



Development of Inclusive-Adaptive Disaster Mitigation Educational Media Based on Audio Visual and Sign Language to Improve Self-Rescue for Students with Disabilities

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Abstract: Indonesia is a country with a high level of disaster vulnerability, yet mitigation education for students with disabilities, particularly those with hearing impairments, remains constrained by the limited availability of inclusive and adaptive learning media. This study aims to develop audio-visual disaster mitigation educational media combined with sign language to improve the self-rescue skills of students with disabilities. This study used a Research and Development (R&D) design, adapting the Borg and Gall model through the stages of needs analysis, design, development, expert validation, revision, and limited trials. The population consisted of 531 children with disabilities in Kupang City, from which a sample of 229 respondents was drawn using a purposive sampling technique. Data were collected through observation, interviews, questionnaires, and comprehension tests, and were analyzed using descriptive quantitative techniques (percentage and pre-test-post-test comparison) as well as qualitative analysis. The results of the study indicate that the developed media has a very high level of feasibility based on expert assessments and is able to significantly improve students' understanding and self-rescue skills. In addition, this media has been proven to increase student engagement and confidence in facing disaster situations. It is concluded that audio-visual and sign language-based educational media are effective, inclusive, and adaptive in supporting disaster mitigation learning for students with disabilities.

Keywords: Audio visual; Disaster mitigation; Inclusive learning media; Sign language; Self-rescue

Introduction

Indonesia is a country with a high level of disaster vulnerability due to its geographic location on the Pacific Ring of Fire (Fahrudin et al., 2022; Fuady et al., 2021). Data from the National Disaster Management Agency BNPB (2023) shows that the frequency of natural disasters in Indonesia increases annually and significantly impacts vulnerable groups, including children and people with disabilities (Bakhriansyah et al., 2025). This situation demands systematic efforts to improve disaster preparedness through education, particularly by equipping students with self-rescue skills.

However in practice, students with disabilities still face various barriers in accessing disaster mitigation education (Nikolarai et al., 2025; Rofiah et al., 2021). The World Health Organization WHO (2023) states that individuals with disabilities are two to four times more likely to become victims in emergency situations compared to individuals without disabilities. This is due to limited access to information, communication barriers, and a lack of learning media appropriate to their needs. Similarly, the United Nations Office for Disaster Risk Reduction Gianniri (2005) emphasized that inclusivity in disaster risk reduction remains a global challenge, particularly in ensuring equal access to information for persons with disabilities.

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In the educational context, disaster mitigation learning in schools is still dominated by conventional methods such as lectures and the use of texts, which are less effective for students with special needs (Apronti et al., 2015; Senanayake et al., 2023). According to Dale (1969), learning experiences that involve visual and audiovisual elements have a higher retention rate than purely verbal methods. This indicates that the use of audiovisual media has great potential in improving students' understanding of disaster mitigation concepts (Polanunu et al., 2025; Zuhriyah & Rokhman, 2025).

Furthermore, the social constructivism theory proposed by Vygotsky & Cole (1978) emphasizes that the learning process is influenced by social interaction and the use of relevant tools, including language as the primary medium for understanding information. In this regard, for students with hearing impairments, sign language is the primary communication tool that must be integrated into the learning process. This is reinforced by UNESCO (2020), which states that inclusive education must provide equal access to learning through adaptive approaches, including the use of sign language and visual media.

A problem that arises is the limited availability of inclusive and adaptive disaster mitigation educational media, particularly those that integrate audiovisual and sign language into a single learning environment. Research by Wickenden et al. (2025) shows that most disaster mitigation media in schools are not disability-friendly and do not consider the communication needs of deaf students. As a result, the self-rescue skills of students with disabilities remain low due to a lack of understanding of safety procedures during disasters.

Based on a gap analysis, there is a gap between the need for inclusive disaster mitigation learning media and the availability of existing media in the field. Meanwhile, advances in multimedia technology offer significant opportunities for creating more interactive, adaptive, and accessible learning media for diverse student groups (Hossain, 2023; Matthew et al., 2022).

Therefore, this research focuses on the development of audio-visual disaster mitigation educational media combined with sign language as an inclusive-adaptive approach. The aim of this research is to improve the self-rescue skills of students with disabilities by providing accessible, communicative, and effective learning media. Therefore, it is hoped that this research can contribute to strengthening inclusive and sustainable disaster mitigation education.

