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A Systematic Review of Tsunami Disaster Mitigation Based on Tsunami Tendenko and Smong: Comparative Insights from Japan and Indonesia for Educational Practices

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Abstract Mastery of disaster mitigation is crucial because it has been proven to minimize loss of life, especially in disaster-prone countries such as Japan and Indonesia. Although many studies discuss the impact and reconstruction after a disaster, studies that specifically explore local wisdom-based mitigation strategies and their potential to be modified in an educational context remain limited. One disaster mitigation strategy that has been proven effective in Japan is Tsunami *Tendenko*, which has similarities to *Smong* in Indonesia, both of which are rooted in local wisdom. This study aims to: (1) understand the concepts of Tsunami *Tendenko* and *Smong* as disaster mitigation strategies from global literature; and (2) describe the learning strategies used in transmitting the two concepts. A literature search was conducted on articles published between 2004 and 2025 and indexed in Scopus and Web of Science, by applying strict inclusion and exclusion criteria. A total of 229 articles were analyzed using a systematic approach in accordance with the PRISMA 2020 guidelines. The results of the study indicate that local wisdom can be utilized in disaster mitigation education through various roles, such as teaching resources, media content, collaboration materials, and the basis for policy making. Delivery strategies include oral approaches, SME products, digital games/media, simulations, arts, and educational programs. This study recommends the need for further research to deepen, refine, and optimize the role of Tsunami *Tendenko* and *Smong* in local wisdom-based disaster mitigation education.

Keywords: Tsunami Tendenko, Smong, disaster mitigation, local wisdom

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1. INTRODUCTION

Natural disasters such as earthquakes, tsunamis, and floods have caused significant loss of life and economic losses throughout history. One of the deadliest disasters in history was the 2004 Indian Ocean tsunami, which killed more than 225,000 people, displaced 1.5 million, and caused economic losses exceeding USD 7 billion (Barenstein & Trachsel, 2012; Murty et al., 2007a; Murty et al., 2007b; Sarp, 2005; Scheffers et al., 2009; Wang et al., 2008). This disaster affected twelve countries, with Indonesia, Thailand, Sri Lanka, and India being the worst affected (Murty et al., 2007; Wang et al., 2008). Another major disaster, the 2011 Great East Japan Earthquake and tsunami, caused economic losses of up to USD 210 billion, making it one of the most expensive natural disasters in the world (Wirtz et al., 2014). Meanwhile, the tsunami caused by the Hunga Tonga-Hunga Ha'apai submarine eruption on 15 January 2022 in the South Pacific region also caused significant economic losses (Sasaki et al., 2025). This series of events reinforces the fact that Japan and Indonesia are countries with a high level of disaster vulnerability (Chiba & Nagamatsu, 2023). Therefore, effective disaster preparedness is essential to minimizing casualties and economic losses.

Related to effective disaster preparedness, Japan and Indonesia as disaster-prone countries (Ruswandi & Maarif, 2023; Tanaka et al., 2021; Veroutsos, 2022) have made continuous efforts to mitigate disasters. Japan has integrated decarbonization and resilience to all hazards, which is critical to achieving the 2030 Agenda, including the Paris Agreement, the Sustainable Development Goals, and the Sendai Framework for Disaster Risk Reduction (Dewit, 2020). Meanwhile, the Government of Indonesia has implemented various programs through the National Disaster Management Agency (BNPB) to reduce disaster risk. These programs include communication efforts before, during and after disasters to increase community awareness and preparedness. In addition, the government has enacted the Disaster Management Law in 2007, which shifted the focus from disaster response to prevention and mitigation (Butt, 2014).

Several studies that have been conducted by Arce et al. (2017), Cato and Oshitani (2024), Goltz (2017), Oe and Kawakami (2021), and Yasushi (2017) explain that one of the disaster mitigation strategies that has succeeded in reducing casualties in Japan is Tsunami *Tendenko*. In line with the Japanese community, Indonesia, as the second country in the world prone to disasters, has a disaster mitigation strategy known as *Smong* (Afrian et al., 2020). Tsunami *Tendenko* and *Smong* are local wisdom-based disaster mitigation strategies. The success of *Tendenko* as a disaster mitigation strategy was measured by the number of casualties during the 2011 Great Tsunami. The Great East Japan Earthquake and subsequent tsunami in 2011 resulted in more than 18,000 fatalities (Koshimura & Shuto, 2015; Yun & Hamada, 2014). On the other hand, Kamaishi City, one of the Japanese cities with a population of 40,000, which has a distance from the epicenter of about 70-150 kilometers (Nakagawa et al., 2013), recorded the lowest casualty rate. In fact, almost all 2000 elementary and junior high school students in the city escaped the tsunami and survived (Oe & Kawakami, 2021). Meanwhile, the Indian Ocean Tsunami of 28 March 2005 had a devastating impact on Aceh province, Indonesia, causing a loss of approximately 163,650 lives, representing 97.5% of the total death toll from

the 2004 tsunami (Bryant, 2014; Doocy et al., 2007; Kitzbichler, 2011; Rahman et al., 2024; Roshetko et al., 2013; Sufri & Lassa, 2024). However, only 7 people died from the tsunami on Simeulue Island which was 40 km south of the epicenter at the time (McAdoo et al., 2006). This remarkable survival rate is attributed to the island's deep-rooted local wisdom, *Smong*, a traditional knowledge system that teaches tsunami awareness and response. Therefore, the Tsunami *Tendenko* and *Smong* are intangible heritage that needs to be preserved so that it can be used as one of the disaster mitigation strategies.

To clarify our conceptual framing, this study uses the term *local wisdom* intentionally, as it holds specific relevance in the Indonesian educational and sociocultural context. Unlike *local knowledge*, which often refers to empirical or technical insight derived from local experience, *local wisdom* encompasses not only knowledge but also ethical values, cultural norms, and socially transmitted practices that guide community behavior and decision-making (Geertz, 1983; Sibarani, 2013). Sibarani (2013) defines local wisdom as "a set of ideas, values, and practices originating from local culture that are wise, full of virtue, and embedded in tradition," making it particularly suitable for use in education aimed at building character and resilience. The emphasis on intergenerational transmission, moral reasoning, and collective memory within *local wisdom* frameworks aligns directly with disaster preparedness goals that require behavioral change and sustained cultural awareness. In addition, *local wisdom* is the term widely recognized and operationalized in Indonesian national education discourse, policy documents, and curricular frameworks (Ministry of Education and Culture, 2017). Therefore, employing this term allows for better alignment with national pedagogical goals, such as those outlined in the *Profil Pelajar Pancasila*, which emphasizes character development through culturally grounded learning.

Most empirical studies on tsunamis in Japan (Iemura et al., 2006; Lee & Hanada, 2020; Raby et al., 2025) and Indonesia (Aldrich & Sawada, 2015; Irwansyah et al., 2024) focus more on disaster impacts and mitigation strategies in general. However, no studies have been found that comprehensively explore the use of local wisdom as a disaster mitigation strategy in the context of education, especially in countries with high disaster potential like Japan and Indonesia. In fact, both countries have distinctive local strategies- Tsunami *Tendenko* in Japan and *Smong* in Indonesia-that have great potential to be modified and integrated into the disaster mitigation education system, considering the cultural, social and geographical characteristics of the local communities. Therefore, this research aims to present a comparative analysis of local wisdom-based disaster mitigation strategies in Indonesia and Japan to fill the existing literature gap, as well as propose a modified concept of disaster mitigation learning strategies that are more contextualized. This research is guided by the following questions:

1) What are the dominant themes in the Tsunami *Tendenko* and *Smong*-related articles reviewed?

2) To what extent have Tsunami *Tendenko* and *Smong* been utilized in the context of education in each country?

3) What learning strategies are used to transmit Tsunami *Tendenko* and *Smong* in disaster mitigation education?

To answer those questions, articles discussing the Tsunami *Tendenko* and *Smong* were using a primary qualitative thematic approach to content analysis, supported by quantitative keyword searches. Findings from each case were then comparatively analyzed analysed to examine the integration of local wisdom in the educational context. This research is expected to assist local governments in formulating more contextualized disaster education policies, as well as serve as a reference for other regions with similar social and geographical characteristics.

2. LOCAL WISDOM OF TSUNAMI TENDENKO AND SMONG AS DISASTER MITIGATION ALTERNATIVES

2.1 Local Wisdom as an Alternative to Disaster Mitigation

Disasters are events that can occur at any time and in any place. Although modern technologies now allow for partial prediction of such events (Krichen et al., 2024), many citizens still lack sufficient knowledge and capacity to act appropriately when disasters occur (Wu et al., 2022). Yet long before such technological advances, communities had already developed local wisdom as a means of disaster mitigation (Irwansyah et al., 2024). This local wisdom as a disaster mitigation approach refers to traditional practices and cultural insights to improve community resilience and preparedness in the face of natural disasters. Attention to communities that use local wisdom as part of disaster mitigation is very important. This is in accordance with the message conveyed in the slogan of the Sustainable Development Goals (SDGs) (United Nations, 2015) that it is very important to leave no one behind in disaster risk reduction (DRR) (Kotani et al., 2023), including communities that uphold local wisdom as a disaster mitigation strategy.

Local wisdom as an approach to disaster mitigation is an alternative for rural communities (Syuryansyah & Habibi, 2024). This is due to the characteristics of rural communities that are mostly very close between individuals so that the delivery of this approach can be effective by word of mouth. Local wisdom as an approach to disaster mitigation has developed from generation to generation after the 1907 tsunami until today. The fame of oral tradition as an alternative approach to disaster mitigation after the 26 December 2004 and 28 March 2005 tsunamis, where local wisdom was considered to reduce casualties, namely only 7 people died on Simeulue Island in Aceh province, Indonesia. The local wisdom is known as *Smong*. In line with *Smong*, Tsunami *Tendenko* as a local wisdom-based disaster mitigation strategy has proven effective in reducing the death toll from the 2011 tsunami in Tohoku (Goltz, 2017). 1,995 out of 2,000 elementary and junior high school students in Kamaishi City, Iwate Prefecture survived the Great East Japan Earthquake on 11 March 2011 (Katada & Kanai, 2016). It is because they have been taught the Tsunami *Tendenko* approach to disaster mitigation that they put it into practice during the Tohoku earthquake (Yasushi, 2017). Tsunami *Tendenko* and *Smong* are similar in the aspect of using local wisdom for disaster mitigation. However, these two approaches have distinctive features and some different principles.

2.2 Disaster Mitigation Through Tsunami *Tendenko* by Japanese People

Tsunami *Tendenko* is a traditional wisdom-based disaster mitigation strategy from the Sanriku region (see Figure 1) in northeastern Japan (facing the Pacific Ocean), where tsunamis are common (Kodama, 2013). Tsunami *Tendenko* became famous after Fumio Yamashita, a historian of Japanese tsunami disasters, developed and disseminated the local wisdom based on his own experience during the great tsunami of 1933 (Yamori, 2013). The term Tsunami *Tendenko* came about when Fumio Yamashita's father used the phrase to explain that the act of escaping the approaching tsunami and leaving his family behind was called *Tendenko*.

Tendenko is an indigenous expression from the coastal area of Sanriku which means that when a tsunami is about to occur, everyone should save themselves (Sekine, 2011). However, this Tsunami *Tendenko* contains additional meanings, namely; by all means, run for the hills quickly, ignore anyone even your parents and children; think only of yourself so as not to be sacrificed, and even if your parents die, no one should blame them. In other words, Tsunami *Tendenko* is a swift decision to save oneself from the worst disaster without thinking of anyone.

