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Disaster Literacy and Mitigation Education: Global Trend and Future Directions for Developing Disaster Mitigation-based Science Learning Model

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Abstract

The publication trend regarding disaster literacy studies and its mitigation education has been moderately growing in the last decade. Systematic review studies, however, providing comprehensive review related to this topic has not been carried out nor also reported in the electronical journals or conference proceedings. A systematic review combining between bibliometric analysis, meta-analysis, and meta-synthesis was used to describe the profile of students' disaster knowledge, examine the effect of disaster mitigation education on disaster knowledge, and present global trends and future directions for developing disaster mitigation-based science learning model. 1,284 eligible documents from Scopus database and 24 specifically eligible documents from Google Scholar published in 2014 – 2023 were used as the data. Results showed that between 2014 and 2023, publication trend of disaster literacy studies and its mitigation education slightly increased, whereas citation trend on the documents relatively fluctuated. At least there were some main emerging themes regarding this topic, such as disaster type, country which often happened disaster, learning environment in disaster mitigation education, the ways to mitigate disasters, methodology, and disaster & its mitigation. Additionally, disaster mitigation education had significantly positive strong effect ($g = 2.615$; $p < 0.05$) on students' disaster knowledge. Moreover, overall, students had enough disaster knowledge. This recent study implies that the development of disaster mitigation-based science learning model can be performed by implementing some phases, such as: (1) situation concept, (2) mitigation practices, (3) knowledge of evacuation routes, and (4) cooperation in mitigation practices.

Keywords: *Bibliometrics; Disaster Literacy; Meta-Analysis; Mitigation Education; Qualitative Meta-Synthesis; Science Learning; Systematic Review.*

1. Introduction

Indonesia is located near the Pacific Ring of Fire, which is the meeting point of the Indo-Australian, Eurasian, and Pacific tectonic plates. Geographically, the country is located in the world's most active disaster-prone area (Cummins, 2017; Kaban et al., 2019; Mardiatno et al., 2017). Although the country is prone to various disasters, disaster

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literacy in Indonesia is still low (Ajar & Ronggowulan, 2022; Atmojo, 2021; Triyanto et al., 2021). Disaster literacy refers to a person's capacity to access, read, comprehend, and utilize the information necessary for decision-making and following instructions in the context of mitigation, preparedness, response, and recovery in facing a disaster (Brown et al., 2014; Fadli & Irwanto, 2020). In recent years, Indonesia has witnessed a significant increase in the occurrence of disasters resulting in loss of life and property. According to BNPB in Ding et al. (2013), natural disasters that occurred between 2000-2019 claimed the lives of 189,765 people, 373,807 people injured, and 48,983,644 victims suffered/displaced with the number of natural disasters occurring 26,928 times. This means that the number of victims in each disaster is larger than that of the disasters. According to Genc et al. (2022) to minimize the material and spiritual losses caused by disasters, the concept of disaster literacy needs to be highlighted. In addition, individuals must not only be familiar with characteristic of disasters, but also acquire attitudes about disasters and put the attitudes into action.

According to H. Y. S. H. Nugroho et al. (2022), one of the most common methods used to warn of an impending disaster is the Early Warning System (EWS). This early warning system was developed based on several advances in related scientific fields such as meteorology, hydrology, and information systems so that it can predict the magnitude of disasters that will occur in the future (Esposito et al., 2022). However, the increasing number of disasters in Indonesia is not followed by improvements of the system or adequate warning tools. The system is only a tool to provide signals but does not provide predictions about the exact date/ time of the happening of a disaster making the community at large cannot be sure when they should be prepared for the evacuation process. According to Brown et al. (2014), although warnings, detailed instructions explaining on how to carry out mitigation, instructions on preparing to face disasters, and instructions on getting safe shelter during a disaster are given, some people are still less prepared to face disasters, and are reluctant to be evacuated due to the lack of knowledge about the dangers of a disaster. Brown et al. (2014) research results show that first aid officers, program evaluators, and media reports also confirm that the community is not sufficiently prepared to face disasters and few of the community use the disaster mitigation services provided. This is because the community's disaster literacy is still very low. In short, disaster literacy in this sense refers to a person's ability to read, comprehend, and apply information to make decisions and carry out instructions for disaster mitigation, response, preparedness and recovery (Brown et al., 2014; Fadli & Irwanto, 2020).

