

Original Research

# Developing a Community-Based Non-Structural Disaster Mitigation Module Integrating Local Knowledge: Evidence from Indonesia as a Middle-Income Country

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## Article history

Received: 4 January 2026

Revised: 13 February 2026

Accepted: 26 February 2026

Published Online: 28 February 2026

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**How to cite this article:** Suparji, Nugroho HSW, Sunarto, Rusdianti A. Developing a Community-Based Non-Structural Disaster Mitigation Module Integrating Local Knowledge: Evidence from Indonesia as a Middle-Income Country. *Health Dynamics*, 2026, 3(2), 65-73. <https://doi.org/10.33846/hd30204>



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## ABSTRACT

**Background:** Natural disasters continue to pose significant challenges globally, particularly in disaster-prone middle-income countries such as Indonesia, where communities are frequently exposed to hydrometeorological and geological hazards. While structural mitigation remains important, non-structural and community-based approaches are increasingly emphasized to enhance contextual relevance and community engagement in disaster risk reduction. This study aimed to develop and assess the feasibility of a community-based non-structural disaster mitigation module integrating local knowledge as an educational resource for disaster-prone communities. **Methods:** The study employed a Research and Development (R&D) approach using a simplified adaptation of the Borg and Gall model. The development process included a needs assessment through in-depth interviews and focus group discussions, module design and development, expert validation, and a limited field trial with target community users. Data were collected using qualitative methods and structured questionnaires, and analyzed descriptively to examine feasibility, acceptability, and relevance. **Results:** The results indicate that the developed module achieved high feasibility scores across content, presentation, language, and integration of local knowledge. User assessments from the limited field trial demonstrated high levels of acceptability and relevance, particularly in relation to clarity, contextual suitability, and usefulness as a learning resource. Revisions based on expert and user feedback were incorporated into the final version of the module. **Conclusions:** In conclusion, this study provides early empirical evidence supporting the feasibility and acceptability of a community-based non-structural disaster mitigation module that integrates local knowledge. The module shows potential for use as an educational tool to support community disaster preparedness activities within similar middle-income country contexts.

**Keywords:** Developing countries; module development; feasibility studies; risk reduction behavior; natural disasters

## 1. INTRODUCTION

Indonesia is a middle-income country with a high level of disaster vulnerability, particularly to hydrometeorological and geological disasters such as landslides.<sup>(1)</sup> Rural areas characterized by hilly topography and

land-use changes, including Genilangit Village, face recurring disaster risks that directly impact community safety, livelihoods, and the sustainability of local development.<sup>(2)</sup> This situation emphasizes the urgency of strengthening disaster mitigation strategies that rely not only on structural approaches but also emphasize community preparedness through contextual and sustainable non-structural mitigation.<sup>(3)</sup>

Various studies indicate that disaster risk at the local level is influenced by key determinants, such as limited risk knowledge, low community preparedness, and the suboptimal integration of local knowledge-based mitigation practices into disaster risk reduction efforts.<sup>(4)</sup> In many rural areas, communities actually possess local experience and wisdom in recognizing early signs of disaster and implementing simple adaptive measures. However, this knowledge is often oral, not systematically documented, and not yet integrated into learning media or structured mitigation guidelines.<sup>(5,6)</sup>

Although the community-based disaster risk reduction (CBDRR) approach has been widely recommended in international literature,<sup>(7)</sup> a research gap remains regarding how local knowledge can be systematically transformed into a non-structural disaster mitigation module that has been tested for feasibility and can be used as a community education tool. Specifically, empirical evidence regarding the process of developing community-based modules through a Research and Development (R&D) approach in the Indonesian rural context remains limited,<sup>(8)</sup> particularly at the validation and initial pilot stages.

Based on this gap, this study aims to develop and test the feasibility of a community-based non-structural disaster mitigation module that integrates local knowledge in Genilangit Village. This research is expected to provide an initial contribution to the development of contextually relevant disaster mitigation education tools and serve as a methodological reference for the development of similar modules in other rural areas in middle-income countries.

