaster mitigation booklet. This developed media is comprehensively organized into four main series representing the Earth's layers, namely Atmosphere, Biosphere, Hydrosphere, and Lithosphere.

The development of this Augmented Reality based disaster mitigation booklet is comprehensively organized into four main series representing the Earth's layers, namely Atmosphere, Biosphere, Hydrosphere, and Lithosphere. Each series is designed not only to transfer academic knowledge but also to integrate these geological concepts with tactical self-evacuation guidelines. The AR feature is applied to transform abstract materials into interactive 3D objects. Scanning the booklet pages will project dynamic simulations of disaster phenomena, such as global warming visualizations in the atmosphere series, water cycle and tsunami mechanisms in the hydrosphere series, and volcanic eruption processes in the lithosphere series. The visualization of the booklet design and the interface of these AR features can be seen in Figure 2.

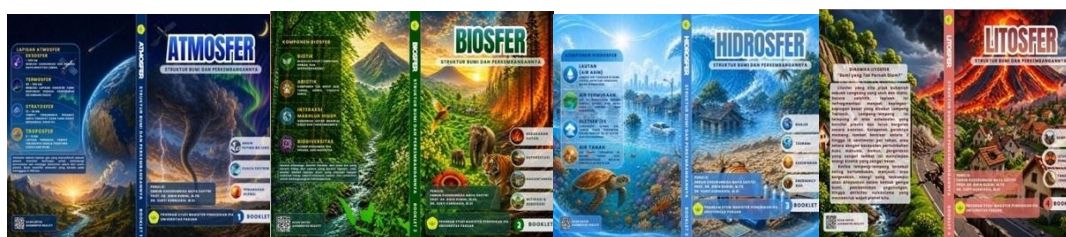


Figure 2. Visualization of the Booklet and Augmented Reality Features on Earth Structure Materials

Before being implemented in field trials, product feasibility was evaluated through a validation process by material experts and media experts. This assessment is crucial to ensure the accuracy of scientific concepts, language effectiveness, and the smooth navigation of AR features within the booklet. The assessment scores from validators were analyzed using Aiken's V index, a summary of which is presented in Table 1 and Table 2.

Table 1. Results of Aiken's V Validity Test by the Material Expert

Assessment Aspect	Number of Indicators	V1 Score	V2 Score	Category
Content Feasibility	7	0.82	0.96	Highly Valid
Language Feasibility	5	0.90	1.00	Highly Valid
Presentation Feasibility	6	0.75	0.96	Highly Valid
Alignment with the Scientific Literacy Framework	4	1.00	1.00	Highly Valid
Average	22	0.87	0.98	Highly Valid

Based on the data presented in Table 1, the first-round material expert validation (V1) produced an average Aiken's V index of 0.87, indicating that the AR-based booklet was already classified as Highly Valid. The highest score was obtained in the Alignment with the Scientific Literacy Framework, which reached 1.00, while Presentation Feasibility received the lowest score of 0.75, suggesting that improvements were mainly required in the organization and presentation of the learning materials. Following the experts' recommendations, the booklet was revised and re-evaluated in the second validation (V2). The results showed a substantial improvement, with the average Aiken's V index increasing to 0.98. All assessment aspects achieved scores ranging from 0.96 to 1.00, demonstrating that the revisions successfully enhanced the quality of the instructional content and fulfilled the material experts' recommendations.

Table 2. Results of Aiken's V Validity Test by the Media Expert

Assessment Aspect	Number of Indicators	V1 Score	V2 Score	Category
Booklet Physical Feasibility	4	0.94	1.00	Highly Valid
Booklet Design and Layout Feasibility	5	0.85	0.95	Highly Valid
Graphic Design Feasibility	6	0.83	0.96	Highly Valid
Augmented Reality (AR) Feasibility	5	0.75	0.95	Highly Valid
Average	20	0.84	0.97	Highly Valid

As presented in Table 2, the first-round media expert validation (V1) resulted in an average Aiken's V index of 0.84, which was also categorized as Highly Valid. Among the evaluated aspects, Booklet Physical Feasibility obtained the highest score 0.94, whereas AR Feasibility received the lowest score 0.75, indicating that several technical aspects of the AR features and visual presentation required refinement. After revising the booklet based on the media experts' suggestions, a second-round validation (V2) was conducted.