As Indonesia has the high potential of disasters, preparedness, early warning, and disaster mitigation efforts are absolutely necessary. According to Suarmika et al. (2022), disaster mitigation is a series of actions and efforts taken to reduce the impact of a disaster which includes preventive actions before a disaster occurs (pre-disaster), actions during a disaster (whilst disaster), and actions taken after a disaster occurs (post disaster). Disaster mitigation is a very important action in order to reduce casualties, property losses, and environmental damage. The need of understanding disaster problems in Indonesia drives disaster mitigation to be integrated into the educational system. One of the policies taken by the Indonesian government is to include the topic and discussion of disaster mitigation in the education curriculum at all levels of education in order to make all students at all levels of education can learn, socialize, and prepare to carry out disaster mitigation as early as possible (Supriyadi et al., 2020).

Some previous studies concluded that disaster education is significantly effective in efforts to minimize disaster risks and build community ability to respond to disasters (Hoffmann & Blecha, 2020; Pinar, 2017; Rogayan & Dollete, 2020). According to Kurniawan and Trimasukmana (2020), disaster education becomes the basis of all disaster risk reduction efforts. Disaster education consists of several forms including disaster management in a community, disaster education for creating a disaster aware society, and local wisdom applied in dealing with disasters (Suarmika et al., 2022). Disaster education

is a method or model for understanding the concept of disaster which attempts to enhance the understanding and expertise required to adapt to the environment in disaster-prone areas. The model can be viewed as an effort to create a society that cares, has the knowledge and skills to prevent disaster problems and avoid possible disaster problems in the future (Whittaker et al., 2015). Thus, in a school context, through the implementation of the model, students are encouraged to involve all learning domains comprising cognitive, affective, and psychomotor as disaster education emphasizes more on how to prevent disaster problems. For this reason, it is necessary to develop a disaster mitigation learning model that focuses more on students' readiness to deal with natural disaster problems rather than disaster management only. In this case, the disaster mitigation learning model follows several operational steps: 1) disaster preparation, 2) disaster risk assessment, 3) disaster management in the form of rescue, rehabilitation, and relocation, 4) disaster prevention knowledge, understanding, and behavioral skills, 5) effective detection and anticipation of disasters, and 6) socialization (Salwa Salsabila & Rafa Dinda, 2021).

The Ministry of Education and Culture of Indonesia in Sukadari et al. (2020) revised the 2013 curriculum by adding the topic of disaster mitigation to the education curriculum which is applied at all levels of education. According to Sakurai and Sato (2016), integrating disaster mitigation in the formal school curriculum is the most effective way to increase public literacy or awareness. Direct learning (Student-centered learning) makes students aware of threatening disasters and understand mitigation efforts. Then, they can spread the knowledge of disaster mitigation to their families and wider communities in their environment (Lamina, 2017). According to Septaria et al. (2020), science subject learning is very suitable for integrating the disaster mitigation content such as analyzing natural disasters that have been occurred and reducing the impact of disasters that will occur. This happens since science subject discuss materials on the basis of on natural phenomena in its learning process which are then analyzed and observed using scientific concepts.

A number of studies present various strategies used in the science learning process for reducing disaster risks. The strategies include cross-curriculum providing disaster materials in the classroom learning process and disaster simulations using the Science, Environment, Technology and Society approach (SETS) (Atmojo, 2021; Maryani, 2021; Pranata et al., 2021), scientific approach (Gunada et al., 2019), E-module based on blended learning (Sumarmi et al., 2021), and learning design based on ADDIE model for improving students' responses as well as proactive thinking and behavior toward disaster mitigation (Ikeda et al., 2021). In addition, combining a game-based learning package with Kolb's experience learning cycle has a significant effect on students' skills of preventing disasters, learning interest, self-awareness, and sense of responsibility (Tsai et al., 2020). Exactly, integrating disaster mitigation in the science learning curriculum is an effective way to increase disaster literacy and mitigation. Yet, there is still limited research focusing on the development of natural science learning models based on disaster mitigation. Therefore, the present study tries to fill the gap by providing a direction for the development of science learning based on the incorporation of disaster mitigation contents in order to enhance students' literacy on disaster and mitigation.