## 2. METHODS

### 2.1 Study Design

This study employed a Research and Development (R&D) approach aimed at developing a community-based non-structural disaster mitigation module integrating local knowledge. The study adopted a modified Borg and Gall development model, simplified

to focus on early-stage product development and initial feasibility testing, which is appropriate for community-based educational innovations in disaster risk reduction contexts.

### 2.2 Development Stages

The development process consisted of five main stages: (1) Needs assessment, involving identification of community disaster risks and documentation of local knowledge related to landslide mitigation; (2) Design, including the formulation of module objectives, content structure, learning strategies, and visual presentation; (3) Development, in which the draft module was produced based on community input and disaster risk reduction principles; (4) Expert validation, conducted to assess content accuracy, language clarity, presentation quality, visual design, and integration of local wisdom; and (5) Limited field testing, aimed at evaluating usability, relevance, and perceived benefits of the module among target users.

### 2.3 Subjects and Respondents

This study involved three main stages of data collection. In the preliminary study phase (n=20), respondents were selected from residents with diverse social backgrounds, community leaders, Destana volunteers, and village officials. The expert validation phase (n=3) involved disaster experts, educational media, and academics in the field of disaster mitigation. Furthermore, the initial trial phase (n=30) included representatives of the product's target user groups, including residents, volunteers, community leaders, and village officials. All respondents were selected using purposive sampling, considering their relevance, experience, and capacity in non-structural disaster mitigation.

### 3.4 Data Collection Techniques

Data were collected using in-depth interviews, focus group discussions (FGDs), expert validation questionnaires, and user response questionnaires. Qualitative data from interviews and FGDs were used to capture community perceptions, experiences, and local mitigation practices. Quantitative data were obtained through Likert-scale questionnaires (1–4) assessing module feasibility in terms of attractiveness, clarity, relevance, and usefulness.

### 3.5 Expert Validation and Product Trial

Expert validation was conducted to ensure the module met academic, pedagogical, and contextual standards. Feedback from experts guided minor revisions, particularly in visual presentation and language simplification. The revised module was then tested in a limited field trial to assess initial acceptability and practical applicability within the community setting.

### 3.6 Data Analysis

Qualitative data were analyzed using thematic analysis involving coding, categorization, and theme development related to local knowledge, risk perception, and mitigation practices. Quantitative data were analyzed descriptively using mean scores and feasibility categories. Instrument reliability was assessed using Cronbach's alpha to evaluate internal consistency. All quantitative analyses were performed using IBM SPSS Statistics (version 25), while qualitative analysis was conducted through manual thematic coding.

### 3.7 Ethical Practices

This study has been reviewed and approved as ethically appropriate by the Health Research Ethics Committee (KEPK) of Poltekkes Kemenkes Surabaya. The

research was conducted in accordance with established ethical standards, including the principles of confidentiality, privacy, and informed consent. Ethical clearance was granted under Certificate No. EA/2393/KEPK-Poltekkes\_Sby/V/2024, issued by the KEPK Poltekkes Kemenkes Surabaya.

## 3. RESULTS

### 3.1 Results of Characteristics of In-Depth Interview Respondents and FGD Participants

A total of 40 participants participated in this study, consisting of 20 respondents in in-depth interviews and 20 participants in focus group discussions (Table 1). Participants in both groups were predominantly male, within the productive age range, with diverse educational backgrounds and community roles, and most were long-time residents of the study area.

### 3.2 Results of Instrument Validity and Reliability

Expert validation results indicate that all assessed aspects met the predefined validity criteria, with mean scores ranging from valid to highly valid (Table 2). The overall reliability coefficient demonstrates acceptable internal consistency of the expert validation instrument.