The average Aiken's V index increased to 0.97, with all aspects scoring between 0.95 and 1.00. These findings indicate that the revisions effectively improved the booklet's media quality, including its visual design, layout, and AR integration, confirming that the final product is highly feasible for classroom implementation.

Product Readability Level

After being declared valid by the expert team, the booklet was tested on a limited scale involving 15 eighth-grade students to measure readability and text comprehensibility levels. This testing was conducted using the Cloze Test instrument to ensure that the language, sentence structure, and presentation of science materials within the booklet can be easily understood by the target users before the product is implemented in broader effectiveness trials. After being declared valid by the expert team, the booklet was tested on a limited scale involving 15 nine-grade students to measure readability and text comprehensibility levels. These students were specifically selected from outside the main research subjects (the 34 students in the effectiveness trial) to prevent any pre-exposure bias that could compromise the validity of the pre-test results. This testing was conducted using the Cloze Test instrument to ensure that the language, sentence structure, and presentation of science materials within the booklet can be easily understood by the target users before the product is implemented in broader effectiveness trials.

Based on the analysis results of the limited trial, an overall average product readability percentage of 86.83% was obtained. This value places this disaster mitigation booklet into the "High (Independent Category)" level. This achievement indicates that the developed teaching materials are capable of effectively facilitating the independent learning process, where students can build their conceptual understanding without confusion in interpreting the text. When reviewed specifically per subchapter, the Structure and Components of the Lithosphere (M7) material successfully recorded the highest readability percentage with a score reaching 94.00%. The high score in this lithosphere material proves that the use of highly targeted vocabulary combined with sharp Earth structure infographics is proven effective in facilitating students to sequence and logically comprehend technical information.

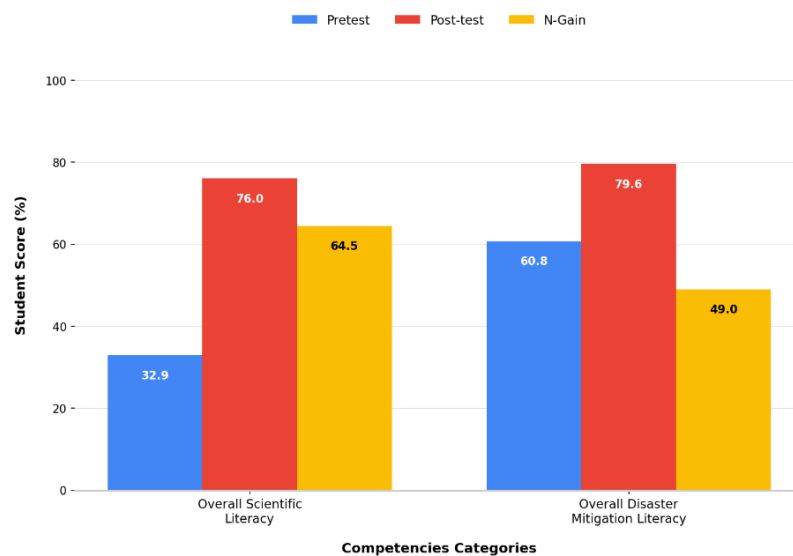
Effectiveness of Improving Scientific and Disaster Mitigation Literacy

Testing the effectiveness of utilizing the Augmented Reality (AR)-based disaster mitigation booklet is the core of this research's findings. Before hypothesis testing was conducted, a normality prerequisite test using the Shapiro-Wilk method showed that the data distribution for both variables was not normally distributed, indicated by a significance value (p) < 0.05. Therefore, comparative testing to determine the significance of the score increase was carried out using the non-parametric Wilcoxon Signed-Rank Test. The overall hypothesis testing results are presented in Table 3.