2. Theoretical Framework

Disaster literacy is a new concept introduced by Brown et al. (2014), which is taken from health literacy and refers to individuals' ability to access, interpret, and fully utilize disaster information in order to make disaster mitigation, preparation, response, and recovery decisions (D. Zhang et al., 2021). Disaster literacy is perceived as a person's capability to read, comprehend, and apply information to make wise decisions and follow instructions in the context of preparing, responding, mitigating, and recovering from a

disaster (Brown et al., 2014; Chung & Yun, 2016; Sampurno et al., 2015). Also, disaster literacy can also be seen as a component of a non-structural approach that emphasizes one's familiarity with disasters. In this case, this literacy can be used to assess and improve a person's and society's preparedness for a disaster. This shows that disaster literacy is closely related to an individual's ability required in facing disaster within the three phases including pre disaster, whilst disaster, and post disaster (Mufit et al., 2020). In short, disaster literacy is a person's ability to obtain information related to a disaster, how to mitigate it, and how to recover when a disaster occurs.

There are several types of indicators used for disaster literacy skills in several studies (See Table 1).

Table 1. Indicators of disaster literacy

Sources	Indicators of Disaster Literacy
Kesumaningtyas et al. (2022)	Functional disaster literacy, basic disaster literacy, critical disaster literacy, and communicative/interactive disaster literacy.
Asshiddiqi et al. (2021) & Firaina et al. (2019)	Disaster signs, disaster impacts, understanding of disasters, and disaster risk reduction.
Nurwin et al. (2015)	Emergency response planning skills, knowledge of minimizing disaster risk, and simulation activities.
Setyastuti et al. (2016)	Criticize and evaluate problems in various disaster contexts, make appropriate judgments about disaster situations, show evidence, interpret disaster, distinguish scientific/non-scientific questions, use knowledge to explain, evaluate, and interpret data in several disaster situations, and use knowledge to provide explanations related to the disaster context.
Chung and Yun (2016)	Disaster prevention attitude (prevention values, prevention awareness, and prevention sense of responsibility), Disaster prevention knowledge (disaster preparedness knowledge, disaster knowledge, and response knowledge), and disaster prevention skills (response behavior and preparedness action)

In terms of its operation definition, variable disaster mitigation literation can be understood as the sequence of knowledge comprising all aspects required to improve disaster risk reduction. Thus, the understanding of disasters, their signals, causes, impacts, and risk reduction can all be considered as indicators of disaster literacy (Suharini et al., 2020). The essential basis for disaster prevention and rescue operations will be laid by disaster preventive education (Chung & Yun, 2016). Disaster preparedness education offers knowledge and skills to save and sustain life, especially for children and youngers both during and after disasters. Disaster risk decrease is crucial for this reason. It lessens the probability that an accident will have negative effects. So, it is very important to learn and have disaster literacy skills as early as possible. There are a number of strategies to reduce disaster risk, such as disaster risk reduction and resilience education programs for children and youth in the Australian context, which have been incorporated into Australia's guiding disaster policy (Ronan et

al., 2016). Since 2006, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and the United Nations International Strategy for Disaster Risk Reduction (UNISDR) have promoted disaster prevention education in schools as a means of incorporating disaster risk reduction knowledge into relevant school curricula and encouraging the application of disaster-resistant building codes to school buildings for the improvement of campus safety. In Indonesia, The Ministry of Education and Culture wants to spread information on disaster risk reduction, safe learning environments, and school disaster management through teachers and facilitators to uphold children's rights to protection, security, and survival as well as their right to receive quality and lasting basic education (Nurwin et al., 2015).

The study by Chung and Yun (2016) aims at investigating Taiwanese school teachers' knowledge of disaster avoidance. The findings indicated that the participants scored highest on disaster prevention skills and lowest on disaster prevention knowledge, out of the three dimensions of disaster prevention literacy (knowledge, attitude, and skills). A similar study was carried out by Uchida et al. (2021). The results of the post-questionnaire on the design and implementation of an ICT-based disaster prevention and mitigation education program for the younger generation demonstrate that the developed disaster education program was well received by many participants. Mubarak et al. (2019) conducted research for contrasting the effectiveness of the training and instructional video screening and control. The results showed that training improved the capability of disaster prevention and mitigation more than that of the instructional video screening and control.

A number of literature review studies only focus on the integration between physics teaching materials and disaster literacy (Mufit et al., 2020), STEM (Science, Technology, Engineering, and Mathematics) and disaster education for building students' disaster literacy (Sampurno et al., 2015), and STEM and a proposed disaster literacy model (Brown et al., 2014). A few of literature review studies also have reported regarding disaster literacy and public health (Çallşkan & Üner, 2021), and the shape of disaster education (Subarno & Dewi, 2022). There are, however, no systematic review studies specifically focusing on disaster literacy and its mitigation education whereby it can provide the global trend in the last decade regarding disaster literacy and its mitigation education, and be future directions to develop disaster mitigation-based science learning model. Particularly, the following research questions are proposed to achieve the aim of this study.