**Table 1.** Characteristics of In-depth interview respondents and FGD participants

Variable	Category	In-depth interviews (n=20)	FGDs (n=20)
Gender	Male	12 (60%)	12 (60%)
	Female	8 (40%)	8 (40%)
Age (years)	25–34	6 (30%)	5 (25%)
	35–44	5 (25%)	6 (30%)
	45–54	5 (25%)	5 (25%)
	55–65	4 (20%)	4 (20%)
Education level	Primary school	4 (20%)	3 (15%)
	Junior high school	4 (20%)	4 (20%)
	Senior high school	11 (55%)	9 (45%)
	Bachelor's degree	1 (5%)	3 (15%)
	Master's degree	–	1 (5%)
Length of residence (years)	≤30	6 (30%)	6 (30%)
	31–40	5 (25%)	5 (25%)
	41–50	6 (30%)	6 (30%)
	>50	3 (15%)	3 (15%)
Occupation / role	Farmer	6 (30%)	5 (25%)
	Housewife	3 (15%)	3 (15%)
	Village official	3 (15%)	3 (15%)
	Disaster-resilient village volunteer	4 (20%)	4 (20%)
	Community leader	3 (15%)	3 (15%)
	Academic	–	1 (5%)
	Others	1 (5%)	–

**Table 2.** Summary of expert validation results and reliability

Validation aspect	Number of items	Mean score range	Validity category	Cronbach's alpha
Content feasibility	5	3.86–4.68	Valid–highly valid	0.53
Presentation feasibility	5	3.41–4.17	Valid	0.52
Language feasibility	5	4.21–4.84	Highly valid	0.52
Visual design feasibility	5	3.84–4.83	Valid–highly valid	0.52
Local knowledge integration	5	3.98–4.83	Valid–highly valid	0.52
Overall (expert validation)	25	–	–	0.78

### 3.3 Results Validity and Reliability of the Limited Field Trial Instrument

All items of the limited field trial instrument demonstrated acceptable validity coefficients and good to very high internal consistency, supporting their use for user-based module assessment (Table 3).

### 3.4 Results of Needs Assessment (Interviews and FGDs)

The needs assessment involved in-depth interviews and focus group discussions (FGDs) with community members, local leaders, disaster-resilient village volunteers, and village officials. The findings indicate that the study area is characterized by steep slopes and former forest land converted into agricultural

use, which are perceived by residents as highly prone to landslides (Table 4). Community members reported recognizing early warning signs such as ground cracks, leaning trees, unusual animal behavior, and increased water seepage prior to landslide events.

Participants also described existing non-structural mitigation practices based on local knowledge, including communal tree planting, simple drainage construction, and collective monitoring of high-risk areas. However, the assessment revealed that evacuation planning remained limited, with no formal evacuation routes, risk maps, or designated assembly points. The community expressed the need for an educational module that uses simple language, visual illustrations, and practical guidance tailored to local conditions.

**Table 3.** Validity and reliability results of the limited field trial instrument

Aspect	Number of Items	r-value Range	p-value	Cronbach's Alpha	Category
Attractiveness	3	0.588–0.674	<0.01	0.781	Reliable
Ease of understanding	3	0.496–0.621	<0.01	0.754	Reliable
Content relevance	3	0.648–0.702	<0.01	0.812	Reliable
Usefulness	3	0.689–0.734	<0.01	0.826	Reliable
Overall (User assessment)	12	–	–	0.894	Highly reliable

**Table 4.** Summary of needs assessment findings based on interviews and FGDs

Theme	Key findings
Area characteristics	The area is characterized by hilly terrain with steep slopes; parts of the land consist of former forest areas converted into agricultural land and settlements.
Disaster risk perception	Community members recognize the area as landslide-prone, particularly during the rainy season with high rainfall intensity and prolonged rainfall duration.
Early warning signs of landslides (local knowledge)	Ground cracks, leaning trees or poles, the emergence of new water seepage or springs, and changes in animal behavior prior to landslide events.
Existing local mitigation practices	Tree planting on slopes, construction of simple drainage systems, collective environmental clean-up activities, and informal monitoring of high-risk areas.
Preparedness and evacuation	No formal risk maps, designated evacuation routes, assembly points, or agreed written evacuation procedures are currently available.
Need for a mitigation module	A module using simple language, visual illustrations, locally relevant examples, and practical guidance on early warning signs, non-structural mitigation, and evacuation.