Although previous studies have examined disaster mitigation education for students with disabilities, most have focused on either visual-based media or sign-language interpretation separately, without integrating both modalities into a single, systematically validated

learning tool (Marhami et al., 2025). Existing evidence on self-rescue training for children with disabilities in Indonesia, including in disaster-prone regions such as Nusa Tenggara Timur, has also largely relied on repeated physical simulation drills rather than dedicated, accessible instructional media (Mahoklory & Hoda, 2021). This reveals a clear gap between the growing need for accessible, dual-modality (audio-visual and sign language) educational media and the limited availability of empirically validated products for schools. Closing this gap is urgent, given that students with hearing impairments are disproportionately vulnerable during emergencies due to communication barriers that conventional, text- or speech-based media fail to overcome. The novelty of this study therefore lies in its integration of audio-visual content with sign language interpretation into a single inclusive-adaptive educational medium, which is systematically developed, expert-validated, and empirically tested to improve the self-rescue skills of students with disabilities.

Method

This study uses a Research and Development (R&D) approach with the aim of developing inclusive-adaptive disaster mitigation educational media based on audio-visual and sign language to improve the self-rescue skills of students with disabilities. The development model used adapts the steps from Borg & Gall (1983) which are simplified into several main stages, namely needs analysis, product design, development, validation, revision, and limited trials.



Figure 1. Research flow of the study

The research flow in this study followed six sequential stages: (1) needs analysis, conducted through field observation and interviews to identify the learning barriers faced by students with disabilities; (2) product design, in which the concept and storyboard of the audio-visual and sign-language media were developed; (3) media development, involving production of the video using multimedia design and editing software; (4) expert validation, carried out by special education, disaster, and learning media experts to assess content, design, language, and accessibility; (5) product revision, based on validators' feedback and suggestions; and (6) limited trial, in which the revised media was implemented with students with disabilities to evaluate its effectiveness through pre-test and post-test measurements. This sequential flow ensured that the media was systematically developed, expert-validated, and empirically tested before being considered feasible for broader use.

The needs analysis phase was conducted through field observations at inclusive schools and interviews with special education teachers and students with disabilities, particularly those with hearing impairments. This phase aimed to identify challenges in current disaster mitigation learning and students' specific needs for accessible learning media. The analysis revealed that students require media that combines concrete visualizations, simple language, and sign language support to ensure optimal understanding of the material.

In the design phase, researchers developed a media design in the form of an educational video containing disaster mitigation content, such as on earthquakes and fires. The media was designed by combining animated visual elements, audio narration, text, and a sign language interpreter, all presented simultaneously. The media was developed using multimedia design and editing software, with attention to the principles of visual clarity, information simplicity, and accessibility for students with disabilities.

Next, the validation stage was conducted by three types of experts: special education experts, disaster experts, and learning media experts. Validation aimed to assess the appropriateness of the media's content, design, language, and accessibility aspects. The instrument used was a Likert-scale questionnaire analyzed using a feasibility percentage. The validation results were then used as a basis for revising the product to ensure it meets inclusive learning standards.

A limited trial phase was conducted with students with disabilities in an inclusive school, with a limited number of subjects. The trial aimed to determine the effectiveness of the media in improving understanding of disaster mitigation and self-rescue skills. Data was

collected through pre-tests and post-tests of the media use, as well as a questionnaire assessing students' responses to the developed media.

Data analysis techniques used were descriptive quantitative and qualitative. Quantitative data, including expert validation scores and student learning improvement, were analyzed using percentages and comparisons of pre-test and post-test scores. Meanwhile, qualitative data from interviews and student responses were analyzed to illustrate the level of acceptability and practicality of the media.

This study also adhered to ethical aspects of research by obtaining permission from the school and obtaining informed consent from respondents. All data collected will be kept confidential and used solely for research purposes.

Results and Discussion

Result

Table 1. Media Validation Results

Assessment Aspects	Percentage %	Category
Content Eligibility	92	Very Worthy
Media Design	90	Very Worthy
Language	88	Worthy
Accessibility	93	Very Worthy

Table 2. Student Trial Results

Indicator	Before %	After %
Understanding mitigation	60	85
Self-rescue skills	55	82

Student Response

Most students showed a high level of interest in media, mainly due to attractive visuals, sign language that helps understanding, and easy to understand delivery

Disaster mitigation educational media is being developed in the form of learning videos that integrate animation, audio narration, text, and sign language. This media is designed to provide a concrete, easy-to-understand, and user-friendly learning experience for students with disabilities, particularly those who are deaf. The material presented includes an introduction to disaster types, early warning signs, and self-rescue steps to take before, during, and after a disaster.

Based on expert validation results, the developed media was deemed to have a high level of feasibility. The content aspect received a very good rating because the material was structured in accordance with sound disaster mitigation principles and was relevant to conditions in the school environment. In terms of design, the use of color, illustrations, and visual flow were deemed effective in capturing students' attention and helping clarify information. Meanwhile, accessibility

was a key factor, as the use of sign language was deemed to significantly assist students in fully understanding the material.