1. What are the global trends and mainly emerging themes in disaster literacy studies and its mitigation education in the last decade?

2. How is the effect of disaster mitigation education on students' disaster knowledge?

3. How are the profile of students' disaster knowledge and the ways to mitigate disaster risk and integrate it in science learning by learning model?

3. Method

To present the trends of disaster literacy studies and its mitigation during one last decade and directions for developing disaster mitigation-based science learning model, additionally describe and analyze disaster knowledge, and examine the effect of disaster mitigation education on the enhancement of disaster knowledge, a systematic review combining among bibliometric analysis, meta-analysis, and meta-synthesis was carried out. Moreover, Donthu et al. (2021) stated that bibliometric analysis is a well-known and rigorous method to explore and analyze the large volumes of scientific data in which it can get a one-step overview, acquire novel ideas for next researches, and recognize knowledge gaps. Then, Suparman and Juandi (2022a, 2022b) argued that meta-analysis is

a series of quantitative methods for estimating and examining the effect of an intervention on dependent variables from some previously relevant studies in a certain topic. Meanwhile, Finfgeld-Connett (2018) defined qualitative meta-synthesis as a qualitative procedure aimed to generate theory across primary qualitative investigations. These analyses were used to conduct this present study. Generally, the procedure to perform this present study consisted of systematic review combined to bibliometric analysis and systematic review combined to meta-analysis and qualitative meta-synthesis.

3.1. Systematic Review and Bibliometric Analysis

Firstly, it would be explained regarding the stages to carry out bibliometric analysis. A lot of bibliometric literatures stated that there were five phases to perform bibliometric analysis, such as: (1) specifying the search keyword, (2) exploring initial search results, (3) refining the documents, (4) compiling the initially statistical data, and (5) analyzing the data (Fuad et al., 2022; Muhammad et al., 2022; Sulistiawati et al., 2023; Suyanto et al., 2023). In detail, each stage to perform bibliometric analysis in this current study was explained in the following subsections.

3.1.1. Specifying the Search Keyword

Scopus database was utilized to find the documents related to disaster literacy studies because this database had a lot of electronically well-qualified documents from numerous scientific fields (Fuadi et al., 2021; Jaya & Suparman, 2021). Specifically, some combinational keywords, such as “disaster literacy” OR “disaster knowledge” OR “disaster mitigation education” were applied to seek the prospective documents which were suitable to disaster literacy studies. The search process of documents in Scopus database was conducted in early September, 2023, specifically at 11.59 PM in Western Indonesian Time.

3.1.2. Exploring Initial Search Results

The results of initial search found 15,151 documents published between 1911 and 2024 and sourced from journal, conference proceeding, book, and book series. Subject area of documents covered social sciences, medicine, engineering, environmental sciences, earth and planetary sciences, computer sciences, business, management & accounting, nursing, mathematics, arts & humanities, agricultural and biological sciences, decision sciences, energy, physics & astronomy, psychology, economics, econometrics & finance, biochemistry, genetics & molecular biology, chemistry, pharmacology, toxicology & pharmaceutics, immunology & microbiology, neuroscience, veterinary, and dentistry. The type of document was such as article, conference paper, review, book chapter, book, conference review, editorial, note, short survey, letter, erratum, data paper, and abstract report whereby the documents were written in English, Chinese, Spanish, German, French, Japanese, Portuguese, Russian, Italian, Persian, Croatian, Polish, Slovenian, Turkish, Dutch, Swedish, Norwegian, Korean, Greek, Czech, Thai, Slovak, Indonesian, Danish, African, Ukrainian, Serbian, Hungarian, Malay, Lithuanian, Icelandic, Bulgarian, and Bosnian. Additionally, the publication stage of documents was in final and in press.

3.1.3. Refining the Documents

To get the eligible documents related to disaster literacy studies, several inclusion criteria were decided. Firstly, the title of document had to contain the keywords, such as “disaster management”, “disaster prevention”, “disaster planning”, “disaster preparedness”, “disaster risk reduction”, “disaster response”, and “disaster mitigation”. Secondly, the document was only written in English and it had been finally published. Thirdly, all of documents were article published in the period of 2014 - 2023 and they were sourced from journal. Fourthly, the subject area of documents covered social sciences, environmental sciences, earth and planetary sciences, arts and humanities, and multidisciplinary. As a consequence, the documents which did not meet the inclusion criteria were removed from the selection process. Many literatures stated that there were

four stages to select the document systematically, such as: (1) identification, (2) screening, (3) eligibility, and (4) inclusion (Helsa et al., 2023; Juandi, Suparman, et al., 2022; Juandi, Tamur, et al., 2022; Suparman et al., 2022; Susiyanti et al., 2022; Yunita et al., 2022). The process of document selection is presented in Figure 1.