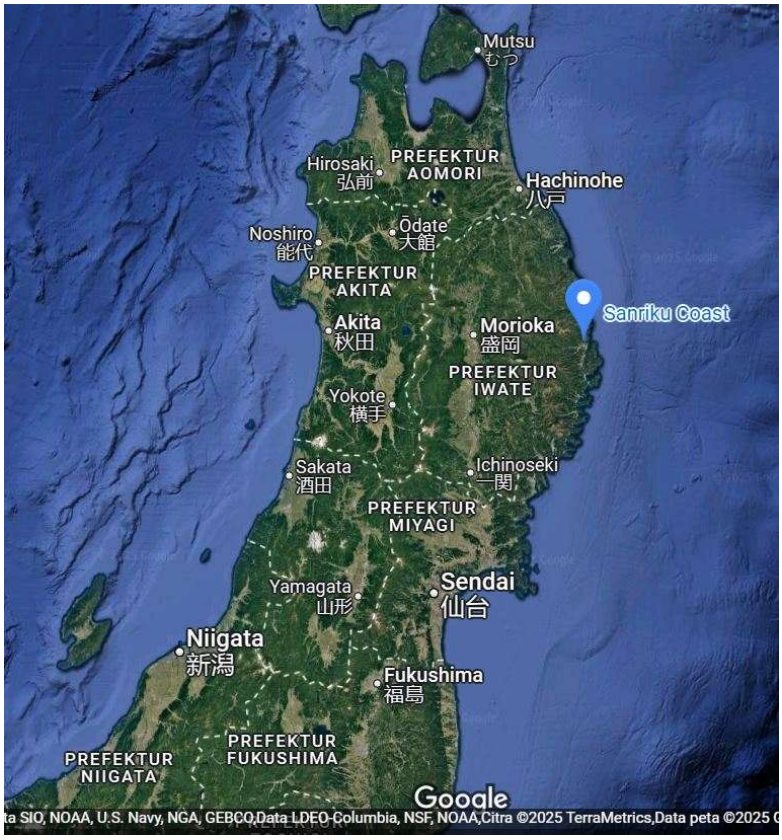

Figure 1. Geographic origin and cultural context of Tsunami *Tendenko* in Sanriku, Japan (source: google maps, 2025)

Tsunami *Tendenko* emphasizes the principle of self-reliance, encourages others to seek shelter, fosters mutual trust first, and reduces feelings of self-deprecation among survivors (Yamori, 2013). So that individuals confidently take action to save themselves without thinking about anyone, including their loved ones. Each individual should have confidence that family members and others will do the same. Local wisdom in Japan has influenced the tsunami response by promoting community-based disaster preparedness, fostering a culture of

resilience, and integrating traditional knowledge into modern disaster management strategies (Panjaitan et al., 2017).

2.3 *Smong* as an Alternative to Disaster Mitigation by Indonesian Communities

Smong is an indigenous term from the Devayan language performed by minority tribes in Simeulue (see Figure 2), Indonesia (Rahman et al., 2022). The word *Smong* means a wave of sea water that rolls and has a height above normal sea waves in general (Gadeng et al., 2018). The people of Simeulue recognize the local wisdom of *Smong* through the verses of *Manafi-nafi* (folklore), *Mananga-nanga* (children's lullabies), *Nandong* (humming) which are introduced to children and grandchildren from cradle to old age (Onrizal et al., 2020). The *Smong* custom is a form of art in the form of spoken poetry that contains signs of a tsunami disaster, including earthquakes, receding sea water, and the arrival of giant waves, as well as stories of the suffering of tsunami victims (Dewi & Sihombing, 2022). The local wisdom of *Smong* is a tsunami early warning system implemented by the people of Simeulue through customs, lullabies to put babies to sleep, and humming.

The content of the message in the humming more or less reads this is a saga from Simeulue island, which conveys the message of *Smong* based on past experiences in 1907. It is said that this story comes from our ancestors, if there is a strong earthquake, the sea water recedes and there is a rumbling sound from the sea, livestock and pets become restless. That means the water will rise or *Smong* is the name, so be prepared to look for a high place so that we can survive. While in Devayan language it is conveyed as follows.

> "*Enggel mon sao surito* (please hear a story), *Inang maso semonan* (once upon a time), *Manoknop sao fano* (a village drowned), *Uwillah da sesewan* (it is told like that), *Unen ne alek linon* (earthquake that started), *Fesang bakat ne mali* (followed by giant wave), *Manoknop sao hampong* (drowned the whole region), *Tibo-tibo maawi* (suddenly). *Anga linon ne mali* (if the earthquake is vehement), *Oek suruik sauli* (followed by receding water), *Maheya mihawali* (be soon to look for places), *Fano me singa aktaek* (a highland in order to be saved), *Ede smong kahan ne* (smong is its name), *Turiang da nenek ta* (the history of our ancestors), *Mi redem teher ere* (please remember this all). *Pesan navi-navi da* (the message and advice), *Smong dumek-dumek mo* (Tsunami is your taking bath water), *Linon uak-uwak mo* (earthquake is your craddle), *Kilek sulu-sulu mo* (lightning are your lamps), *Eklaik kedang kedang mo* (thunders are your drums)" (Gadeng et al., 2018).

Based on the content of the Smong poem story above, it can be told that there was once a very powerful event that destroyed an area of Simeulue. The event began with a catastrophic vibration or shock that made the residents leave their homes. Shortly afterwards, the sea receded a great distance from the shore and after a few minutes the sea returned with such speed and waves that it drowned all the settlements. This event is known as Smong. Therefore, if there is a very large earthquake followed by receding sea water, immediately save yourself

by running to higher ground. The poem is embedded in every resident of Simeule, the origin of Smong local wisdom and a disaster-prone area. Smong stories are deeply embedded in communities through oral traditions and social interactions. These stories are passed down from generation to generation, helping communities recognize and respond effectively to tsunami threats (Rahman et al., 2017; Ramli et al., 2024).

Figure 2. Geographic origin and cultural context of the Smong oral tradition on Simeulue Island, Indonesia (source: Google Maps, 2025)

3. RESEARCH METHOD

3.1 Search Strategy

The researchers conducted a literature search of journal articles through multiple rounds in Scopus, Web of Science (WOS), EBSCO, SAGE, DOAJ, JSTOR, and ScienceDirect databases. To broaden the findings, we also involved searching through Google Scholar. We searched for articles using the keywords "smong" and "tendenko" separately. We did this to obtain many articles. If we used the keyword "smong" in conjunction with "learning", "education", "disaster", the search results were not optimal. Likewise, when we searched for articles related to Tsunami *Tendenko*, we used the keyword "tendenko" to maximize the number of articles identified. We conducted literature searches on these databases in March 2025. For the Google scholar platform, we used the keywords "tendenko education schools" and "smong education schools" to specify articles that fit the theme of this research. We also applied the time span of 2004 - 2025 in each search of "tendenko education schools" and "smong education schools" on Google Scholar. The search resulted in 2,139 documents with details as shown in Table 1 below.

To reduce the risk of platform-related bias, especially when incorporating open-access or grey literature, the search strategy involved several quality control measures. First, articles were screened for credibility by prioritizing publications in peer-reviewed journals, conference proceedings, or institutional repositories with clear editorial processes. Documents lacking basic bibliographic transparency or identifiable sources were excluded. In addition, articles retrieved from Google Scholar were cross-validated against Scopus and Web of Science to confirm their presence in academically recognized databases, helping filter out non-academic or low-impact sources.

Furthermore, to enhance the credibility of selected materials, peer debriefing was conducted with domain experts. For the Tsunami *Tendenko* data, this involved collaboration among all research team members, a professor, a subject-matter expert, and two Japanese doctoral students experienced in disaster-related studies. For *Smong*-related data, peer debriefing included a professor with over a decade of field experience in the region and two local lecturers with research expertise on *Smong*. This external validation served as a critical check on the selection process and interpretation of findings (Freysteinson et al., 2013). To ensure inclusive and context-sensitive coverage especially given the underrepresentation of local or regionally significant studies in mainstream indexing systems, platform diversification was essential. Supplementing Scopus and Web of Science with Google Scholar and JSTOR enabled the identification of culturally grounded research that might otherwise have been overlooked. This balanced approach ensured both academic rigor and inclusiveness in the study of localized disaster knowledge.

Table 1. Distribution of the number of articles related to "smong" and "tendenko" from various platforms

No.	Source	Number of articles with	
		Tendenko	Smong
1.	Scopus	10	39
2.	WoS	8	13
3.	EBSCO	0	3
4.	SAGE	2	33
5.	DOAJ	0	7
6.	JSTOR	8	852
7.	ScinceDirect	20	102
8.	Google Scholar	267	775
Total		315	1.824

Source: search results from various platforms listed, 2025

The results of the literature search are presented in the identification stage of the PRISMA flowchart (see Figure 3 and Figure 4). Through initial screening, we found seven identical Tsunami *Tendenko*-related documents from different platforms, twelve identical *Smong*-related documents from different platforms, and no duplicate documents from the Scopus, Web of Science (WOS), EBSCO, SAGE, DOAJ, JSTOR, and ScienceDirect databases. This process resulted in 41 documents related to *Tendenko* and 1,049 documents related to *Smong*. Meanwhile, data from Google Scholar collected 267 articles related to Tsunami *Tendenko* and 775 articles related to *Smong*. The data is ready for further filtering.

Furthermore, the sampling technique used was purposive sampling. This method uses criteria that have been determined by the research team in selecting samples. The sample selection criteria are divided into inclusion and exclusion criteria. Inclusion criteria are sample criteria that the researchers want based on the research objectives (Hazari, 2023). While the exclusion criteria specify conditions that prevent otherwise eligible participants from being included in the study (Suraña-Sánchez & Aramendia-Muneta, 2024).

The inclusion criteria in this study were a) Tsunami *Tendenko* and/or *Smong* articles published in 2004 - 2025, b) articles published in journals indexed by Scopus, Web of Science (WOS), DOAJ, or ScienceDirect. Exclusion criteria included a) studies that did not have full-text articles, b) studies that did not use primary data, and c) articles that were not written in English were excluded. We ensured the scientific validity of the articles by selecting articles that had undergone peer review prior to publication (Zainudin et al., 2019). After excluding irrelevant studies, a total of 19 documents on Tsunami *Tendenko* and 19 documents on *Smong* were selected.

3.2 Selection Process

The next process in this review was to select literature in such a way that the literature selected was the most relevant to the objectives of this study. This process is included in the Tsunami *Tendenko* data screening stage in the PRISMA (see Figure 3) and *Smong* (see Figure 4) flowcharts. We did this through data management aided by Mendeley reference management software. We utilized the group library feature to determine duplicates and eligibility of each document based on predetermined criteria. The selection process was done manually in three stages, namely reading the title, the abstract, then the content of each article. Document eligibility refers to the agreed inclusion and exclusion criteria. Data from eligible studies were extracted based on pre-defined criteria, with data including manuscript ID, author, year of publication, journal, study design, and reported outcomes. Five authors discussed any differences in judgement that arose to reach consensus on article selection. The PRISMA flowchart for the selection of Tsunami *Tendenko* and *Smong* literature included in this study is presented in Figure 3 and Figure 4.

Based on Figure 3, the first stage of Tsunami *Tendenko* data analysis resulted in 10 articles from Scopus, 8 articles from Web of Science, 2 articles from SAGE, 14 articles from JSTOR, 20 articles from ScienceDirect, and 267 articles from Google Scholar. The next process was to read the abstracts and full texts. As a result of this analysis, 269 articles were excluded from the document content reading process. The selection process resulted in 19 Tsunami *Tendenko* articles to continue in the coding process.

Based on Figure 4, the first stage of Tsunami *Tendenko* data analysis resulted in 39 articles from Scopus, 13 articles from Web of Science, 3 articles from EBSCO, 33 articles from SAGE, 7 articles from DOAJ, 852 articles from JSTOR, 102 articles from ScienceDirect, and 775 articles from Google Scholar. The results of abstract and full-text analysis obtained a total of

1,805 articles were excluded from the document content reading process. The selection process resulted in 19 *Smong* articles to continue in the coding process.

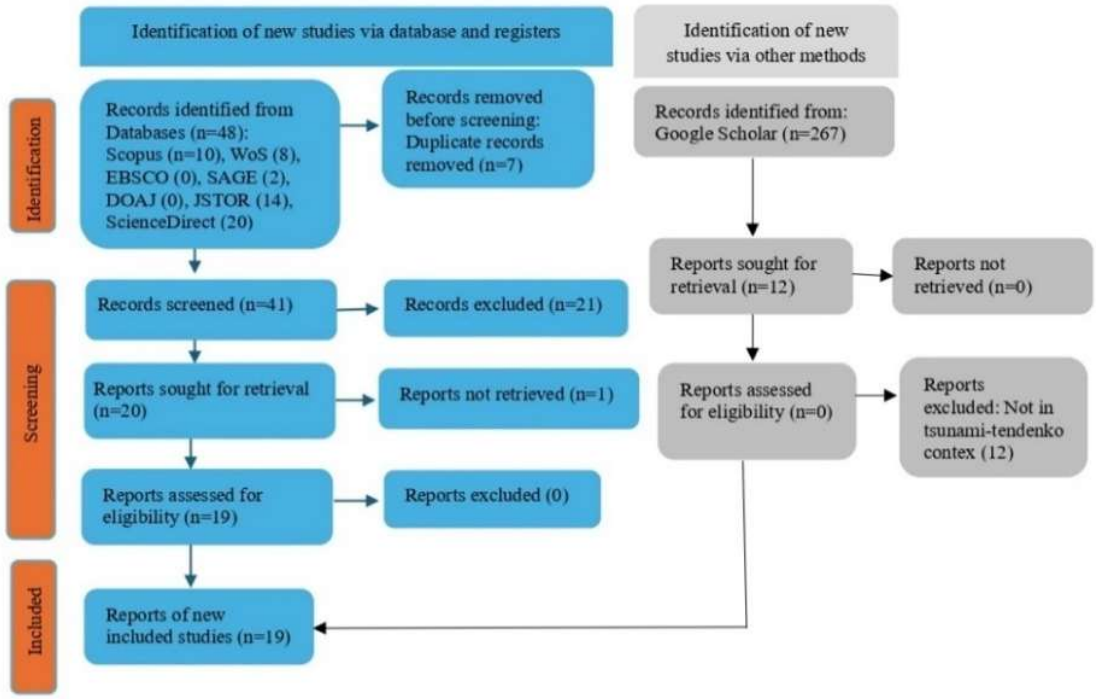

Figure 3. PRISMA 2020 flow diagram for Tsunami *Tendenko* systematic reviews (Page et al., 2021)