Table 3. Wilcoxon Signed-Rank Test Statistical Results

Variable	Comparison	Statistical Test	W Value	Z Value	Sig. (p-value)	Rank-Biserial Correlation
Scientific Literacy	Pre-test – Post-test	Wilcoxon Signed-Rank Test	0.000	-5.086	< 0.001	-1.000
Disaster Mitigation Literacy	Pre-test – Post-test	Wilcoxon Signed-Rank Test	0.000	-5.086	< 0.001	-1.000*

Based on Table 2, the statistical analysis results show a significance value (p-value) of < 0.001 for both the Scientific Literacy and Disaster Mitigation Literacy variables. Because this p-value is much smaller than the significance level ($\alpha = 0.05$), the null hypothesis (H_0) is absolutely rejected. This empirically proves that there is a highly significant difference in students' abilities between before and after using the AR booklet. Furthermore, the perfect Rank-Biserial Correlation value obtained of -1.000 (along with a W value = 0.000) reflects a very strong effect size, where 100% of students in the research sample demonstrably experienced an increase in scores without a single one experiencing a score decrease. Next, to measure the magnitude of the effectiveness degree from this intervention, calculations were performed using the N-Gain Score index. The comparison of the average pre-test and post-test achievements, as well as the N-Gain surge for both variables, is evaluated side-by-side as visualized in Figure 4.

**Figure 4.** Comparison of Pre-test, Post-test, and N-Gain Scores on Scientific Literacy and Disaster Mitigation Literacy Capabilities

The visualization in Figure 3 illustrates a highly positive score growth dynamic. In the Scientific Literacy variable, students began learning with a very low initial condition (an average pre-test score of 32.9). However, thanks to the 3D visual stimulation that concretized geological materials, the score skyrocketed drastically to 76.0 during the post-test, resulting in an N-Gain index of 0.645. Meanwhile, for the Disaster Mitigation Literacy variable, students' pre-test scores stood at 60.8 and increased consistently to 79.6 during

the post-test, recording an N-Gain index of 0.490. Referring to Hake's interpretation criteria, the obtained N-Gain values of 0.645 and 0.490 both fall into the Moderate Category. This achievement convincingly affirms that the implementation of the AR-based disaster mitigation booklet successfully provided a dual-output intervention. This media is not only effective in boosting the academic achievement of theoretical scientific literacy, but also robust in reconstructing students' disaster preparedness capabilities into a functional evacuation skill.

Media Practicality and Preparedness Response

The final stage of evaluating the ADDIE development model is measuring the practicality or acceptability level of the product in the field from the perspective of direct users, namely students and science teachers. This practicality analysis is important to ensure that the Augmented Reality (AR)-based disaster mitigation booklet not only has high cognitive effectiveness but also possesses a good execution level when used in real conditions. The analysis results show that this media received a very positive response. The practicality assessment by students obtained an average percentage of 87.99% (Very Good Category), while the assessment by science teachers reached 87.42% (Very Practical Category). These high figures prove that the AR booklet is easy to operate, its instructions are clear, and it is highly adaptive to support classroom learning scenarios.

In addition to assessing the practicality of the tool, this study also captured specific changes in students' affective and psychomotor responses to disasters. This measurement used a structured preparedness questionnaire instrument based on the KAS (Knowledge, Attitude, Skill) model. Overall, students' disaster mitigation literacy achievements obtained a classical average percentage of 85.06%, which falls into the Very Good Category. The details of the achievement percentages for each dimension are visualized in Figure 5.