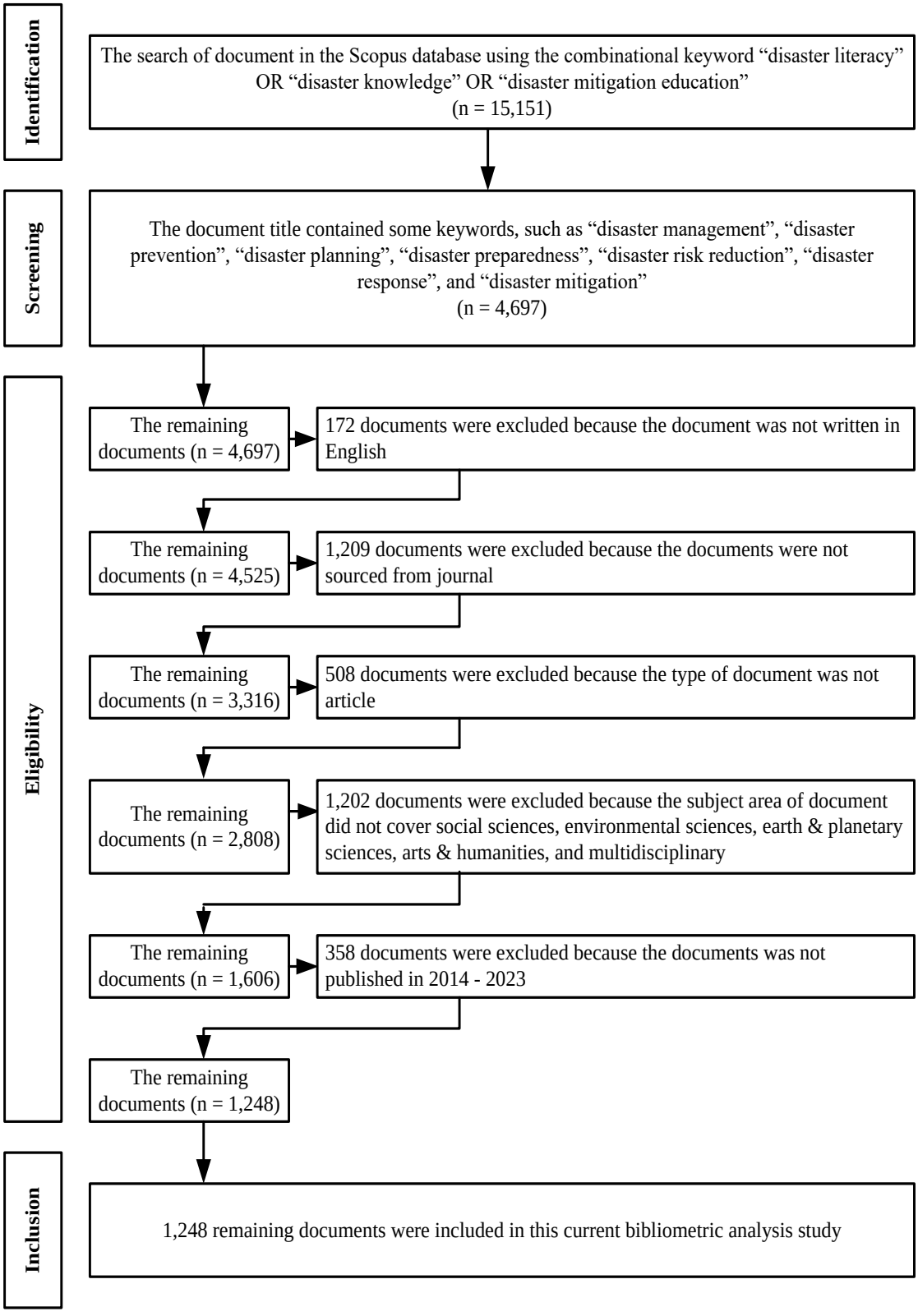

Figure 1. The process of document selection

3.1.4. Compiling the Initially Statistical Data

The eligible documents were obtained from the Scopus database in two versions: Comma Separated Values (CSV) and Research Information System (RIS), each of which contained bibliometric data, abstracts, keywords, and bibliographic data (Muhammad et al., 2022). Additionally, the Perish or Publish (PoP) software's RIS format supplied information on authors, the number of document citations they received, document titles, publishing years, document sources, publishers, and the types of documents they created (Suyanto et al., 2023). Moreover, the introduction of PoP software provided a summary of the descriptive analysis, including the number of publications (TP), the number of citations (TC), the number of citations per publication (NCP), the number of authors per publication (NAP), the h-index, the g-index, and the years between publications and citations (Muhammad et al., 2022). Meanwhile, the CSV format provided in the VOSviewer software showed the most publications and citations based on some categories including author, country, source, and institution. It also showed keyword occurrence, the strength of the relationship overall, various visualizations, and clustering (Suyanto et al., 2023).

3.1.5. Analyzing the Data

To examine the data, several analyses were undertaken, including performance analysis and co-word analysis. Specifically, performance analysis was used to demonstrate the development of publication and citation of disaster literacy studies during the last decade. Meanwhile, co-word analysis was employed to present the most frequently emerging keywords and the distribution of appearing keywords related to disaster literacy studies in the current period in which at least it could provide some themes to propose future directions for developing disaster mitigation-based science learning model. Co-word analysis was enriched by some additional analyses, such as visualization analysis and thematic analysis. According to Fuad et al. (2022), performance analysis could be supported by the software of PoP while the software of VOSviewer supported another analysis like as co-word analysis.

3.2. Systematic Review and Meta-Analysis & Qualitative Meta-Synthesis