### 3.5 Product Characteristics and Module Design

The module was developed to serve as an educational tool for community-based non-structural disaster mitigation (Table 5). The objective of the module was to provide structured information and practical guidance on disaster risk awareness, locally relevant mitigation practices, and basic evacuation procedures in landslide-prone areas.

The content structure of the module was organized into five main sections: (1) an introductory section outlining local disaster risk conditions; (2) a section explaining basic concepts of non-structural disaster mitigation; (3) a section describing local knowledge and community roles in landslide risk reduction; (4) a section documenting community experiences and existing mitigation practices; and (5) a section presenting simple evacuation guidance and safety actions.

The delivery method combined text-based explanations with visual elements to facilitate comprehension among community members. The module incorporated short narratives, step-by-step

guidance, and illustrative examples derived from local contexts. Learning activities were designed to be participatory, including reflection questions and discussion prompts intended for group-based community learning sessions.

In terms of media format, the module was produced as an illustrated booklet complemented by supporting visual materials, such as diagrams, photographs, and infographics. The layout employed clear typography and structured page organization to support ease of reading during community-based educational activities.

### 3.6 Expert Validation Results

Expert validation was conducted by specialists in disaster management, educational media, language, and local culture. The validation results showed high mean scores across all assessed aspects, indicating that the module met the predefined feasibility criteria (Table 6). Minor comments provided by experts were recorded for revision purposes, particularly related to visual consistency and simplification of selected terminology.

**Table 5.** Summary of module design and development

Component	Description
Module objective	To provide structured learning materials on community-based non-structural disaster mitigation, focusing on risk awareness, local knowledge, and basic evacuation guidance in landslide-prone areas.
Target users	Community members living in landslide-prone areas, including local leaders and disaster-resilient village volunteers.
Content structure	Five sections: (1) local disaster risk context; (2) basic concepts of non-structural mitigation; (3) local knowledge and community roles; (4) existing community mitigation practices; (5) simple evacuation guidance.
Learning approach	Community-based and participatory learning, using short narratives, step-by-step guidance, and discussion prompts derived from local contexts.
Delivery method	Combination of text-based explanations and visual support to facilitate understanding during group-based learning activities.
Media format	Illustrated booklet supported by diagrams, photographs, and infographics designed for community education settings.

### 3.7. Limited Field Trial Results

A limited field trial involved representatives from the target community as potential users of the module (Table 7). User assessments showed high average scores across all evaluated aspects. Content relevance and usability received the highest average scores, while ease of understanding scored slightly lower, but still acceptable. User feedback was documented to inform

minor revisions to language and layout in subsequent development stages.

### 3.8 Product Revision

Module revisions were implemented based on feedback from expert validation and limited field trials. Content revisions included the addition of locally relevant examples and clarification of key concepts related to early warning signs and evacuation procedures. Language adjustments included simplifying

technical terms and improving sentence structure to enhance readability for community users. Visual revisions included improving layout consistency, increasing font size, and enhancing the clarity of illustrations and diagrams. These revisions resulted in the final version of the module, which was used as a result of the development phase.

**Table 6.** Expert validation results of the non-structural disaster mitigation module

Assessed aspect	Mean score*	Feasibility category
Content accuracy and relevance	3.75	Highly feasible
Language clarity	3.62	Highly feasible
Presentation and organization	3.68	Highly feasible
Visual design and layout	3.55	Highly feasible
Integration of local knowledge	3.78	Highly feasible
Overall feasibility	3.68	Highly feasible

\*Likert scale: 1 = not feasible, 2 = less feasible, 3 = feasible, 4 = highly feasible.