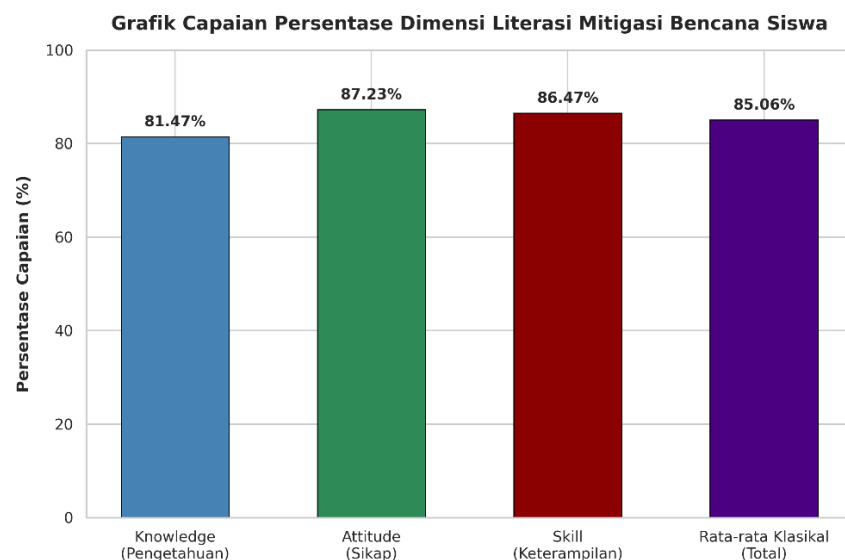


Figure 5. Achievement of Disaster Mitigation Literacy Dimensions Based on the KAS Framework

Based on Figure 4, the Knowledge dimension recorded a percentage of 81.47%, which proves that students' initial understanding regarding the functions of evacuation routes up to disaster readiness bags has been firmly established. The highest achievement

actually occurred in the preparedness Attitude dimension, which touched the 87.23% mark. This massive increase in the affective domain reflects the media's success in touching students' emotional awareness; they now demonstrate a high level of social care, collective responsibility towards the environment, and mental readiness to face crises. Furthermore, the action Skill dimension also achieved a highly robust percentage of 86.47%. This affirms that students are psychomotorically trained and capable of executing emergency operations in the field, such as reading hazard maps and independently determining evacuation routes. Comprehensively, the AR booklet successfully bridged cognitive theories with real safety skills.

The successful implementation of the Augmented Reality (AR)-based disaster mitigation booklet in this study confirms the comprehensive achievement of the dual-output targets. On one hand, this instructional media proved capable of sharply boosting academic achievements, indicated by the skyrocketing average score of students' scientific literacy from 32.94 during the pre-test to 76.03 during the post-test. At the same time, this booklet also succeeded in reconstructing students' emergency response capabilities, where the disaster mitigation literacy mastery score rose consistently from 60.78 to 79.59.

The successful implementation of the Augmented Reality (AR)-based disaster mitigation booklet in this study confirms the comprehensive achievement of the dual-output targets. On one hand, this instructional media proved capable of sharply boosting academic achievements, indicated by the skyrocketing average score of students' scientific literacy from 32.94 during the pre-test to 76.03 during the post-test. This significant acceleration in scientific literacy aligns with the findings of Amalina et al. (2025) and Damayanti et al. (2025), who reported that AR-based learning media effectively enhances students' abilities to explain scientific phenomena and understand geological dynamics. At the same time, this booklet also succeeded in reconstructing students' emergency response capabilities, where the disaster mitigation literacy mastery score rose consistently from 60.78 to 79.59. This finding corroborates previous studies by Fitri et al. (2025) and Wulandari et al. (2025), which demonstrated that integrating AR simulations into mitigation booklets significantly strengthens students' disaster literacy and emergency response preparedness.

The significance of this acceleration in the scientific literacy domain was strongly influenced by the presence of AR technology, which functionally bridged students' cognitive limitations in processing theoretical and isolated geological science materials. The placement of interactive 3D simulations on abstract materials, such as volcanic eruption processes, tsunami-triggering hydrological cycles, and tectonic plate shifts, proved capable of optimally facilitating students' scientific "Competency Dimensions". Through AR triggers, something that was previously massive in size and beyond the reach of direct observation inside the classroom has now transformed into concrete spatial visual representations (Syahputra et al., 2024). This finding strengthens the postulates of Yilmaz (2021) and Lino Padang et al. (2022), stating that the integration of virtual objects into real learning spaces effectively frees students from the burden of blind memorization, thereby allowing their cognitive capacities to be diverted towards critical reasoning, scientifically explaining phenomena, and evaluating natural evidence.