Secondly, it would be explained related to the phases to conduct a systematic review combined to meta-analysis and meta-synthesis. Many literatures stated that there were seven phases to perform systematic review, such as: (1) defining research problem, (2) deciding the inclusion criteria, (3) searching the document, (4) selecting the document, (5) coding the data, (6) analyzing the data, and (7) interpreting the results and making a report (Suparman, Juandi, et al., 2021a, 2021b). In detail, each phase to carry out systematic review combined to meta-analysis and meta-synthesis in this present study was explained in the following subsections.

3.2.1. Deciding the Inclusion Criteria

The search of documents related to disaster mitigation education and disaster literacy using electronical search engine could appear a lot of potential documents. This implied that some inclusion criteria had to be decided to limit the research questions. The inclusion criteria were such as: (1) participants in the document covered pre-school students, primary and secondary students, and college students in Indonesia; (2) the research approach in the document was quantitative or qualitative using a few research designs, such as quasi-experiment research or descriptive research; (3) the document was empirical article written in English, sourced from journal, published between 2018 and 2023, and indexed by Google Scholar or Scopus; (4) the intervention in most of documents was disaster mitigation education applying some learning models, such as thematic learning, problem-based learning, and project-based learning assisted by e-book, educational games, pocket book, and innovative booklet; (5) the outcome in the document was disaster knowledge or disaster literacy; and (6) of all documents, some documents

reported the adequate statistical data to calculate the effect size, and some documents provided descriptively statistical information and qualitative information related to disaster knowledge or disaster literacy. These inclusion criteria became the guidelines in searching and selecting the document.

3.2.2. Searching and Selecting the Document

A few of combinational keywords, such as “disaster mitigation education AND disaster knowledge” or “disaster mitigation education AND disaster literacy” were applied to search documents in several electronical databases, such as Google Scholar, Semantic Scholar, DOAJ, ERIC, and Science Direct. Then, Moher et al. (2009) stated that there were four phases in selecting the document systematically consisting of identification, screening, eligibility, and inclusion. The process of document selection for meta-analysis and meta-synthesis in this current study is presented in Figure 2.