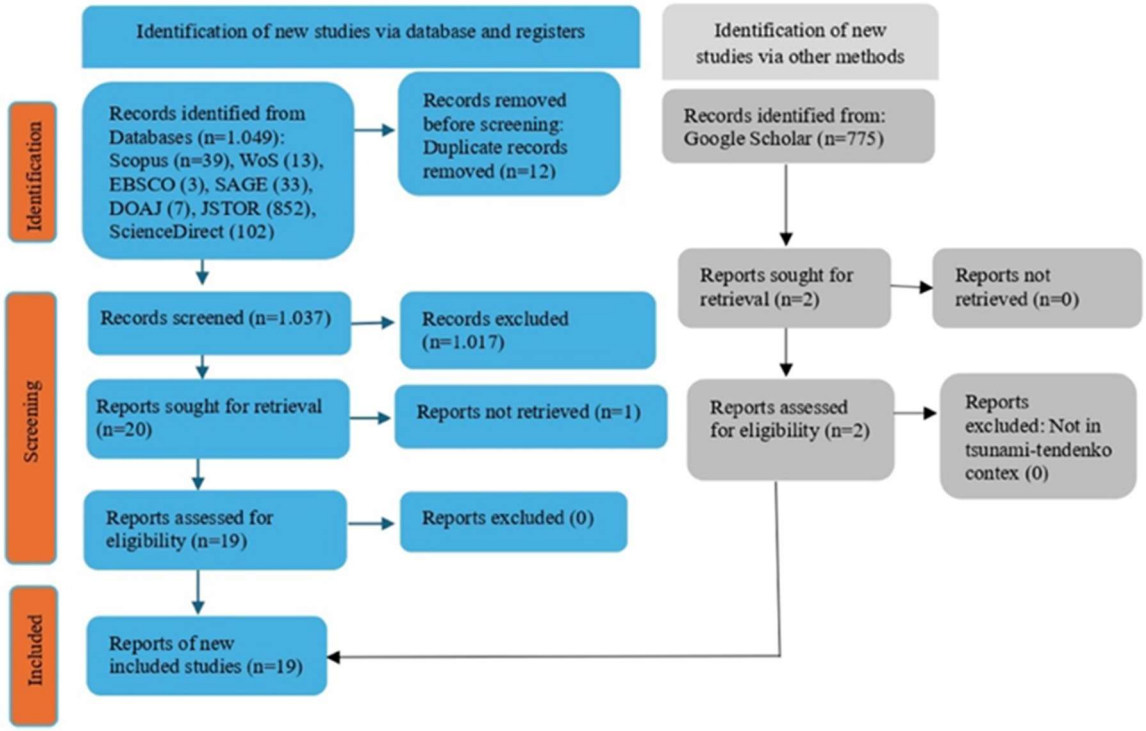

Figure 4. PRISMA 2020 flow diagram for *Smong* systematic reviews (Page et al., 2021)

3.3 Coding and Analysis

This study employed a qualitative content analysis approach with a thematic orientation, drawing on a structured and iterative review of relevant literature. The coding framework was developed through a hybrid process that combined deductive and inductive techniques. Initially, we identified paradigmatic references from high-quality publications related to local wisdom and learning strategies in disaster education. These references provided a foundation for the preliminary coding categories. The first step involved the identification of core concepts and recurring patterns related to local wisdom in education. These were organized into thematic codes, which were then further refined through manual article reviews and discussed in several Focus Group Discussion (FGD) sessions involving multiple researchers. Although the study did not formally apply grounded theory procedures such as open or axial coding, its principles informed our openness to emergent categories throughout the analysis.

To ensure analytical rigor and transparency, we incorporated strategies commonly used in thematic analysis, including 1) identifying recurring patterns and meanings across the selected sources; 2) organizing individual codes into broader conceptual themes (e.g., "oral tradition," "media-based learning," "cultural resilience"); and 3) interpreting the relationships among codes to construct meaning about the roles of *Smong* and *Tendenko* in disaster education. Quality assurance measures were implemented through multiple coder validations, peer debriefings with external experts, and triangulation of data from various platforms and document types. This approach allowed us to maintain both methodological rigor and flexibility, ensuring the validity of our qualitative findings. Based on this process, we identified two major categories: (1) themes related to local wisdom in education, and (2) learning strategies relevant to disaster mitigation. Table 2 presents a sample of our coding scheme related to the first category.

Table 2. Description of research themes related to local wisdom

Local wisdom in education	Brief description	Representational articles
Basic concept of local wisdom	The research theme focuses on the collective knowledge, practices and beliefs developed and preserved by the community.	(Salehuddin & Jaafar, 2024)
Cultural preservation	The research theme focuses on stabilising and restoring a culture to prevent further destruction without changing its historical integrity.	(Stefania & George, 2024)

Themes related to learning strategies were derived by focusing on methods commonly used in disaster risk education. These strategies were grouped into two main codes: media and simulation-based learning (Table 3).

Table 3. Description of research themes related to learning strategies

Learning strategy	Brief description	Representational articles
Learning media	Learning strategies focus on the use of all tools and methods used to convey knowledge (such as textbooks, digital tools, software, and interpersonal interactions).	(Bartolomé, 2025)
Simulation	Simulation-based learning strategies focus on interactions with real or virtual objects, devices or people and opportunities to change the flow of these interactions with decisions and actions made by learners.	(Heitzmann et al., 2019)

In line with the integrated disaster risk management (IDRM) framework, learning strategies such as oral transmission, SME-based learning products, gamification/ICT tools, arts-based education, and formal education programs were coded as part of a comprehensive approach to community-based disaster resilience. Additional coding categories addressed the roles played by local wisdom, such as its inclusion in teaching materials, curricular content, intergenerational transmission, and policy considerations. Throughout the coding process, we remained open to newly emerging codes while ensuring alignment with our research objectives. Despite our team's prior expertise in education and cultural studies, cross-validation and peer feedback were essential for minimizing researcher bias. Finally, the relationships among themes were visualized using tables and Sankey diagrams (Figure 5), providing an overview of the evolving learning strategies associated with local wisdom-based disaster education (Xu et al., 2023).

4. RESULTS

4.1 Themes in the Tsunami *Tendenko* and *Smong*-Related Articles Reviewed

Table 4 shows the details of the frequency of themes in the Tsunami *Tendenko* and *Smong* articles reviewed in this study.

Table 4 highlights key themes in disaster mitigation learning through Tsunami *Tendenko* and *Smong*. Tsunami *Tendenko* research peaked in 2015, four years after Japan's major tsunami, with fluctuating trends from 2013 to 2022. *Smong*-related studies focus on history and cultural preservation, peaking in 2018 and 2024, over a decade after the Simeulue tsunami.

While frequency-based thematic coding helped us identify dominant topics across the reviewed literature, it is important to clarify that frequency was not used as a proxy for importance. Rather, it served as a heuristic tool to map the thematic landscape. In alignment with the nature of integrated disaster risk management where local wisdom, cultural specificity, and community knowledge systems are central, our analysis prioritized conceptual richness, contextual relevance, and depth of contribution alongside numeric frequency.

Table 4. Frequency of themes in Tsunami *Tendenko* and *Smong* articles

Theme	Tsunami *Tendenko*	Total	*Smong*	Total
Basic concept	(Asai, 2015; Cato & Oshitani, 2024; Kodama, 2013; Yamori, 2013)	4	(Rahman et al., 2022; Sutton et al., 2021)	2
History and preservation	(Goltz, 2017)	1	(Gadeng et al., 2018; Latumeten & Janah, 2024; McAdoo et al., 2006; Rahman et al., 2017, 2018, 2024; Rahman & Munadi, 2019; Ramli et al., 2024; Suciani et al., 2018; Syafwina, 2014)	10
The role of traditional knowledge in disaster mitigation	(Arce et al., 2017; Koshimura & Shuto, 2015)	2	(Onrizal et al., 2020; Sutton et al., 2020; Syahputra, 2019)	3
Disaster Mitigation Learning	(Katada & Kanai, 2016; Kitagawa, 2015, 2021; Maeda & Hashimoto, 2019; Matsuura & Shaw, 2015; Nagata et al., 2022; Niwa et al., 2015; Oe & Kawakami, 2021; Suzuki, 2014; Takahashi et al., 2015; Uchida et al., 2021)	12	(Gadeng et al., 2019; Lubis, 2019; G. Maulana et al., 2022; I. Maulana et al., 2021)	4
Total		19		19

To strengthen interpretive depth, we employed a form of evaluative annotation during coding. Articles were not only categorized by theme but also assessed for the nature of their contribution whether empirical or conceptual, policy-relevant, grounded in community engagement, or pedagogically innovative. For instance, some themes such as “oral tradition” or “simulation-based learning,” though frequent, were further examined in light of how they were theorized or implemented in local contexts.

This hybrid approach allowed us to surface not only what themes were most commonly discussed but also which articles offered significant insights into disaster education practices rooted in cultural knowledge. In this process, lower-frequency articles that offered high cultural or pedagogical relevance, such as those documenting intergenerational transmission or local-language, adaptation were also given interpretive weight in the discussion. Looking ahead, this approach offers a foundation for more robust methodological developments. Future research

may benefit from integrating semi-quantitative strategies such as weighted coding matrices, contribution scoring, or citation/context co-analysis. These enhancements, as noted in the Limitations and Further Research section, would support more rigorous comparisons while retaining the contextual sensitivity essential to research on local wisdom in disaster mitigation.

4.2 Tsunami *Tendenko* and *Smong* Utilised in Education

Table 5 shows that the role of Tsunami *Tendenko* in education includes its use as teaching material for disaster mitigation, learning media content, cooperation material, and as a basis for policy proposals. However, this study did not identify any indexed academic studies that explicitly address the use of *Smong* as educational policy material. This absence, however, should be interpreted with caution. It may reflect not only a genuine gap in the literature but also a limitation of the search strategy employed. While the systematic search was conducted across Scopus, Web of Science, Google Scholar, and JSTOR using both English and Indonesian keywords this approach was constrained in its ability to capture grey literature, regional government documents, and informal school or community-based initiatives that may not be documented through formal academic channels.

It is likely that relevant policy practices involving *Smong* such as its integration into local school drills, community education efforts, or regional curricula exist outside globally indexed databases, particularly in the form of local regulations or unpublished programmatic activities. Therefore, the absence of academic references to *Smong* as a formal policy object does not necessarily indicate a lack of policy engagement. To acknowledge this nuance, future research should extend beyond indexed databases and actively seek out local government archives, curriculum documents, and practitioner interviews. This would allow a more complete understanding of how *Smong* is positioned within education policy frameworks at the regional or institutional level. Such an approach also addresses the broader issue of epistemic justice by recognizing and including the forms of local knowledge and practice that often remain invisible in dominant academic discourse.

Table 5. The role of Tsunami Tendenko and Smong based on the reviewed article

Role	Tsunami *Tendenko*	*Smong*
Disaster mitigation teaching materials	(Niwa et al., 2015; Oe & Kawakami, 2021; Pholasa & Samat, 2016; Sun, 2013; Takahashi et al., 2015)	(Gadeng et al., 2019)
Learning media content	(Nagata et al., 2022; Uchida et al., 2021)	(Latumeten & Janah, 2024; G. Maulana et al., 2022; I. Maulana et al., 2021)
Cooperation materials	(Matsuura & Shaw, 2015)	(Lubis, 2019)
Policy considerations	(Goltz, 2017; Katada & Kanai, 2016; Kitagawa, 2015; Maeda & Hashimoto, 2019; Suzuki, 2014)	

4.3 Tsunami *Tendenko* and *Smong* Learning Strategies

The following learning strategies for Tsunami *Tendenko* and *Smong* are based on the articles reviewed. Based on Table 6, learning strategies for Tsunami *Tendenko* are through games/ICT/media, simulations, and education programs . Whereas *Smong* is taught through oral, SME product names, games/ICT/Media, simulation, artistry, and education programs. This shows that *Smong* learning strategies are more diverse than Tsunami *Tendenko*, but Tsunami *Tendenko* simulation is more researched than *Smong* simulation. This needs to be studied more deeply related to the implementation of *Smong* simulation as a learning strategy.