**Table 7.** Results of limited field trial based on user assessment

Assessed aspect	Mean score*	Feasibility category
Attractiveness	3.70	Highly feasible
Ease of understanding	3.55	Highly feasible
Content relevance	3.78	Highly feasible
Usefulness	3.80	Highly feasible
Overall user assessment	3.71	Highly feasible

\*Likert scale: 1 = not feasible, 2 = less feasible, 3 = feasible, 4 = highly feasible.

## 4. DISCUSSION

This study provides initial empirical evidence on the feasibility and acceptability of a community-based non-structural disaster mitigation module that integrates local knowledge. Findings from the expert validation process and limited trials indicate that the developed non-structural disaster mitigation module meets the feasibility criteria and is acceptable to key stakeholders, both in terms of substance and presentation. The content's suitability to the local risk context and the clarity of the material's structure indicate that the module is appropriately designed for use in a community-based learning environment. The high level of acceptance from target users also reflects that the module's format and

language align with community needs and characteristics, thus offering the potential for use as an educational medium to support community preparedness without exceeding the limitations of the development design used in this study.

Several studies applying the Community-Based Participatory Research (CBPR) approach have found that active community participation in the process of identifying local needs and analyzing existing issues provides a strong foundation for developing more appropriate and meaningful interventions, as local community experiences serve as a primary source for designing materials and action strategies.<sup>(9)</sup> In this module development research, in-depth interviews and focus group discussions revealed the community's real need for materials that align with local experiences and the challenges they face daily.<sup>(10)</sup> Participatory approaches such as Community-Based Participatory Research in education and module development have proven effective in bridging the gap between academic knowledge and real-world practice by actively involving the community in the design and implementation process of the materials.<sup>(11)</sup> These qualitative findings were then used as the basis for filling the module with elements identified by the community, resulting in a context-based and participatory module that values local experiences and specific community needs, reduces the risk of disconnected research from local realities, and increases ownership and relevance of the materials for the target participants.

The role of the community in module development is particularly evident when they are not only considered as objects of study but also as active partners at every stage of development through focus group discussions (FGDs) and collaborative discussions. This significantly enhances the sense of ownership of the modules.<sup>(12)</sup> Research involving community participation shows that community participation in identifying needs, selecting materials, and assessing learning content makes the materials more relevant and acceptable, as they derive from the voices and expectations of the community itself. As a result, the modules are not created top-down, but rather reflect the participation and strength of local capacities, strengthening educational empowerment based on the local social and cultural context.<sup>(13)</sup> For example, co-creation and participatory learning can enrich module design with community expertise, giving end users a sense of ownership and responsibility for the content.<sup>(14,15)</sup>

The assessment results from educational experts indicate that the module has met the criteria for content suitability, language clarity, and presentation and organization of materials, which are essential elements in the principles of effective learning design. Input from experts is crucial to ensure that the learning objectives, material sequence, and examples presented are logically structured and easily understood by adult learners, without ignoring the local context that is characteristic of community-based modules. This finding is in line with learning design theory that emphasizes the importance of matching content, learner characteristics, and learning context for materials to be relevant and applicable, especially in adult education that requires direct connections to their lived experiences and real needs.<sup>(16)</sup> Furthermore, the expert assessment serves as a formative evaluation that improves the module's academic and pedagogical quality, while ensuring that the development of community-based teaching materials remains in line with the principles of participatory and contextual learning, as recommended in the development of community-based education modules.<sup>(17)</sup>

The findings of this study reinforce previous research showing that the development of community-based learning modules or media with active community participation tends to have better relevance and acceptance than top-down approaches. Several studies have shown that integrating contextual needs and local experiences into learning materials can increase community understanding, ownership, and willingness to use and apply the developed materials.<sup>(18)</sup> Unlike previous studies that typically emphasize community participation during program implementation, this study prioritizes the community as a key stakeholder from the needs analysis stage to the development of module content through in-depth interviews and focus group discussions. This extends the literature by demonstrating that community involvement in the early stages of community empowerment-based module development is crucial for bridging the gap between academic knowledge and field practice.<sup>(19)</sup>