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More than simply fixing pure cognitive aspects, the substance of this research's success is actually characterized by students' paradigm shifts in the affective and psychomotor dimensions. The high achievements in the disaster mitigation Attitude (87.23%) and Skill (86.47%) dimensions are not merely products of reading booklet activities, but rather the fruit of a local context approach based on real problem solving. The significant increase in both of these domains was triggered by the integration of machitanken (environment exploration) activities into the teaching material guide. This exploration method forced students to step out of the classroom, observe school topography, independently identify landslide-prone points, and collaboratively compile hazard maps and design evacuation routes.

This contextual hands-on activity stimulated a sense of social care, environmental conservation responsibility, and students' operational agility during crises (Rachman et al., 2024). Consequently, students' understanding of natural disasters did not stop as mere theoretical discourse on paper, but transformed holistically into actual self-rescue life skills. This comprehensive evaluation reaffirms the framework of Chung and Yen (2016) as well as the findings of Prihantini et al. (2020) that an education proportionally blending science mastery (Knowledge), preparedness attitude formation (Attitude), and emergency skill practices (Skill) is a central key in shaping a generation possessing high resilience towards future disasters.

CONCLUSION

Based on the research and development results that have been conducted, it can be concluded that the Augmented Reality (AR)-based disaster mitigation booklet on the Earth Structure and Its Development material is proven highly feasible, practical, and effective to be implemented in Natural Sciences (IPA) learning. In terms of validity, this media was declared highly feasible based on expert assessments from material experts and media experts. In terms of practicality, this booklet was also considered highly practical and received very positive acceptability responses from users, both by students and classroom science teachers. The implementation of this AR-based booklet proved

significantly effective in providing a double impact (dual-output). This is evidenced by the improvement in achievement (N-Gain Score) in scientific literacy of 0.645 and disaster mitigation literacy of 0.490, both of which are in the good improvement category. Thus, the presence of AR technology and contextual approaches within this booklet not only succeeded in facilitating students' academic needs in understanding abstract concepts of the Earth's structure, but holistically managed to reconstruct students' capabilities, preparedness attitudes, and resilience in facing disaster threats in their surrounding environment. Based on the formulated research objectives and the results of the development process, this study concludes that the Augmented Reality (AR)-based disaster mitigation booklet on Earth Structure learning is proven highly feasible, practical, and effective. First, in terms of product feasibility and characteristics, the developed media achieved a "highly valid" category based on the Aiken's V index assessments from both material and media experts, confirming its academic and technical readiness. Second, regarding product practicality, the booklet received "very practical" and positive responses from both science teachers (87.42%) and students (87.99%), demonstrating its ease of use, readability, and high acceptability in real classroom settings. Third, concerning its effectiveness, the implementation of this AR booklet significantly fulfilled the dual-output target. It successfully boosted students' scientific literacy (achieving a Moderate N-Gain of 0.645) and systematically improved their disaster mitigation literacy across the Knowledge, Attitude, and Skill dimensions (achieving a Moderate N-Gain of 0.490). Ultimately, the integration of 3D AR technology and contextual approaches within this booklet effectively facilitates students' academic needs in understanding abstract concepts while holistically building their disaster preparedness and resilience.

DECLARATION OF GENERATIVE AI

The author(s) declare that no generative AI or AI-assisted technologies were used in the writing process of this manuscript.

CONFLICTING INTEREST STATEMENT

The author(s) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

FUNDING INFORMATION STATEMENT

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

AUTHORSHIP CONTRIBUTION STATEMENT

Embun Khoerunnisa Maya Safitri: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing - Original Draft. **Bibin Rubini:** Supervision, Validation, Writing - Review & Editing. **Surti Kurniasih:** Supervision, Validation, Writing - Review & Editing.

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