Table 6. Learning Strategies for Tsunami *Tendenko* and *Smong*

Learning Strategy	Tendenko-tsunami	Smong
Oral to oral		(Onrizal et al., 2020; Rahman et al., 2018; Ramli et al., 2024; Sutton et al., 2020, 2021; Syahputra, 2019)
SME Products		(Gadeng et al., 2018)
Games/ICT/Media	(Nagata et al., 2022; Uchida et al., 2021)	(Latumeten & Janah, 2024; G. Maulana et al., 2022)
Simulation	(Niwa et al., 2015; Oe & Kawakami, 2021; Sun, 2013; Takahashi et al., 2015)	(Gadeng et al., 2019)
Arts		(I. Maulana et al., 2021)
programme	(Matsuura & Shaw, 2015)	(Lubis, 2019)

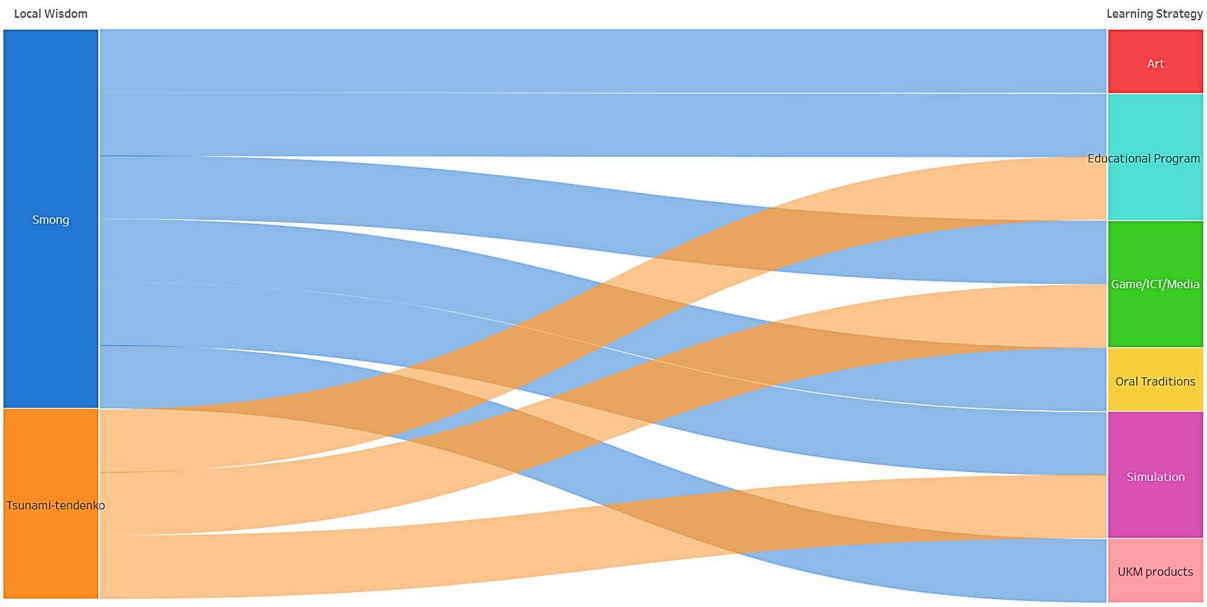

Figure 5. Learning strategies for Tsunami *Tendenko* and *Smong*

5. DISCUSSION

5.1 Themes in Tsunami *Tendenko* and *Smong*-Related Articles Reviewed

Based on the results of the data analysis, it was found that the most common theme discussed in Tsunami *Tendenko*-related articles was disaster mitigation learning. In contrast, few articles focused on history and cultural preservation. This is not surprising as many recent studies in the field of education emphasized the viewpoint of integrating local wisdom in learning on the grounds that integrating local wisdom helps preserve cultural heritage and ensures that education remains relevant to the lives of students and society (Arjaya, Suastra, et al., 2024; Hasan & Monita, 2024; Pearnpitak et al., 2024). This shows that proper learning can be used as a means of improving students' abilities and at the same time can be used as a means of cultural preservation.

Tsunami-prone areas require effective education on disaster mitigation to prepare residents for potential future risks (Firaina & Fauzi, 2021; Haryono, 2020; Suboh et al., 2024). The *Tendenko* approach, which emphasizes individual survival over helping others, has been shown to significantly increase survival rates during tsunamis, as evidenced by the survival rates of almost all elementary and junior high school students in one city during the 2011 Great East Japan Earthquake (Kodama, 2015). Without proper education and understanding, the *Tendenko* approach may be misunderstood or misapplied, potentially leading to negative impacts. An ethical analysis of Tsunami *Tendenko* learning is essential to dispel confusion and doubt about evacuation policies in disasters, by highlighting considerations of both moral and practical aspects.

In addition, the frequent discussion of the Tsunami *Tendenko* in disaster mitigation education articles is largely due to Japan's long history and systematic approach to developing disaster mitigation strategies based on scientific knowledge. Japan has a long history of dealing with tsunamis and other natural disasters, which has encouraged the development of comprehensive disaster preparedness plans and management systems (Hamada, 2014; Hein, 2014; Pongponrat & Ishii, 2018). The 2011 Great East Japan Earthquake and Tsunami highlighted the need for improved disaster mitigation strategies and led to significant changes in Japan's approach to disaster management (Kânoğlu & Synolakis, 2015; Koshimura & Shuto, 2015; Mochizuki & Komendantova, 2017). In general, Japan's disaster mitigation strategy relies heavily on scientific research and evidence-based policies. Japan also has the Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030, which is a global framework for disaster risk reduction. SFDRR is a comprehensive global strategy that aims to reduce disaster risk and increase resilience. This integration aims to build a culture of safety and resilience from a young age (Nakano & Shaw, 2017; Nakum et al., 2022; Sakurai & Sato, 2016). Schools are considered important in community-based disaster risk reduction efforts. Schools act as centers for the dissemination of disaster-related information and involve the community in participatory education programs (Pickering et al., 2021; Takahashi et al., 2015).

Different things happen in *Smong* research. The *Smong* articles reviewed are dominated by the themes of *Smong* history and preservation. Most researchers are interested in documenting

and preserving *Smong* narratives to ensure its survival amid modernization and globalization (Rahman et al., 2024). They are interested in studying *Smong* to help in developing community resilience models that can be applied in other areas prone to natural disasters (Rahman et al., 2017). *Smong* stories have significantly increased community resilience to tsunamis by embedding disaster risk reduction knowledge into daily life. Therefore, previous research has been dominated by the history and preservation of *Smong* so that *Smong* becomes a cultural identity of the Simeulue community (Rahman et al., 2022). The development of *Smong* in the Simeulue community so far is the result of the important role of the community because the tradition is passed down from generation to generation through oral. So that without going through a formal education, *Smong* has been understood by the community (Marhadi et al., 2024). This is the reason why studies do not focus on the preservation of *Smong* from the educational aspect.

Building on this gap, the current study extends the discussion by exploring how *Smong* can be preserved through educational and digital strategies that are adaptive to globalization and changing learning patterns among younger generations. Traditionally passed down through lullabies (*mananga-nanga*), chants (*nandong*), and folklore (*manafi-nafi*), *Smong* faces increasing threats due to the dominance of digital media and the erosion of local languages. In response, recent approaches have begun to incorporate *Smong* into digital and interactive learning formats to ensure its continued relevance. One such approach involves digitally mediated children's literature. Latumeten and Janah (2024) show how *Smong* is effectively integrated into digital storytelling platforms like *Literacy Cloud*, using titles such as *"Tsunami"* and *"Smong, the Dragon"*. These stories reinterpret *Smong* through engaging, age-appropriate narratives and visuals that enhance comprehension, disaster awareness, and empathy among children.

Another strategy involves game-based learning. Maulana et al. (2022) developed the *SERGANA* (*Serigala Siaga Bencana*) game, which embeds Nandong *Smong* into a disaster simulation modeled after the popular *Werewolf* game. This interactive format fosters student engagement through role-playing while embedding indigenous knowledge and institutional roles, resulting in a 42% increase in post-test scores on disaster preparedness. Furthermore, visual and participatory media offer additional pathways for cultural adaptation. Reimagining *Smong* as a dragon, for example, allows its core messages and values to be communicated in ways that are visually resonant and culturally meaningful to digitally native youth. These examples illustrate that the resilience of *Smong* lies not only in its oral tradition but also in its capacity for adaptation. Rather than being threatened by digital media and globalization, *Smong* can be preserved through intentional integration into digital literature, interactive learning tools, and school-based initiatives. Such strategies ensure that *Smong* remains a dynamic and transformative system of local knowledge for future generations.

While *Tendenko* and *Smong* both emphasize early evacuation and survival, their modes of transmission and value systems face unique adaptation challenges. For *Smong*, the main challenge lies in preserving its oral tradition, which is deeply rooted in storytelling, lullabies, and communal memory. As younger generations increasingly rely on digital media and formal education, there is a risk that these traditional forms of knowledge may be viewed as outdated

or irrelevant. Additionally, the decreasing use of the Devayan language on Simeulue Island poses a threat to the continued transmission of *Smong* in its original cultural form. For Tsunami *Tendenko*, the challenge is more ethical and cultural. The principle of self-evacuation, leaving others behind to save oneself, may conflict with modern values of collectivism and care for others, especially in multicultural societies or among children taught to prioritize empathy. The adaptation of this principle requires careful contextualization in moral education and sensitivity in public messaging to avoid misinterpretation as selfishness.

Technological advancements also pose both opportunities and obstacles. While digital tools can facilitate the dissemination of local wisdom (e.g., through gamification, simulations, or multimedia archives), they may also lead to detachment from traditional values if not designed with cultural integrity in mind. Furthermore, the formalization of this wisdom into school curricula may dilute their communal and spiritual significance if they are stripped of their local context. Therefore, the study acknowledges that the integration of *Smong* and *Tendenko* in education systems must be both culturally sensitive and technologically adaptive, requiring collaboration between educators, local communities, and curriculum developers. We have included this analysis in the revised manuscript to emphasize the importance of balancing tradition with innovation.

In addition, in Indonesia, disaster education has not systematically become a major part of the national curriculum. Although there have been initiatives to include disaster mitigation in learning, its implementation is still sporadic and has not been widely integrated as it has in Japan. Schools in Indonesia often rely heavily on local government initiatives for disaster risk reduction (DRR) education, and local governments may be hesitant to invest in these programs (Amri & Giyarsih, 2022). There is also a lack of facilities and resources needed for effective disaster education, especially in areas such as Aceh (Ridha et al., 2022). There are also significant gaps in teacher training and professional development, which affect the practical application of disaster education techniques in the classroom (Apronti et al., 2015). Although school-based DRR education has been linked to family and community-based programs, the integration and sustainability of these efforts are still inconsistent (Amri & Giyarsih, 2022; Topno, 2021). From these findings, it can be seen that Japan has a more formal and policy-based approach to disaster mitigation, while Indonesia still maintains *Smong* as part of the community narrative. Japan has a more centralized education system with national policies governing the integration of disaster mitigation into the curriculum, while in Indonesia this policy is not yet evenly distributed.

Integrating local wisdom such as Tsunami *Tendenko* and *Smong* into the formal education system presents its own set of challenges, especially in decentralized education systems like Indonesia's. In such systems, a uniform curriculum may not be sufficient. Instead, regional adaptation models are necessary, allowing for the contextualisation of local values such as *Smong* and *Tendenko* rather than enforcing a standardized approach. These models can ensure that local knowledge is included in ways that respect the cultural, social, and educational contexts of different regions. This flexibility is crucial to account for the variations in educational infrastructure, resources, and disaster experiences across the country. Given Indonesia's decentralized education system, future curriculum development efforts for disaster

education should focus on these regional adaptations, ensuring that local wisdom and practices are appropriately reflected in educational materials and strategies.

5.2. Tsunami *Tendenko* and *Smong* Utilised in Education

Based on the analysis, it was found that the role of Tsunami *Tendenko* in education is as a teaching material for disaster mitigation, learning media content, material for cooperation, and a basis for policy proposals. However, this study has not found a study oriented towards the use of *Smong* as an educational policy material. This is not surprising because in Indonesia at junior high schools, this material is integrated in social science lessons, while in senior high school, this material is taught in geography subjects (Ridha et al., 2022). While disaster education is indeed present in Indonesia's national curriculum through subjects such as Science, Civic Education (PPKn), and Bahasa Indonesia, its implementation remains fragmented and inconsistent across regions and levels. Much of its integration depends on local initiatives, teacher capacity, and school-specific priorities, leading to variation in both the depth and cultural relevance of the content—especially regarding the inclusion of local wisdom like *Smong* or *Tendenko*. In contrast, Japan has developed more structured and institutionalized approaches. ICT-based disaster education programs such as the YOU@RISK Tsunami Disaster Edition in Miyagi Prefecture have been implemented to strengthen student preparedness (Nagata et al., 2022). Japanese schools also serve as evacuation centers and regularly conduct tsunami drills, reinforcing disaster awareness through formalized systems (Grau Vila, 2024).