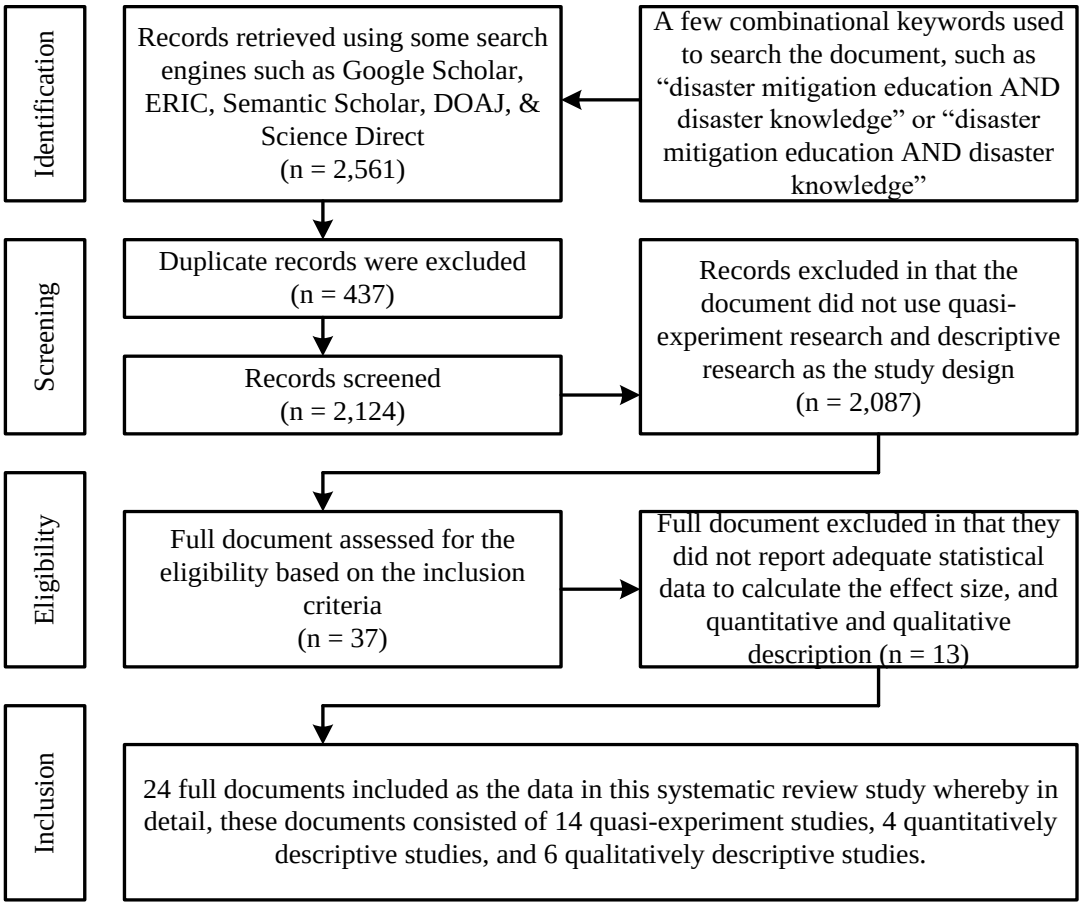

Figure 2. PRISMA flow-diagram of document selection for meta-analysis and meta-synthesis

3.2.3. Extracting the Data

The coding sheet was used to facilitate extracting process of the substantial information from each document. The information consisted of statistical data, categorical data, and descriptively quantitative and qualitative data. Particularly, statistical data covered mean, deviation standard, sample size, and p-value (See Tabel 2).

Table 2. The information related to statistical data

Authors	Experiment Group			Control Group			P-value
	Mean	DS	N	Mean	DS	N	
Nurfalah et al. (2022)	10.00	2.17	5	6.80	1.35	5	
Atmojo et al. (2018)	72.34	4.25	30	41.37	2.93	30	
Noviana et al. (2021)	79.70	6.21	72	60.30	4.37	72	
Juhadi et al. (2021)	81.35	7.21	30	51.92	5.32	30	
Rahayuni et al. (2022)	87.63	5.69	52	58.52	11.29	52	
Nugroho and Daniamiseno (2022)	81.05	8.25	30	41.23	3.73	30	
Septaria and Dewanti (2021)	85.31	11.62	30	61.73	8.21	30	
Rifai (2018)	73.21	8.71	30	34.46	3.34	30	
Rusilowati et al. (2012)	81.42	9.36	30	54.21	5.63	30	
Nurcahyo and Winanti (2021)			33			33	0.002
Mahmudah and Fauzia (2022)			12			12	0.661
Proulx and Aboud (2019)			102			101	0.003
Ilyasa et al. (2020)			31			20	0.001
Suharini and Baharsyah (2020)			30			29	0.002

Meanwhile, categorical data consisted of research approach, design research, participant's educational level, school geographical location, disaster type, and scientific field (See Table 3).

