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DEVELOPMENT OF DISASTER MITIGATION-BASED MATHEMATICS LEARNING MATERIALS TO ENHANCE MATHEMATICAL APPLICATION SKILLS AMONG JUNIOR HIGH SCHOOL STUDENTS IN PIDIE JAYA

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ABSTRACT
Indonesia is a disaster-prone country that requires the strengthening of disaster mitigation education from an early age, including through school-based learning. The abstract nature of mathematics often causes students to struggle with applying mathematical concepts to real-world situations. This study aims to develop disaster mitigation-based mathematics learning materials and to test their feasibility and effectiveness in improving the mathematical application skills of junior high school students in Pidie Jaya Regency. This study employed the Research and Development (R&D) method using the ADDIE development model, which includes the stages of analysis, design, development, implementation, and evaluation. The research subjects were junior high school students in Pidie Jaya Regency. Research instruments included an expert validation sheet, a student response questionnaire, and a mathematical application skills test. Data were analyzed descriptively to determine the validity and practicality of the media, and gain score analysis was conducted to assess the effectiveness of the learning media. The results indicate that the disaster mitigation-based mathematics learning media falls into the "feasible" to "highly feasible" categories. Student responses were positive, and test results showed an improvement in students' mathematical application skills after using the learning media. Thus, the developed learning media is effective as an alternative for contextual learning and supports disaster mitigation education in schools.
Keywords: *Instructional Media, Mathematics, Disaster Mitigation, Mathematical Applications, Junior High School*.

INTRODUCTION

Indonesia is one of the countries with the highest disaster vulnerability rates in the world due to its geographical location within the Pacific Ring of Fire. This makes Indonesia prone to various types of natural disasters, such as earthquakes, tsunamis, floods, and landslides. Therefore, systematic efforts are needed to improve community disaster preparedness through formal education. Schools serve as strategic spaces for fostering a culture of disaster awareness from an early age.(Nieveen, 2013)

Disaster mitigation education plays a crucial role in shaping students' knowledge, attitudes, and skills in dealing with disaster risks. However, its implementation is still predominantly limited to geography and science classes. The integration of disaster

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mitigation into mathematics education remains relatively limited, even though mathematics makes a significant contribution to risk analysis, disaster data processing, graph interpretation, mathematical modeling, and decision-making based on quantitative calculations.

Over the past five years, various studies have highlighted the importance of contextual learning in improving the quality of mathematics education. An OECD study (2019) emphasizes that 21st-century mathematical literacy requires students to apply mathematical concepts to real-world situations. It reports that students' low mathematical application skills are caused by learning that remains procedure-oriented and lacks context. Research by Mailizar et al. indicates that the use of disaster contexts in mathematics learning materials can increase student engagement and risk awareness. Additionally, research by Zulfikar and Ismi (2025) reveals that environment-based learning materials can enhance students' interest in learning, conceptual understanding, and computational skills, while simultaneously fostering environmental awareness and creativity.(Widodo & Putra, 2021)

Although these studies indicate that the integration of real-world contexts—whether environmental or disaster-related—has a positive impact on learning outcomes, most still focus on improving motivation or general learning outcomes. Studies that specifically develop disaster mitigation-based mathematics learning media with the aim of improving students' mathematical application skills remain limited. Furthermore, there is a lack of research that systematically integrates local disaster contexts into the design of learning media using a structured development model and comprehensive effectiveness evaluation.(Johan et al., 2022)

As a region that has experienced a major earthquake, Pidie Jaya Regency has a high need to strengthen disaster mitigation education in schools. However, the development of mathematics learning media that links mathematical concepts to the context of local earthquake mitigation remains limited. This indicates the existence of a research gap as well as an opportunity for innovation in the development of contextual learning media based on disaster mitigation.(Hasanah & Sunarty, 2025)

Based on the above discussion, this study aims to develop a contextual mathematics

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learning medium based on disaster mitigation that is relevant to local conditions in Pidie Jaya, as well as to test its effectiveness in improving junior high school students' mathematical application skills. This study is expected not only to contribute to improving the quality of mathematics education but also to support the strengthening of a disaster-aware culture through interdisciplinary integration(Zulkriansyah et al., 2025)

METHODS

This study is a research and development (R&D) project aimed at producing disaster mitigation-based mathematics learning materials and testing their feasibility, practicality, and effectiveness in improving students' mathematical application skills. The development model used is the ADDIE model, which includes the stages of analysis, design, development, implementation, and evaluation, as this model is systematic, flexible, and widely used in the development of learning materials. The study was conducted at a junior high school in Pidie Jaya Regency, Aceh Province, with 30 students selected through purposive sampling based on student characteristics and class availability for the pilot test.(Sugiyono, 2022)