These findings are consistent with previous studies highlighting the importance of integrating local knowledge and community participation in disaster risk reduction. For instance, research by Lassa et al. (2018) demonstrated that community-based disaster risk reduction initiatives in Indonesia significantly improved local preparedness through the utilization of indigenous practices and participatory approaches.<sup>(19)</sup> Similarly,

Herningtyas et al. (2023) emphasized that local knowledge plays a critical role in early warning recognition and adaptive mitigation strategies in disaster-prone communities.<sup>(4)</sup> Furthermore, Setiawan et al. (2022) found that the development of community-based disaster education modules using a Research and Development approach resulted in higher relevance and usability compared to conventional top-down materials.<sup>(18)</sup> In line with these studies, the present research confirms that integrating local knowledge into structured learning modules enhances contextual suitability, user acceptance, and practical applicability. However, unlike previous studies that primarily focused on program implementation, this study contributes by systematically developing and validating a module product, thereby strengthening the evidence base for community-based educational tools in non-structural disaster mitigation.<sup>(20)</sup>

Practically, the module designed in this study has the potential to serve as a learning and educational tool in the community, particularly for field facilitators, cadres, volunteers, and community educators. The module's local context, accessible language, and inclusion of community experiences and practices make it easily applicable in outreach activities, group discussions, and community-based training. This module serves as a resource for improving community understanding, awareness, and participation regarding the learning issues, thus supporting community empowerment efforts for sustainability without relying solely on formal teaching methods.

Methodologically, this study demonstrates that a Research and Development (R&D) approach combined with in-depth interviews and Focus Group Discussions (FGDs) has proven effective in developing modules within a community context. This approach allows researchers to comprehensively investigate real needs, local experiences, and community perspectives, resulting in a product that is more appropriate and responsive to the situation on the ground. Furthermore, the evaluation process by education experts plays a crucial role in ensuring the module's academic quality, clarity of delivery, and pedagogical feasibility, while ensuring that the integration of the local context remains within a sound scientific framework. Thus, the combination of participatory methods and expert evaluation can be a systematic and quality model in the development of community-based teaching materials.

This study faces several limitations. The module was piloted on a limited scale and in one specific area,

making the findings less applicable. Furthermore, the study did not evaluate the module's long-term impact on behavioral change or increased community preparedness. Therefore, it is recommended that future research test its effectiveness using a quasi-experimental or longitudinal design, and adapt the module to different disaster-prone areas to test its consistency and sustainability.

## 5. CONCLUSION

Based on the results of the module development research, it can be concluded that the community-based non-structural disaster mitigation module is highly feasible for use, both based on expert validation and limited trials. The integration of disaster and local cultural aspects is the module's main strength, while the display and language aspects still require minor improvements. The evaluation instrument demonstrated high validity and reliability, supporting the module's systematic use in community education and training. Product revisions improved the contextuality and accessibility of the material for local users. It is recommended that this module be widely implemented with facilitator assistance, and that regular evaluations be conducted for continuous improvement.

## Ethical Approval

This study has been reviewed and approved as ethically appropriate by the Health Research Ethics Committee (KEPK), Poltekkes Kemenkes Surabaya (approval no. EA/2393/KEPK-Poltekkes\_Sby/V/2024).

## Acknowledgement

The authors would like to express their sincere appreciation to the village government and community members of Genilangit Village for their participation and support during the data collection process. They also thank the experts and participants who provided valuable input for the development and validation of this research module.

## Competing Interests

All the authors declare that there are no conflicts of interest.

## Funding Information

No funds were received for this study.

## Underlying Data

Derived data supporting the findings of this study are available from the corresponding author on request.

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