History education in Indonesia often relies on memorization, which does not engage students or connect historical knowledge with contemporary issues (Agustinova et al., 2023). The quality of history education is also affected by overall challenges in the Indonesian education system, including teacher shortages, inadequate infrastructure, and financial constraints (Rosser & Fahmi, 2018; Samala et al., 2024). There is still a lack of textbooks and teaching materials that incorporate local wisdom, particularly in science education. Most existing teaching materials are not designed to teach science through the context of local wisdom, thus limiting their effectiveness (Arjaya, Subagia, et al., 2024; Erman & Wakhidah, 2023; Sapoetra, 2020). Many teachers face obstacles in integrating local wisdom into lesson plans, assessments, and overall implementation in science learning. This suggests the need for better training and resources for teachers to effectively incorporate local wisdom into their teaching practices (Arjaya, Subagia, et al., 2024; Suciati, 2023). Despite efforts to integrate history into the Indonesian education system, implementation still requires strengthening teacher competencies, facilities, and support from various parties.

This contrast in integration also reflects deeper epistemological asymmetries between the two systems. Literature on Tsunami *Tendenko*, particularly from Japanese sources, is often framed through a formal-scientific lens, emphasizing its institutional adoption, simulation protocols, and quantifiable outcomes. In contrast, *Smong* is rooted in oral tradition, lived community memory, and cultural expression frequently explored through ethnographic or community-participatory approaches. As such, the two systems represent distinct knowledge frameworks: one standardized and policy-aligned, the other embedded in intergenerational

values and moral narratives. To address this imbalance, the study took deliberate steps to avoid privileging one epistemology over the other. Both *Tendenko* and *Smong* are presented as valid, culturally situated forms of disaster knowledge. The strengths and limitations of each are acknowledged: *Tendenko* offers scalability and institutional support but risks becoming procedural without cultural depth, while *Smong* is rich in moral and social meaning yet faces challenges in documentation and formal integration. The inclusion of both international academic sources and regionally published Indonesian literature, such as studies from national journals and local-language repositories, was essential to mitigate indexing bias and ensure balanced representation.

We emphasize that meaningful comparison between *Tendenko* and *Smong* should not aim to homogenize these traditions or force them into a single evaluative framework. Rather, each should be appreciated for its contextual integrity, grounded in the socio-cultural realities from which it emerges. At the same time, we encourage cross-learning**,** exploring how these distinct knowledge systems can inform, complement, and enrich one another when thoughtfully integrated. This perspective aligns with recent scholarship advocating for epistemic pluralism in disaster education, particularly within culturally diverse contexts such as the Asia-Pacific. By embracing this pluralism, disaster risk education can become more inclusive, equitable, and locally resonant, while still engaging with global standards and innovations in the field.

5.3 Tsunami *Tendenko* and *Smong* Learning Strategies

Based on Table 6, learning strategies for Tsunami *Tendenko* are through games/ICT/media, simulations, and education programs . Whereas *Smong* is taught through oral, SME product names, games/ICT/Media, simulation, artistry, and education programs . This shows that *Smong* learning strategies are more diverse than Tsunami *Tendenko*, but Tsunami *Tendenko* simulation is more researched than *Smong* simulation. This needs to be studied in more depth in relation to the applicability of *Smong* simulation as a learning strategy. Findings related to the use of games as tsunami learning are in line with research results by Maulida et al. (2023) that the use of games such as the Roblox-based Tsunami Survival game has been effective in teaching young people about tsunami preparedness through interesting stories and interactive games. In addition, simulation became a Tsunami *Tendenko* and *Smong* strategy because simulation and regular practice are essential to increase critical awareness and evacuation intentions among students (Maulida et al., 2023). What is different in the use of strategies in teaching local wisdom as disaster mitigation between Tsunami *Tendenko* and *Smong* is the use of *Smong* as the name of micro and small business products in Indonesia. The use of the word *Smong* as the name of micro and small business products is considered effective because these products can reach various circles of society so that it can be a stimulus for public curiosity related to *Smong*.

Local wisdom-based disaster mitigation learning strategies in Indonesia are more diverse than in Japan. This is because the population in Indonesia is more numerous and diverse so that the way of delivering learning follows the characteristics of diverse students. The right learning

approach can be done by adjusting the diverse cultural backgrounds of students so that the learning process is relevant and effective (Dwiningrum et al., 2021; Hamid et al., 2021; Triastari et al., 2021). The diversity of community backgrounds in Indonesia requires the incorporation of local wisdom into educational and community-based approaches, so that the learning process is more easily adapted to the diverse characteristics of students (Andreastuti et al., 2019; Marhadi et al., 2024; Simarmata & Indrawati, 2022; Triastari et al., 2021). In addition, local communities in Indonesia also have an awareness of using various cultural strategies, including traditional oral and written knowledge, to mitigate disasters, highlighting the importance of culture and local knowledge in disaster mitigation. In contrast, Japanese strategies are more standardized and technology-driven, with a focus on scientific advancement and regional collaboration (Ikeda & Silapunt, 2022; Ophiyandri et al., 2022). Japan's cultural context and historical experience with disasters may influence approaches to disaster mitigation learning strategies. Japan collaborates with other countries, including Indonesia, to share knowledge and improve disaster preparedness. Projects such as the ARCH Project aim to strengthen regional collaboration and improve disaster health management across ASEAN countries (Ikeda & Silapunt, 2022). Japan utilizes a multilingual education platform for cross-border disaster preparedness, which enables real-time interaction and shared learning between Japanese and Indonesian youth (Koesoema et al., 2021). This shows that Japan also has a Tsunami *Tendenko* learning strategy that is appropriate for its people. Effective local wisdom learning strategies for disaster mitigation cannot be judged on diversity, but on success in reducing the number of deaths due to disasters.

While the variety of learning strategies is noteworthy, it is important to note that diversity alone is not an indicator of effectiveness. The more relevant benchmark is the actual impact of these strategies on preparedness outcomes, such as reduced casualties and improved community response. Although this review identifies a broad spectrum of learning formats from oral traditions and lullabies to gamified simulations and visual media, it does not offer a formal comparative evaluation of the effectiveness of each approach based on standardized disaster preparedness indicators. This limitation stems from the heterogeneous nature of the reviewed literature in terms of methodology, sample populations, scope, and evaluative focus. Most studies prioritize cultural relevance, implementation design, or educational potential rather than measurable outcomes such as knowledge retention, behavioral change, or evacuation response time. Only a few studies, such as Maulana et al. (2022), apply empirical assessments like pre- and post-tests.

6. CONCLUSION

From an educational perspective, this study provides important insights into the role of practical local wisdom in disaster mitigation. The findings underline that proper implementation of learning can be used as a means of improving students' abilities and at the same time can be used as a means of cultural preservation. The utilization of local wisdom as disaster mitigation can be done as disaster mitigation teaching materials, learning media

content, cooperation materials, and the basis for proposals for policy making. In learning local wisdom as a means of disaster mitigation can be done through oral, SME product names, games/ICT/media, simulations, artistry, and education programs. However, it is important to align learning strategies with the background and characteristics of specific learners. This study found that it is important to conduct further research related to modifying the actions and principles of Tsunami *Tendenko* with the value of caring for others in *Smong* to ensure that there is no element of egoism in Tsunami *Tendenko*.

Furthermore, this study advocates *Smong* research from various aspects of education for disaster mitigation and learner potential. The use of local wisdom can be used as an alternative to cultural preservation in the midst of rapid technological advances. In addition, the use of local wisdom in learning is likely to foster a more dynamic and interactive learning environment that encourages critical thinking, problem-solving, and collaborative skills among students, and environmental care character. This study recommends an expanded focus on incorporating these competencies to ensure holistic educational approach that addresses learning and equips students with decision-making in various situations for future challenges.

Teachers' limited understanding of Tsunami *Tendenko* and *Smong* also presents significant challenges, necessitating targeted professional development initiatives. Teachers must understand and apply a comprehensive approach that aligns the utilisation of local wisdom and appropriate learning strategies to optimize the development of learners' potential. The findings provide a clear picture of alternative roles and strategies for teaching Tsunami *Tendenko* and *Smong* for researchers, educators and policy makers. The research found the role of Tsunami *Tendenko* and *Smong* as disaster mitigation teaching materials, learning media content, collaborative materials, and a basis for policy proposals. These insights can be a catalyst for further research related to Tsunami *Tendenko* and *Smong* to refine and optimize the role of local wisdom in disaster mitigation from an educational aspect.

However, challenges remain, particularly regarding limited teacher understanding of Tsunami *Tendenko* and *Smong*, which highlights the need for targeted professional development and support. Teachers must be equipped to apply an integrative and culturally responsive pedagogical approach that aligns local wisdom with appropriate instructional strategies, thereby enhancing student engagement and learning outcomes. The findings offer valuable insights for researchers, educators, and policy-makers concerning the potential roles and strategies of Tsunami *Tendenko* and *Smong* in disaster education. While this study did not find indexed academic literature positioning *Smong* as an explicit component of formal education policy, this absence may reflect both a gap in the literature and limitations in how localized knowledge systems are captured through conventional research databases.

To address this, we acknowledge that the integration of local wisdom such as *Smong* into disaster mitigation education cannot rely solely on its cultural value, but must be supported by systemic, policy-aligned mechanisms. Although Indonesia's national education policy has not formally institutionalized a locally based disaster education model, current frameworks present strategic opportunities for integration. First, the competency-based and flexible nature of the *Merdeka Belajar* Curriculum (*Kurikulum Merdeka*) allows for the incorporation of local

content (*muatan lokal*) and project-based learning. This provides an opportunity to embed *Smong* and other indigenous knowledge into learning modules that are contextually relevant to local communities. Second, teacher training and local partnerships play a crucial role. Capacity-building initiatives should involve collaboration between local governments, traditional leaders, and teacher education institutions. Embedding community elders and cultural practitioners within training-of-trainers (ToT) models can help bridge the gap between formal education systems and community-rooted knowledge traditions. Third, the Ministry of Education's *Profil Pelajar Pancasila* framework offers a strong foundation for integrating local wisdom like *Smong*, as it promotes core values such as collective memory, empathy, and vigilance principles that align closely with *Smong's* cultural teachings. Lastly, pilot programs and policy advocacy are essential. Successful local-level initiatives, particularly those in regions such as Simeulue and Aceh, can serve as evidence-based models to inform broader policy development. Collaboration between researchers, practitioners, and policy-makers is needed to document these initiatives and promote their scalability at the national level. Thus, while current policy infrastructure may not yet fully support the widespread integration of local wisdom-based education, this study's recommendations are designed to operate within existing systems to promote gradual, scalable, and policy-compatible models of implementation.

For future research, it is also recommended to include local studies and grey literature to ensure a more comprehensive scope of the literature. This can be achieved by leveraging local repositories or conducting interviews with practitioners and experts in the field, such as research reports from institutions, theses, or conference materials. These sources can offer valuable insights that may not be captured in traditional academic databases, thereby broadening the understanding of local wisdom and its educational applications in disaster mitigation.

In addition, future studies may benefit from the integration of semi-quantitative analytic strategies to complement qualitative insights. Techniques such as weighted coding matrices**,** contribution scoring, or citation/context co-analysis can offer more rigorous comparisons across cases or themes, while still maintaining sensitivity to local and cultural variation. These methodological enhancements would allow researchers to move beyond frequency counts and toward a more layered interpretation of influence, depth, and practical relevance across diverse sources. Such directions would not only strengthen methodological robustness but also ensure that research in this field remains inclusive, contextually grounded, and aligned with the complex realities of disaster risk reduction in culturally diverse settings.

This study also encourages future studies to adopt quasi-experimental**,** mixed-methods**,** or longitudinal designs that allow for more rigorous evaluation of the effectiveness of different pedagogical formats. Such approaches can help determine which strategies most effectively support disaster preparedness outcomes such as increased knowledge retention, behavioral change, or timely evacuation while still honoring the cultural foundations of local wisdom-based learning.