During the analysis phase, learning needs were identified through an analysis of the curriculum, student characteristics, mathematics learning conditions, and the local disaster context, using observations, teacher interviews, and a pre-test of mathematical application skills. The design phase includes the formulation of learning objectives, selection of materials, development of indicators for mathematical application skills, learning activities, and media design that integrates junior high school mathematics content with the context of disaster mitigation. Next, in the development stage, the media products were produced and validated by subject matter experts and media experts to assess content suitability, curriculum alignment, disaster mitigation integration, language, and presentation.(Akker et al., 2013)

The implementation phase involved a pilot test of the instructional media in mathematics classes, where students used the media to solve mathematics problems based on disaster mitigation and then completed a response questionnaire to assess the media's practicality. The evaluation phase aimed to assess the media's effectiveness by comparing the pretest and posttest results of students' mathematical application skills. The research instruments included an expert validation sheet, a student response questionnaire, and a " " test of mathematical application skills. Validation and student response data were analyzed descriptively using means and percentages, while pretest and posttest data were analyzed using the Shapiro–Wilk normality test, paired t-tests, and N-Gain calculations to determine the level of improvement in learning outcomes(Arikunto, 2020)

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RESULTS AND DISCUSSION

This study produced disaster-mitigation-based mathematics learning materials developed using the ADDIE model, which includes the stages *of analysis, design, development, implementation, and evaluation* (Branch, 2009). The research results and discussion are presented in an integrated manner based on each stage of development to address the issue of low mathematical application skills among junior high school students in Pidie Jaya Regency.(Astri et al., 2025)

Table 1. Summary of Learning Media Development Results Based on the ADDIE Model

ADDIE Stage	Focus of Activities	Results Obtained
Analysis	Analysis of learning needs, student characteristics, curriculum, and disaster context	Initial mathematical achievement scores were low (average pretest score of 56.8); mathematics instruction was not yet contextual
Design	Design of media structure, mathematics content, disaster mitigation context, and mathematical application indicators	Contextual media design based on disaster mitigation is structured in accordance with the junior high school curriculum
Development	Media development and expert validation	Average validation score of 3.62 on a scale of 4.00 (very suitable category)
Implementation	Media pilot test with junior high school students in Pidie Jaya	Positive student response rate of 86.4% (very practical category)
Evaluation	Evaluation of validity, practicality, and effectiveness	Posttest score 78.6; N-Gain 0.50 (moderate category)

The analysis phase revealed that mathematics instruction in junior high schools in Pidie Jaya Regency remains focused on solving routine problems and fails to connect the material to real-life contexts. The impact is evident in students' low mathematical application skills, as indicated by a pretest average score of 56.8. Students struggle to

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understand contextual problems and interpret the results of mathematical solutions.(Pujani et al., 2025)

These findings align with those of Widodo and Putra (2021), who state that abstract mathematics instruction results in students being less able to apply mathematical concepts in daily life. A curriculum analysis indicates that junior high school mathematics content has significant potential for integration with disaster mitigation contexts, particularly in earthquake-prone areas such as Pidie Jaya Regency(Nuraeni et al., 2024) .

Based on the analysis results, the *design* phase for developing instructional media that integrates mathematics content with the context of disaster mitigation was carried out. The media was designed around disaster-related problems relevant to the students' environment, such as earthquake data analysis and safe distance calculations. Additionally, indicators of mathematical application skills were developed to include the ability to understand problems, create mathematical models, solve the models, and interpret the results. This design approach aims to shift learning from merely mastering procedures toward meaningful and applied learning, as recommended in the "(Fourilla & Fauzi, 2021)

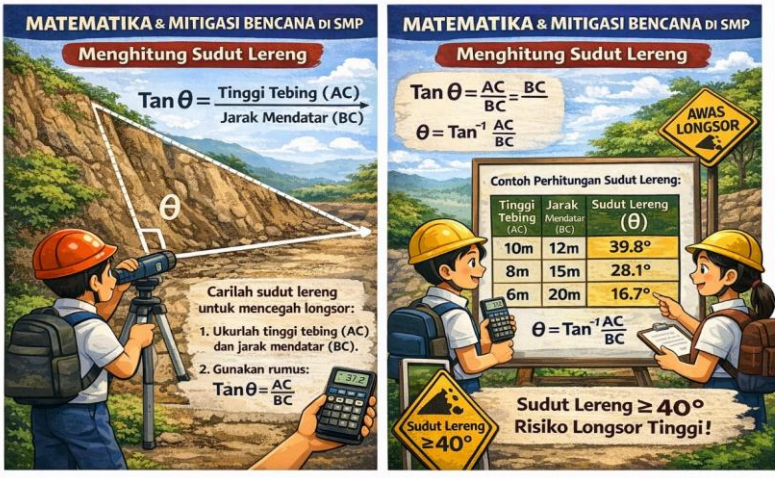

Figure1 of Disaster Mitigation-Based Learning Media

During the *Development* phase, the educational media developed are validated by subject matter experts and media experts. The validation of the educational media is conducted by two expert validators: a subject matter expert and a media expert. The assessment focuses on several key aspects, including content appropriateness, alignment