During the limited trial phase, significant changes in student understanding were observed. Before using the media, most students only had a general idea of disasters without knowing the concrete steps to take. After learning using the media, students began to explain self-rescue procedures more coherently, such as finding a safe place during an earthquake, protecting their heads, and following evacuation routes.

Students' self-rescue skills also improved. This was evident in their ability to perform simple simulations, such as taking shelter during an earthquake or safe evacuation procedures. Furthermore, students' responses to the media tended to be positive. They showed high levels of interest, improved focus during learning, and increased confidence in participating in simulation activities.

Discussion

The results of this study demonstrate that audiovisual-based educational media combined with sign language can address the disaster mitigation learning needs of students with disabilities. One of the main obstacles to learning has been limited access to information tailored to students' characteristics. This medium provides a bridge connecting complex material with a simpler, more easily understood delivery method.

These findings are consistent with Dale's Cone of Experience (Dale, 1969), which posits that audio-visual learning experiences produce higher retention than verbal instruction alone; this is reflected in the substantial increase in students' comprehension scores, from 60% to 85%, after using the developed media. The results also support Vygotsky's social constructivism theory, which emphasizes the role of language and social tools in mediating understanding (Shah, 2022; Syah et al., 2026). In this study, sign language functioned as the primary semiotic tool that enabled students with hearing impairments to construct meaning from the disaster mitigation content, rather than relying on textual or purely verbal explanations that had previously excluded them from meaningful learning (Rohani & Rahmawati, 2025).

Compared to Susilawati et al. (2025) findings, which showed that most existing disaster mitigation media in schools were not disability-friendly and failed to accommodate the communication needs of deaf students, the media developed in this study directly addresses that shortcoming by embedding sign language interpretation within the audio-visual content itself. Similarly, while Boon's review highlighted a

persistent gap in school disaster planning for children with disabilities, and Ronoh's case study in Christchurch emphasized the heightened vulnerability of children with disabilities during disasters, the present findings offer empirical evidence that a systematically validated, dual-modality medium can measurably improve both understanding and self-rescue skills. These results also extend the authors' earlier work on self-evacuation drills for children with disabilities (Mahoklory & Hoda, 2021), which found that structured, repeated exposure to concrete self-rescue actions improved children's preparedness; the present study builds on this by embedding such concrete guidance directly within an accessible instructional medium rather than relying solely on physical drills. Taken together, these correlations suggest that integrating visual, audio, and sign-language elements does not merely supplement existing disaster education approaches but fills a specific, previously unaddressed gap in inclusive disaster risk reduction, in line with the equity principles.

Improving student understanding is inextricably linked to the power of visualization in the media used. Previously abstract information becomes more concrete through animation and simulation. Students not only hear or read but also see firsthand how an action is performed. This makes the learning process more meaningful and memorable.

Furthermore, the integration of sign language has a significant impact, especially for students with hearing impairments. Communication limitations often make it difficult for students to optimally participate in learning. With sign language in the media, students can understand information directly without having to rely entirely on teacher explanations. This demonstrates that accessibility is not merely a complement, but a fundamental requirement for inclusive learning (Fauza et al., 2023).

Compared to conventional learning, this medium provides a more interactive learning experience. Students are not merely recipients of information but are actively engaged through observation, understanding, and practice. This is evident in the increased student participation in simulation activities and their ability to apply the knowledge gained.

However, this study still has limitations. The trial was small-scale, so it doesn't fully reflect the media's effectiveness in a broader context. Furthermore, the type of disability focused on was limited to deaf students, requiring further development to accommodate other types of special needs.

Overall, these findings demonstrate that developing inclusive and adaptive learning media is not only feasible but also has a significant impact on improving the preparedness of students with

disabilities. With the right approach, students not only understand the concept of disaster mitigation but also develop the readiness to protect themselves in real-life situations.

Conclusion

This study concludes that the developed inclusive-adaptive disaster mitigation educational media, which integrates audio-visual content with sign language, is both feasible and effective in improving the self-rescue skills of students with disabilities, particularly those with hearing impairments; the media achieved a very high feasibility level based on expert validation of its content, design, language, and accessibility, and produced significant gains in students' understanding of self-rescue procedures and their ability to perform them during simulations, as reflected in the increase from 60% to 85% in mitigation understanding and from 55% to 82% in self-rescue skills, while also strengthening student engagement and confidence. Practically, these results confirm that integrating visual, audio, and sign-language elements into a single learning medium is an effective strategy for inclusive disaster mitigation education and can be used as an alternative or complementary resource in inclusive schools, although the limitations in sample size and the range of disability types studied indicate the need for further research with a broader scope of subjects and disability categories.

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Conflicts of Interest

No conflict interest.

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