REFERENCES

Afrian, R., Hariadi, J., Akob, B., & Islami, Z. R. (2020). Local Culture Inventory for Disaster Mitigation Learning. *IOP Conference Series: Earth and Environmental Science*, *412*(1). https://doi.org/10.1088/1755-1315/412/1/012017

Agustinova, D. E., Sutimin, L. A., & Purwanta, H. (2023). The Importance and Value of Integration Knowledge in the Context of Informatization Teaching 21st Century. *Educational Administration: Theory and Practice*, *29*(1), 107–122. https://doi.org/10.17762/kuey.v29i1.502

Aldrich, D. P., & Sawada, Y. (2015). The physical and social determinants of mortality in the 3.11 tsunami. *Social Science and Medicine*, *124*, 66–75. https://doi.org/10.1016/j.socscimed.2014.11.025

Amri, I., & Giyarsih, S. R. (2022). Monitoring urban physical growth in tsunami-affected areas: A case study of Banda Aceh City, Indonesia. *Geojournal*, *87*(3), 1929-1944. https://doi.org/10.1007/s10708-020-10362-6

Andreastuti, S., Paripurno, E., Gunawan, H., Budianto, A., Syahbana, D., & Pallister, J. (2019). Character of community response to volcanic crises at Sinabung and Kelud volcanoes. *Journal of Volcanology and Geothermal Research*, *382*, 298-310. https://doi.org/10.1016/j.jvolgeores.2017.01.022

Apronti, P. T., Osamu, S., Otsuki, K., & Kranjac-Berisavljevic, G. (2015). Education for disaster risk reduction (DRR): Linking theory with practice in Ghana's basic schools. *Sustainability*, *7*(7), 9160-9186. https://doi.org/10.3390/su7079160

Arce, R. S. C., Onuki, M., Esteban, M., & Shibayama, T. (2017). Risk awareness and intended tsunami evacuation behaviour of international tourists in Kamakura City, Japan. *International Journal of Disaster Risk Reduction*, *23*(April), 178–192. https://doi.org/10.1016/j.ijdrr.2017.04.005

Arjaya, I. B. A., Suastra, I. W., Redhana, I. W., & Sudiatmika, A. A. I. A. R. (2024a). Global Trends in Local Wisdom Integration in Education: A Comprehensive Bibliometric Mapping Analysis from 2020 to 2024. *International Journal of Learning, Teaching and Educational Research*, *23*(7), 120–140. https://doi.org/10.26803/ijlter.23.7.7

Arjaya, I. B. A., Subagia, I. W., Redhana, I. W., & Hermawan, I. M. S. (2024b). A systematic review: The problems of the science learning process in local wisdom context. In H. H. & R. T. (Eds.), *AIP Conference Proceedings* (Vol. 3106, Issue 1). American Institute of Physics. https://doi.org/10.1063/5.0215098

Asai, A. (2015). Tsunami-tendenko and morality in disasters. *Journal of Medical Ethics*, *41*(5), 365–366. https://doi.org/10.1136/medethics-2013-101629

Barenstein, J. D., & Trachsel, S. (2012). The role of informal governance in post-disaster reconstruction and its impact on elderly people's social security in coastal Tamil Nadu. In *Post-Disaster Reconstruction and Change* (pp. 157-176). CRC Press. https://doi.org/10.1201/b13027

Bartolomé, E. (2025). Didactic models for active and inquiry-based learning of machines and mechanisms. *International Journal of Mechanical Engineering Education*. https://doi.org/10.1177/03064190241310053

Bryant, E. (2014). Tsunami: The underrated hazard (Third Edition). In *Tsunami: The Underrated Hazard*.

Butt, S. (2014). Disaster management law in Indonesia: From response to preparedness? In *Asia-Pacific Disaster Management: Comparative and Socio-Legal Perspectives* (pp. 183–196). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-39768-4_9

Cato, S., & Oshitani, K. (2024). Tsunami-tendenko follows the antiextinction principle, not utilitarianism. *Journal of Medical Ethics*. https://doi.org/10.1136/jme-2023-109674

Chiba, Y., & Nagamatsu, S. (2023). Increasing the Resilience of Japanese Companies to Address Multi-hazard Risks. *IDRiM Journal*, *13*(2), 90-103. https://doi.org/10.5595/001c.91475

Dewi, I. M., & Sihombing, G. P. (2022). Kearifan Lokal Masyarakat Pulau Simeulue Dalam Menghadapi Bencana Alam Tsunami Dan Implikasinya Pada Ketahanan Nasional. *... (Indonesian Maritime Journal)*, 289–306. https://jurnalmaritim.tnial.mil.id/index.php/IMJ/article/view/130%0Ahttps://jurnalmaritim.tnial.mil.id/index.php/IMJ/article/download/130/94

Dewit, A. (2020). Is Japan a climate leader? Synergistic integration of the 2030 Agenda. *Asia-Pacific Journal: Japan Focus*, *18*(3), 1–22. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85096315154&partnerID=40&md5=19bf2c7be0b12756e152de2869c739cb

Doocy, S., Gorokhovich, Y., Burnham, G., Balk, D., & Robinson, C. (2007). Tsunami mortality estimates and vulnerability mapping in Aceh, Indonesia. *American Journal of Public Health*, *97 Suppl 1*, S146-151. https://doi.org/10.2105/AJPH.2006.095240

Dwiningrum, S. I. A., Sumunar, D. R. S., Sitompul, N., Setyawan, S. L. H. P., Sholekhah, E., & Nahdi, K. (2021). Student Knowledge about Disaster in Vocational School and High School: Case study in Lombok, Indonesia. In B. S.P., S. A., M. E., M. E., S. null, M. E., & R. A. (Eds.), *IOP Conference Series: Earth and Environmental Science* (Vol. 630, Issue 1). IOP Publishing Ltd. https://doi.org/10.1088/1755-1315/630/1/012020

Erman, E., & Wakhidah, N. (2023). An expert judgment of textbook draft of local wisdom-based learning of science: A preliminary study. In D. A. (Ed.), *AIP Conference Proceedings* (Vol. 2619). American Institute of Physics Inc. https://doi.org/10.1063/5.0122709

Hamid, B., Zaman, M., Farooq, S., Fatima, S., Sayyed, R. Z., Baba, Z. A., ... & Suriani, N. L. (2021). Bacterial plant biostimulants: a sustainable way towards improving growth, productivity, and health of crops. *Sustainability*, *13*(5), 2856. https://doi.org/10.3390/su13052856

Hasan, F. M., & Monita, D. (2024). Revitalisation of Rejang tribal local wisdom: integration of cultural values in the operational curriculum innovation of elementary schools in Rejang Lebong, Indonesia. *Education 3-13*. https://doi.org/10.1080/03004279.2024.2318246

Firaina, R., & Fauzi, A. (2021). Analysis of the competency standard of its graduates for the developing of physics e-book with tsunami theme. *Journal of Physics: Conference Series*, *1876*(1). https://doi.org/10.1088/1742-6596/1876/1/012036

Freysteinson, W. M., Lewis, C., Sisk, A., Wuest, L., Deutsch, A. S., & Cesario, S. K. (2013). Investigator reflections: A final debriefing following emotionally sensitive mirror research. *Holistic nursing practice*, *27*(3), 177-184. https://doi.org/10.1097/HNP.0b013e31828a0968

Gadeng, A. N., Maryani, E., & Ningrum, E. (2019). The Simulation of Smong in Geography Learning to Enhance Understanding of Disaster. *IOP Conference Series: Earth and Environmental Science*, *286*(1). https://doi.org/10.1088/1755-1315/286/1/012013

Gadeng, A. N., Maryani, E., & Rohmat, D. (2018). The Value of Local Wisdom Smong in Tsunami Disaster Mitigation in Simeulue Regency, Aceh Province. *IOP Conference Series: Earth and Environmental Science*, *145*(1). https://doi.org/10.1088/1755-1315/145/1/012041

Geertz, C. (1983). *Local Knowledge: Further Essays in Interpretive Anthropology*. Basic Books.

Goltz, J. D. (2017). Tsunami Tendenko: A Sociological Critique. *Natural Hazards Review*, *18*(4), 1–7. https://doi.org/10.1061/(asce)nh.1527-6996.0000254

Grau Vila, C. (2024). Tohoku resilient schools and youth engagement in memory after 2011 tsunami. *Disaster Prevention and Management*, *33*(5), 646–662. https://doi.org/10.1108/DPM-10-2023-0273

Hamada, M. (2014). Mitigation measures against future natural disasters. In *Springer Series in Geomechanics and Geoengineering* (Issue 9784431548). https://doi.org/10.1007/978-4-431-54892-8_6

Hamid, N., Trihatmoko, E., Herlina, M., & Aroyandini, E. N. (2021). Developing a model for disaster education to improve students' disaster mitigation literacy. *Journal of Disaster Research*, *16*(8), 1243–1256. https://doi.org/10.20965/jdr.2021.p1243

Haryono, E. (2020). Mechanism of increasing preparedness tsunami: Ombak-learning model development. *Science of Tsunami Hazards*, *39*(3), 156–167. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85092944298&partnerID=40&md5=572186925b1622c350e1aeba793e2e79

Hasan, M. F., Monita, D., & Nugraheni, A. S. (2024, November). Sociolinguistics of regional languages: An analysis of Javanese and Madurese usage among elementary school children in Jember, Indonesia. In *Forum for Education Studies* (Vol. 2, No. 4, pp. 1583-1583). https://doi.org/10.59400/fes1583

Hazari, A. (2023). *Sampling Types and Methods. In: Research Methodology for Allied Health Professionals*. Springe. https://doi.org/https://doi.org/10.1007/978-981-99-8925-6_6

Hein, P. (2014). Expecting the unexpected: A case study on tsunami mitigation in Fujisawa (Japan). *Environmental Hazards*, *13*(1), 1–20. https://doi.org/10.1080/17477891.2013.772890

Heitzmann, N., Seidel, T., Hetmanek, A., Wecker, C., Fischer, M. R., Ufer, S., Schmidmaier, R., Neuhaus, B., Siebeck, M., Stürmer, K., Obersteiner, A., Reiss, K., Girwidz, R., Fischer, F., & Opitz, A. (2019). Facilitating Diagnostic Competences in Simulations in Higher Education A Framework and a Research Agenda. *Frontline Learning Research*, *7*(4), 1–24. https://doi.org/10.14786/flr.v7i4.384

Iemura, H., Takahashi, Y., Pradono, M. H., Sukamdo, P., & Kurniawan, R. (2006). Earthquake and tsunami questionnaires in Banda Aceh and surrounding areas. *Disaster Prevention and Management: An International Journal*, *15*(1), 21–30. https://doi.org/10.1108/09653560610654211

Ikeda, S., & Silapunt, P. (2022). Introduction to the project for strengthening the ASEAN regional capacity on disaster health management (ARCH project). *Prehospital and disaster medicine*, *37*(S1), s1-s10. https://doi.org/10.1017/S1049023X22000036

Irwansyah, M., Nursaniah, C., Qadri, L., & Mariana, M. (2024). City of prone natural disasters: Mitigating post-tsunami on the coastal of Banda Aceh, Indonesia. *Environmental Challenges*, *15*. https://doi.org/10.1016/j.envc.2024.100925

Kânoğlu, U., & Synolakis, C. (2015). Tsunami Dynamics, Forecasting, and Mitigation. In *Coastal and Marine Hazards, Risks, and Disasters*. https://doi.org/10.1016/B978-0-12-396483-0.00002-9

Katada, T., & Kanai, M. (2016). The school education to improve the disaster response capacity: A case of "Kamaishi Miracle." *Journal of Disaster Research*, *11*(5), 845–856. https://doi.org/10.20965/jdr.2016.p0845

Kitagawa, K. (2015). Continuity and change in disaster education in Japan. *History of Education*, *44*(3), 371–390. https://doi.org/10.1080/0046760X.2014.979255

Kitagawa, K. (2021). Disaster risk reduction activities as learning. *Natural Hazards*, *105*(3), 3099–3118. https://doi.org/10.1007/s11069-020-04443-5

Kitzbichler, S. (2011). Built back better? Housing reconstruction after the tsunami disaster of 2004 in Aceh. *Asian Journal of Social Science*, *39*(4), 534–552. https://doi.org/10.1163/156853111X597314

Kodama, S. (2013). Tsunami-tendenko and morality in disasters. *Journal of Medical Ethics*, *41*(5), 361–363. https://doi.org/10.1136/medethics-2012-100813

Kodama, S. (2015). Tsunami-tendenko and morality in disasters. *Journal of Medical Ethics*, *41*(5), 361–363. https://doi.org/10.1136/medethics-2012-100813

Koesoema, A. P., Irawan, Y. S., & Egawa, S. (2021). Development of a multilingual educational platform for cross-nation real-time distant interaction in youth disaster preparedness between Indonesia and Japan. In B. S.P., S. A., M. E., M. E., S. null, M. E., & R. A. (Eds.), *IOP Conference Series: Earth and Environmental Science* (Vol. 630, Issue 1). IOP Publishing Ltd. https://doi.org/10.1088/1755-1315/630/1/012019

Koshimura, S., & Shuto, N. (2015). Response to the 2011 Great East Japan Earthquake and Tsunami disaster. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *373*(2053). https://doi.org/10.1098/rsta.2014.0373

Kotani, H., Okai, H., Nejima, S., & Tamura, M. (2024). Initial responses of mosques in Ishikawa and Toyama after the 2024 Noto Peninsula earthquake, Japan. *Journal of Disaster Research*, *19*(6), 1006-1015. https://doi.org/10.1016/j.iotcps.2023.09.002

Krichen, M., Abdalzaher, M. S., Elwekeil, M., & Fouda, M. M. (2024). Managing natural disasters: An analysis of technological advancements, opportunities, and challenges. *Internet of Things and Cyber-Physical Systems*, *4*, 99-109. https://doi.org/10.1016/j.iotcps.2023.09.002

Irwansyah, M., Nursaniah, C., & Qadri, L. (2024). Improving the Quality of Pond Land Spatial in Watershed, Between Preparedness and Sustainability in Disaster Mitigation in Aceh: A Qualitative Study. *Polish Journal of Environmental Studies*, *33*(6). https://doi.org/10.15244/pjoes/184632

Kodama, M. (2013). Competing through ICT capability. *Palgrave Macmillan Books*. https://doi.org/10.1057/9781137286932

Kodama, T. (2015). Japan's Immigration Problem. *Daiwa Institute of Research*, *29*.