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with the curriculum, integration of disaster mitigation, language quality, and media presentation.(Fuedsi et al., 2024)

Table 2. Results of Learning Media Validation

Evaluation Aspects	Average Score	Category
Content Suitability	3.60	Highly Appropriate
Curriculum Alignment	3.55	Highly Appropriate
Integration of disaster mitigation	3.70	Highly Appropriate
Language	3.65	Very Good
Media Presentation	3.60	Very Good
Overall average	**3.62**	**Very Good**

Based on Table 1, the instructional media received an overall average score of 3.62 out of a maximum score of 4.00, falling into the "highly acceptable" category. This indicates that the media met the criteria for content, construct, and presentation validity. This finding aligns with Nieveen's (2013) assertion that a developed product is considered valid if it meets the aspects of alignment in objectives, content, and instructional design.(Safitri et al., 2025)

The *implementation* phase was conducted by pilot-testing the learning media with junior high school students in Pidie Jaya Regency. During the learning process, students demonstrated active engagement in solving mathematical problems related to the context of disaster mitigation. (Novitasari & Qurrotaini, 2024)

Table 3. Results of the Student Response Survey

Evaluated Aspects	Percentage (%)	Category
Ease of use	89	Very Practical
Clarity of content	84	Very Practical
Student engagement	86	Very Practical
Usefulness of the media	87	Very Practical
Average	**86.4**	**Very Practical**

Table 2 shows that the learning media received an average positive response of

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86.4% in the "very practical" category. This indicates that the media is easy to use, engaging, and helps students understand the math material. These results align with Akker et al. (2013), who state that the practicality of media is demonstrated by ease of use and positive user acceptance. (Platini, 2022)

The *evaluation* phase was conducted to assess the effectiveness of the learning media by comparing the *pretest* and *posttest* results of students' mathematical application skills. Before testing the hypotheses, the normality of the *pretest* and *posttest* data was tested using the Shapiro–Wilk test. The test results showed that the significance values for both the pretest and posttest were greater than 0.05, indicating that the data were normally distributed and met the requirements for parametric testing. A paired t-test was used to determine whether there was a significant difference between the pretest and posttest scores of students' mathematical application skills at after using disaster mitigation-based mathematics learning media. (Aziz et al., 2023)

Table 4. Results of the Paired t-Test

Statistics	Value
Sample Size (n)	30
Pre-test mean	56.8
Posttest mean	78.6
Calculated t-value	12.82
Sig. (p-value)	0.000
Decision	H_0 is rejected

Based on Table 4, the calculated t-value is 12.82 with a significance level of $p < 0.05$. This indicates that there is a significant difference between students' mathematical application skills before and after using disaster mitigation-based mathematics learning media. Thus, the developed learning media has a significant effect on improving students' mathematical application skills. (The *N-Gain* calculation of 0.50, which falls into the moderate category, indicates that the learning media has a positive impact on improving students' mathematical application skills (Ismi & Rahmatina, 2025)

The results of the study indicate that the development of disaster-mitigation-based mathematics learning materials using the ADDIE model significantly improves students'

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mathematical application skills. The integration of disaster-related contexts makes learning more relevant and meaningful for students, enabling them to more easily connect mathematical concepts with real-life situations.(Aziz et al., 2023)

These findings align with the OECD (2019), which emphasizes that mathematics instruction should encourage students to apply mathematics to solve real-life problems. Furthermore, the results of this study support the findings of Mailizar et al. (2023), who state that incorporating a disaster context into mathematics instruction can enhance student engagement and conceptual understanding.

Thus, the learning media developed not only improves students' academic abilities but also contributes to fostering disaster mitigation awareness in schools, particularly in disaster-prone areas such as Pidie Jaya Regency.(Djara et al., 2023)

CONCLUSION

The disaster-mitigation-based mathematics learning media developed using the ADDIE model has been found to be valid, practical, and effective, making it suitable for use in mathematics instruction at the junior high school level. These results indicate that the developed media meets the criteria for content appropriateness, visual appeal, and ease of use, thereby optimally supporting the learning process. The success of this development also demonstrates that learning media designed to meet students' needs can serve as an effective tool to help them better understand the material.

The use of this medium has been shown to significantly improve students' mathematical application skills. This is evident from the increase in students' average scores from 56.8 before the medium was used to 78.6 after the instruction was implemented. This improvement indicates that students are becoming increasingly capable of connecting mathematical concepts to problem situations, constructing mathematical models, performing calculations, and interpreting the results obtained in relevant contexts.

In addition to improving learning outcomes, the integration of disaster mitigation contexts into learning materials also makes the learning process more contextual and meaningful. Students do not merely learn mathematics as an abstract concept but also understand its application in real-life situations relevant to their daily lives, particularly in disaster-prone areas such as Pidie Jaya Regency. Thus, this educational material not only plays a role in enhancing students' mathematical skills but also helps foster awareness and preparedness regarding disasters.

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