Koesoema, A. P., Irawan, Y. S., & Egawa, S. (2021). Development of a multilingual educational platform for cross-nation real-time distant interaction in youth disaster preparedness between Indonesia and Japan. In *IOP Conference Series: Earth and Environmental Science* (Vol. 630, No. 1, p. 012019). IOP Publishing. https://doi.org/10.1088/1755-1315/630/1/012019

Latumeten, A. A. T., & Janah, U. (2024). Indigenous Knowledge and Disaster Resilience for Children: Reading Smong in Selected Literacy Cloud Short Stories. *... : Journal on ...*, *10*(1), 60–75. https://prologue.sastra.uniba-bpn.ac.id/index.php/jurnal_prologue/article/view/168%0Ahttps://prologue.sastra.uniba-bpn.ac.id/index.php/jurnal_prologue/article/download/168/102

Lee, Y.-J., & Hanada, S. (2020). An Examination of the Self-Evaluations Over Time of the 3.11 Tsunami Survivors Regarding Their Post-Disaster Recovery. *IDRiM Journal*, *10*(1), 23–42. https://doi.org/10.5595/001c.16747

Lubis, T. (2019). Learning Nandong in Schools as a Medium to Inform the Simeuluenese Local Wisdom: An Anthropolinguistics Approach. *Studies in English Language and Education*, *6*(2), 262–272. https://doi.org/10.24815/siele.v6i2.14066

Maeda, K., & Hashimoto, H. (2019). Exploring the potential of the practice of Inochi-tendenko in current disaster prevention education: The interaction effect of teachers' attitudes toward disaster prevention education and the organizational climate in schools. *Research in Social Psychology*, *35*(3), 91–98. https://doi.org/10.14966/jssp.1830

Marhadi, A., Ino, L., Suraya, R. S., Janu, L., Said, T., & Gaho, R. (2024). Understanding local wisdom as specific knowledge in natural disaster mitigation: An empirical lessons in Tiworo, Indonesia. *Kasetsart Journal of Social Sciences*, *45*(4), 1383–1392. https://doi.org/10.34044/j.kjss.2024.45.4.31

Maulana, G. F., & Arovah, N. I. (2022). The psychometric evaluation of the immune status questionnaire in Indonesia. *Eastern Journal of Medicine*, *27*(3), 380-388. https://doi.org/10.5505/ejm.2022.93764

Maulana, I. T., Firdian, F., Rahmelina, L., Ningsih, S. R., Suryani, K., & Putri, R. A. (2021). E-Learning effective during the Covid-19 era. *Ilkogretim Online*, *20*(2).

Matsuura, S., & Shaw, R. (2015). Exploring the possibilities of school-based recovery and community building in Toni District, Kamaishi. *Natural Hazards*, *75*(1), 613–633. https://doi.org/10.1007/s11069-014-1344-8

Maulana, G., Hasanah, U., Hanum, S., Urrahmi, S., Dzikri, T. A., & Oktari, R. S. (2022). Disaster education through the adaptation of the werewolf game and acehnese local wisdom. *E3S Web of Conferences*, *340*, 1–4. https://doi.org/10.1051/e3sconf/202234003005

Maulana, I., Raswita, L., Karlina, S., Zahratunnisa, Mukarram, M. H. A., & Oktari, R. S. (2021). PASMINA: Arts-based tsunami education with an Islamic theme adopted from Nandong Smong. *IOP Conference Series: Earth and Environmental Science*, *708*(1). https://doi.org/10.1088/1755-1315/708/1/012094

Maulida, A., Hanif, H., Kamal, M., & Oktari, R. S. (2023). Roblox-based tsunami survival game: A tool to stimulate early childhood disaster preparedness skills. In P. P., R. A., O. A., B. M., O. R.S., R. R., & M. E. (Eds.), *E3S Web of Conferences* (Vol. 447). EDP Sciences. https://doi.org/10.1051/e3sconf/202344702003

McAdoo, B. G., Dengler, L., Prasetya, G., & Titov, V. (2006). Smong: How an Oral History Saved Thousands on Indonesia's Simeulue Island during the December 2004 and March 2005 Tsunamis. *Earthquake Spectra*, *22*(3_suppl), 661–669. https://doi.org/10.1193/1.2204966

Ministry of Education and Culture. (2017). *Panduan Penguatan Pendidikan Karakter*. Jakarta: Kemendikbud

Mochizuki, J., & Komendantova, N. (2017). In Search of Perfect Foresight? Policy Bias, Management of Unknowns, and What Has Changed in Science Policy Since the Tohoku Disaster. *Risk Analysis*, *37*(2), 219–230. https://doi.org/10.1111/risa.12602

Murty, M. N., Kumar, S., & Dhavala, K. K. (2007a). Measuring environmental efficiency of industry: a case study of thermal power generation in India. *Environmental and Resource Economics*, *38*(1), 31-50. https://doi.org/10.1007/s10640-006-9055-6

Murty, T. S., Aswathanarayana, U., & Nirupama, N. (2007b). The energetics of the tsunami of 26 December 2004 in the Indian Ocean: A brief review. In T. S. Murty, U. Aswathanarayana, & N. Nirupama (Eds.), *The Indian Ocean tsunami* (1st ed., pp. 1–10). CRC Press.

Nagata, T., Ikeda, M., Kimura, R., & Oda, T. (2022). Development of Tsunami Disaster Risk Reduction Education Program for Children with No Experience of Earthquake Disaster – Practice and Verification at Shichigahama Town, Miyagi Prefecture. *Journal of Disaster Research*, *17*(6), 1000–1014. https://doi.org/10.20965/jdr.2022.p1000

Nakagawa, A., Furukawa, H., Konishi, R., Kudo, D., Matsumura, T., Sato, D., Abe, Y., Washio, T., Arafune, T., Yamanouchi, S., Kushimoto, S., & Tominaga, T. (2013). The great east Japan earthquake: Lessons learned at Tohoku University Hospital during the first 72 hours. *IEEE Pulse*, *4*(3), 20–27. https://doi.org/10.1109/MPUL.2013.2250851

Nakano, G., & Shaw, R. (2017). Education governance and the role of science and technology. In *Science and Technology in Disaster Risk Reduction in Asia: Potentials and Challenges*. https://doi.org/10.1016/B978-0-12-812711-7.00011-0

Nakum, V. K., Ahamed, M. S., Isetani, S., Chatterjee, R., Shaw, R., & Soma, H. (2022). Developing a framework on school resilience for risk-informed decision-making. *Progress in Disaster Science*, *15*. https://doi.org/10.1016/j.pdisas.2022.100237

Niwa, T., Okaya, M., & Takahashi, T. (2015). TENDENKO: Agent-based evacuation drill and emergency planning system. In G. F. & N. E. (Eds.), *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)* (Vol. 9002, pp. 167–179). Springer Verlag. https://doi.org/10.1007/978-3-319-14627-0_12

Oe, H., & Kawakami, S. (2021). A disaster prevention programme using virtual schemes: Recommendation of tradition populaire integrated with tendenko as an approach to immersive training. *International Journal of Disaster Risk Reduction*, *57*. https://doi.org/10.1016/j.ijdrr.2021.102135

Onrizal, Auliah, N. L., & Mansor, M. (2020). Mitigation and adaptation on tsunami catastrophes in Indonesia through education and geodetic networks. *AIP Conference Proceedings*, *2221*(January). https://doi.org/10.1063/5.0003013

Ophiyandri, T., Istijono, B., Hidayat, B., & Yunanda, R. (2022). Readiness analysis of public buildings in Padang City for tsunami temporary evacuation shelter. *GEOMATE Journal*, *22*(94), 113-120. https://doi.org/10.21660/2022.94.j2391

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *The BMJ*, *372*(71), 1–9. https://doi.org/10.1136/bmj.n71

Panjaitan, B., Gomez, C., & Pawson, E. (2017). Potential coping capacities to avoid tsunamis in Mentawai. In M. I. & Z. null (Eds.), *AIP Conference Proceedings* (Vol. 1857). American Institute of Physics Inc. https://doi.org/10.1063/1.4987108

Pearnpitak, K., Akahat, N., & Moungon, P. (2024). Driving a three-age learning curriculum from local wisdom under the "yangkhinok model" in Thailand. *Humanities, Arts and Social Sciences Studies*, *24*(3), 618–631. https://doi.org/10.69598/hasss.24.3.267777

Pholasa, P., & Samat, C. (2016). Design of cognitive tools to enhance problem-solving in computer language programming for high school students. In W. S.L., B. A.G., M. H., B. G., J. J., Y. J.-C., B. M.P., D. M., G. M., L. C.-P., S. J.G., I. S., G. A., H. C., K. G., R. M.M.T., S. P., T. P., C. W., … Y. C. (Eds.), *ICCE 2016 - 24th International Conference on Computers in Education: Think Global Act Local - Main Conference Proceedings* (pp. 645–647). Asia-Pacific Society for Computers in Education. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85018953425&partnerID=40&md5=0a353d0fe29eaa133bcbd1b9cf0c053f

Pickering, C. J., Guy, E., Al-Baldawi, Z., McVean, L., Sargent, S., & O'Sullivan, T. (2021). "I believe this team will change how society views youth in disasters": the EnRiCH Youth Research Team: a youth-led community-based disaster risk reduction program in Ottawa, Canada. *Canadian Journal of Public Health*, *112*(5), 957–964. https://doi.org/10.17269/s41997-021-00486-8

Pongponrat, K., & Ishii, K. (2018). Social vulnerability of marginalized people in times of disaster: Case of Thai women in Japan Tsunami 2011. *International Journal of Disaster Risk Reduction*, *27*, 133–141. https://doi.org/10.1016/j.ijdrr.2017.09.047

Raby, A., Pomonis, A., Suppasri, A., Adams, K., Açikgőz, N., Baiguera, M., Idris, Y., Latcharote, P., Marafini, F., McGovern, D., Meilianda, E., Mistry, H., Nurdin, S., Opabola, E., Ornthammarath, T., Trumikaborworn, N., & Rossetto, T. (2025). Approaches to post-tsunami coastal reconstruction: Comparisons across Indonesia, Thailand, and Japan. *International Journal of Disaster Risk Reduction*, *117*. https://doi.org/10.1016/j.ijdrr.2024.105138

Rahman, A., & Munadi, K. (2019). Communicating Risk in Enhancing Disaster Preparedness: A Pragmatic Example of Disaster Risk Communication Approach from the Case of Smong Story. *IOP Conference Series: Earth and Environmental Science*, *273*(1). https://doi.org/10.1088/1755-1315/273/1/012040

Rahman, A., Nazaruddin, M., Januriyadi, N. F., & Affan, M. (2024). Cross-generational Smong narratives in Aceh's tsunami resilience. *Asia-Pacific Journal of Regional Science*, *8*(3), 943–970. https://doi.org/10.1007/s41685-024-00346-6

Rahman, A., Sakurai, A., & Munadi, K. (2017). Indigenous knowledge management to enhance community resilience to tsunami risk: Lessons learned from Smong traditions in Simeulue island, Indonesia. *IOP Conference Series: Earth and Environmental Science*, *56*(1). https://doi.org/10.1088/1755-1315/56/1/012018

Rahman, A., Sakurai, A., & Munadi, K. (2018). The analysis of the development of the Smong story on the 1907 and 2004 Indian Ocean tsunamis in strengthening the Simeulue island

community's resilience. *International Journal of Disaster Risk Reduction*, *29*, 13–23. https://doi.org/10.1016/j.ijdrr.2017.07.015

Rahman, A., Sakurai, A., Sutton, S., Syahbandir, M., & Nofriadi, N. (2022). Smong means more than tsunami: The understanding of tsunami in the Indonesian context. In R. A., I. Y., H. H.A., M. null, M. E., M. T., R. I., S. A., M. E., & O. A. (Eds.), *E3S Web of Conferences* (Vol. 340). EDP Sciences. https://doi.org/10.1051/e3sconf/202234003010

Ramli, Gadeng, A. N., Azis, D., Yusuf, Y. Q., & Razali. (2024). The role of oral traditions in internalizing smong wisdom: Perspectives from the Simeulue community. *Indonesian Journal of Applied Linguistics*, *14*(2), 229–239. https://doi.org/10.17509/ijal.v14i2.74903

Ridha, S., Rahman, A., Abdi, A. W., & Kamil, P. A. (2022). The implementation of disaster education after the sixteen years of the 2004 Indian Ocean Tsunami in Aceh-Indonesia: Progress or regress? In R. A., I. Y., H. H.A., M. null, M. E., M. T., R. I., S. A., M. E., & O. A. (Eds.), *E3S Web of Conferences* (Vol. 340). EDP Sciences. https://doi.org/10.1051/e3sconf/202234003003

Roshetko, J. M., Idris, N., Purnomosidhi, P., Zulfadhli, T., & Tarigan, J. (2013). Farmer extension approach to rehabilitate smallholder fruit agroforestry systems: The "nurseries of excellence (NOEL)" program in Aceh, Indonesia. *Acta Horticulturae*, *975*, 649–656. https://doi.org/10.17660/ActaHortic.2013.975.81

Rosser, A., & Fahmi, M. (2018). The political economy of teacher management reform in Indonesia. *International Journal of Educational Development*, *61*, 72–81. https://doi.org/10.1016/j.ijedudev.2017.12.005

Ruswandi, D., & Maarif, S. (2023). Implementation of disaster response policy in Indonesia. In H. A., F. null, S. S., S. A., & R. A. (Eds.), *E3S Web of Conferences* (Vol. 464). EDP Sciences. https://doi.org/10.1051/e3sconf/202346410003

Sakurai, A., & Sato, T. (2016). Promoting education for disaster resilience and the Sendai framework for disaster risk reduction. *Journal of Disaster Research*, *11*(3), 402–412. https://doi.org/10.20965/jdr.2016.p0402

Salehuddin, K., & Jaafar, N. M. (2024). Jawi Spelling Reformation to Increase Jawi-Literacy and for its Revitalization: A Conceptual Paper. *GEMA Online Journal of Language Studies*, *24*(2), 117–135. https://doi.org/10.17576/gema-2024-2402-07

Samala, A. D., Rawas, S., Santiago, C.-C., Bondarenko, O., Samala, A. G., & Novaliendry, D. (2024). Harmony in Education: An In-Depth Exploration of Indonesian Academic Landscape, Challenges, and Prospects Towards the Golden Generation 2045 Vision. *TEM Journal*, *13*(3), 2436–2456. https://doi.org/10.18421/TEM133-71

Sapoetra, J. (2020). An Analysis of Local Content in the Local English Textbooks in Indonesian High Schools. In V. S., M. M.B., L. C.-H., G. T.L., M. null, & S. A. (Eds.), *Journal of Physics: Conference Series* (Vol. 1477, Issue 4). Institute of Physics Publishing. https://doi.org/10.1088/1742-6596/1477/4/042023

Sarp, N. (2005). Disaster preparedness in health care. *World Hospitals and Health Services: The Official Journal of the International Hospital Federation, 41*(1), 18–20.

Sasaki, N., Ueno, Y., Ozono, R., Nakano, Y., & Higashi, Y. (2025). Association between liver fibrosis, plasma volume status, and cardiovascular mortality: The Hiroshima Study on Glucose Metabolism and Cardiovascular Diseases. *European Journal of Heart Failure*. https://doi.org/10.1002/ejhf.3677

Scheffers, A., Kelletat, D., & Engel, M. (2009). Die Entwicklung der Tsunamiforschung nach der Katastrophe vom 26. Dezember 2004. *Geographische Rundschau, 61*(12), 12–18.

Sekine, R. (2011). Did the People Practice "Tsunami Tendenko"? -The reality of the 3.11 tsunami which attacked Shizugawa Area, Minamisanriku Town, Miyagi Prefecture-. *The 2011 East Japan Earthquake Bulletin of the Tohoku Geographical Association*. http://tohokugeo.jp/articles/e-contents22.html

Stefania, I., & George, P. (2024). Conservation and Preservation Standards for Paintings. In *Springer Proceedings in Materials* (Vol. 33, pp. 147–158). Springer. https://doi.org/10.1007/978-3-031-42239-3_13

Suciati. (2023). Integrating local wisdom in science learning: An opportunities and challenges. In D. A. (Ed.), AIP Conference Proceedings (Vol. 2619). American Institute of Physics Inc. https://doi.org/10.1063/5.0125371

Sibarani, R. (2013). Kearifan Lokal: Hakikat, Peran, dan Metode Tradisi Lisan. *Jurnal Antropologi Indonesia*, 34(1), 11–19

Simarmata, D. P., & Indrawati, D. R. (2022, November). Using local wisdom for climate change mitigation. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1109, No. 1, p. 012004). IOP Publishing. https://doi.org/10.1088/1755-1315/1109/1/012004

Suboh, T. P., Rosemary, R., & Rahman, A. (2024). Disaster mitigation education (DME): A bibliometric study from Scopus database. In M. M. (Ed.), *IOP Conference Series: Earth and Environmental Science* (Vol. 1356, Issue 1). Institute of Physics. https://doi.org/10.1088/1755-1315/1356/1/012044

Suciani, A., Islami, Z. R., Zainal, S., Sofiyan, & Bukhari. (2018). «Smong» as local wisdom for disaster risk reduction. *IOP Conference Series: Earth and Environmental Science*, *148*(1). https://doi.org/10.1088/1755-1315/148/1/012005

Sufri, S., & Lassa, J. A. (2024). Integration of disaster risk reductionand climate change adaptation in Aceh: Progress and challenges after 20 Years of Indian Ocean Tsunamis. *International Journal of Disaster Risk Reduction*, *113*. https://doi.org/10.1016/j.ijdrr.2024.104894

Sun, Y. (2013). Disaster Education Based on Community of Practice: A Case Study in Okitsu Community. *Journal of Integrated Disaster Risk Management*, *3*, 92–106. https://doi.org/10.5595/idrim.2013.0056

Suraña-Sánchez, C., & Aramendia-Muneta, M. E. (2024). Impact of artificial intelligence on customer engagement and advertising engagement: A review and feture research agenda. *International Journal of Consumer Studies*, *48*(2), 1–22. https://doi.org/10.1111/ijcs.13027

Sutton, S. A., Paton, D., Buergelt, P., Meilianda, E., & Sagala, S. (2020). What's in a name? "Smong" and the sustaining of risk communication and DRR behaviours as evocation fades. *International Journal of Disaster Risk Reduction*, *44*(April 2019), 101408. https://doi.org/10.1016/j.ijdrr.2019.101408

Sutton, S. A., Paton, D., Buergelt, P., Sagala, S., & Meilianda, E. (2021). Nandong smong and tsunami lullabies: Song and music as an effective communication tool in disaster risk reduction. *International Journal of Disaster Risk Reduction*, *65*(September 2020), 102527. https://doi.org/10.1016/j.ijdrr.2021.102527

Suzuki, N. (2014). New Trends in Learning about Disaster Prevention: Some Lessons from the 2011 Great East Japan Earthquake. *Literacy Information and Computer Education Journal*, *5*(2), 1549–1555. https://doi.org/10.20533/licej.2040.2589.2014.0206

Syafwina. (2014). Recognizing Indigenous Knowledge for Disaster Management: Smong, Early Warning System from Simeulue Island, Aceh. *Procedia Environmental Sciences*, *20*, 573–582. https://doi.org/https://doi.org/10.1016/j.proenv.2014.03.070

Syahputra, H. (2019). Indigenous knowledge representation in mitigation process: a study of communities' understandings of natural disasters in Aceh Province, Indonesia. *Collection and Curation*, *38*(4), 94–102. https://doi.org/10.1108/CC-11-2017-0046

Syuryansyah, S., & Habibi, F. (2024). The role of local wisdom in disaster mitigation: A Systematic Literature Review (SLR) approach. *International Journal of Disaster Management*, *6*(3), 327-344. https://doi.org/10.24815/ijdm.v6i3.34734

Takahashi, K., Kodama, M., Gregorio, E. R., Tomokawa, S., Asakura, T., Waikagul, J., & Kobayashi, J. (2015). School Health: An essential strategy in promoting community resilience and preparedness for natural disasters. *Global Health Action*, *8*. https://doi.org/10.3402/gha.v8.29106

Tanaka, H., Shiiba, N., & Huang, M. C. (2021). Tsunami Impact Assessment and Vulnerability Index Development using Computable General Equilibrium (CGE) Model and Geographic Information System (GIS) - A Study on Mie Prefecture, Japan. *Journal of Integrated Disaster Risk Management*, *11*(1), 46–63. https://doi.org/10.5595/001c.28384

Topno, P. N. (2021). Building Disaster Resilience Through Primary and Higher Education. In *Handbook of Disaster Risk Reduction for Resilience: New Frameworks for Building Resilience to Disasters* (pp. 203-221). Cham: Springer International Publishing. https://doi.org/10.24815/ijdm.v6i3.34734

Triastari, I., Dwiningrum, S. I. A., & Rahmia, S. H. (2021). Developing Disaster Mitigation Education with Local Wisdom: Exemplified in Indonesia Schools. In S. A., bin I. H., N. N., V. E., C. P., L. Y., M. null, & G. S.R. (Eds.), *IOP Conference Series: Earth and Environmental Science* (Vol. 884, Issue 1). IOP Publishing Ltd. https://doi.org/10.1088/1755-1315/884/1/012004

Uchida, O., Tajima, S., Kajita, Y., Utsu, K., Murakami, Y., & Yamada, S. (2021). Development and Implementation of an ICT-based Disaster Prevention and Mitigation Education Program for the Young Generation. *Information Systems Frontiers*, *23*(5), 1115–1125. https://doi.org/10.1007/s10796-020-10082-9

United Nations (2015). Transforming Our World: The 2030 Agenda for Sustainable Development. Resolution Adopted by the General Assembly on 25 September 2015, 42809, 1-13. https://doi.org/10.1007/s13398-014-0173-7.2

Veroutsos, E. (2022). *The World's 10 Most Earthquake Prone Countries*. Worldatlas.Com.

Xu, Z., Zhou, B., Yang, Z., Yuan, X., Zhang, Y., & Lu, Q. (2023). NeatSankey: Sankey diagrams with improved readability based on node positioning and edge bundling. *Computers & Graphics*, *113*, 10–20. https://doi.org/https://doi.org/10.1016/j.cag.2023.05.001

Wang, Y., Cheng, H., Edwards, R. L., Kong, X., Shao, X., Chen, S., ... & An, Z. (2008). Millennial-and orbital-scale changes in the East Asian monsoon over the past 224,000 years. *nature*, *451*(7182), 1090-1093. https://doi.org/10.1038/nature06692

Wirtz, C. M., Hofmann, S. G., Riper, H., & Berking, M. (2014). Emotion regulation predicts anxiety over a five-year interval: A cross-lagged panel analysis. *Depression and anxiety*, *31*(1), 87-95. https://doi.org/10.1002/da.22198

Wu, L., Cui, P., Pei, J., Zhao, L., & Guo, X. (2022, August). Graph neural networks: foundation, frontiers and applications. In *Proceedings of the 28th ACM SIGKDD conference on knowledge discovery and data mining* (pp. 4840-4841). https://doi.org/10.1145/3534678.3542609

Yamori, K. (2013). Revisiting the concept of tsunami tendenko: Tsunami evacuation behavior in the great east Japan earthquake. *Journal of Disaster Research*, *8*(1), 115–116. https://www.scopus.com/inward/record.uri?eid=2-s2.0-84873457581&partnerID=40&md5=3d7df38ae71b602e8f33c0ab73dbaf36

Yasushi, O. (2017). Misunderstandings and understanding of "Tsunami Tendenko." *Proceedings of the Japan Society of Civil Engineers F6 (Safety Issues)*, *73*(1), 82–91.

Yun, N.-Y., & Hamada, M. (2014). Evacuation behavior and fatality during the 2011 Tohoku tsunami. *Science of Tsunami Hazards*, *33*(3), 144–155. https://www.scopus.com/inward/record.uri?eid=2-s2.0-84908457874&partnerID=40&md5=3365f237841f09e77acf466b5d1e613b

Zainudin, M., Subali, B., & Jailani. (2019). Construct validity of mathematical creativity instrument: First-order and second-order confirmatory factor analysis. *International Journal of Instruction*, *12*(3), 595–614. https://doi.org/10.29333/iji.2019.12336a