Table 3. The information related to categorical data

Categorical Data	Groups	Frequency	Percentage
Research approach	Quantitative	18	75.00%
	Qualitative	6	25.00%
Research design	Quasi-experimental research	14	58.33%
	Descriptive research	10	41.67%
Participant's educational level	Pre-school	3	12.50%
	Primary school	9	37.50%
	Secondary school	10	41.67%
	College/University	2	8.33%
School geographical location	Java	10	41.67%
	Sumatera	8	33.33%
	Borneo	1	4.17%
	Celebes	1	4.17%
	Bali & South-east Nusa	4	16.67%
Disaster Type	General	15	62.50%
	Volcanic eruption	3	12.50%

	Earthquake	5	20.83%
	Landslide	1	4.17%
Scientific Field	Environmental education	16	66.67%
	Geography education	3	12.50%
	Science education	3	12.50%
	Natural science	1	4.17%
	Physics education	1	4.17%

On the other hand, descriptively quantitative and qualitative data contained quantitative and qualitative information (See Table 4).

Table 4. The information related to descriptively quantitative and qualitative data

Authors	Quantitative or Qualitative Results
Atmojo (2021)	The average of students' disaster knowledge is 51.50% and categorized as enough knowledge (n = 99 students).
Najid et al. (2021)	The average of students' disaster knowledge is 44.85% and categorized as less knowledge (n = 121 students).
M. I. Shofa et al. (2021)	The average of students' disaster knowledge is 73.33% and categorized as enough knowledge (n = 26 students).
Sahidu et al. (2021)	The average of students' disaster knowledge is 78.80% and categorized as enough knowledge (n = 26 students).
Ihsan et al. (2022)	The steps to mitigate the disaster consist of (1) the concept of the situation, (2) mitigation practices, (3) knowledge of evacuation routes, and (4) cooperation in mitigation practices.
Noviana et al. (2021)	Students can define disaster mitigation as an endeavor to limit or eliminate risks and disaster effects, identify natural and non-natural disasters, and discuss disaster management procedures.
Ayub et al. (2021)	Disaster mitigation tools in learning environment significantly contributes on students' disaster knowledge.
Opilah et al. (2023)	There is no exist of physics materials integrated in disaster mitigation education so that it affects students' low disaster knowledge.
Pradina and Pratama (2021)	Disaster mitigation education using pocket booklet is one of the solutions in enhancing students' disaster knowledge.
Oktaria et al. (2023)	Students' disaster literacy skills in designing materials in disaster mitigation education is low.

To guarantee that the data extracted was valid and reliable to be used and subsequently evaluated, two specialists in meta-analysis and meta-synthesis study - statistics and mathematics lecturers - participated in the process of data extraction (Vevea et al., 2019). To gauge the consistency of the coders, the Cohen's Kappa test was applied. Overall, Kappa score of 0.91 indicated that the level of agreement among coders was nearly flawless (McHugh, 2012). This means that the data coded in this recent study had been valid and eligible to be analyzed.

3.2.4. Analyzing the Data

In a literature, Cooper et al. (2013) mentioned that statistical data used in meta-analyses frequently led to publication bias. This suggested that a number of publishing bias analyses would need to be carried out, including funnel plot analysis and the fill and trim test. Since all of the empirically primary studies participating in this meta-analysis had some heterogeneities in research participant, educational level, class capacity, instruments, and other factors, random effect model was chosen as an estimated model (Helsa et al., 2023). Additionally, the Hedge's formula was selected to compute the effect size in that it facilitated studies which had relatively small sample size (Suparman & Juandi, 2022a, 2022b). Moreover, Cohen et al. (2018) categorized the effect size into four classifications, such as: $g = 0.00 – 0.20$ (weak), $g = 0.21 – 0.50$ (modest), $g = 0.51 – 1.00$ (moderate), and $g > 1.00$ (strong). Then, to examine the significance of the effectiveness of disaster mitigation education on students' disaster knowledge, the Z test was conducted. Subsequently, the percentage was used as a measurement unit to describe the profile of students' disaster knowledge in which Suparman, Jupri, et al. (2021) classified it into three categories, such as: 0 – 50% (less knowledge), 51% - 80% (enough knowledge), and 81% - 100% (good knowledge). Meanwhile, thematic analysis was performed to describe qualitative results (Finfgeld-Connett, 2018). All calculations and also analyses were assisted by a few software, such as Comprehensive Meta-Analysis (CMA) and Ms. Excel.

4. Results

4.1. Bibliometric Analysis

In total, 1,248 eligible and qualified articles concerning disaster literacy studies and its mitigation were used as the data. The articles were taken from electronic journals and published between 2014 and 2023. The texts were also written in English and covered a variety of topics, including multidisciplinary, social sciences, environmental sciences, earth and planetary sciences, and arts and humanities. In this study, various analyses were carried out, including performance analysis and co-word analysis enhanced by network analysis. Each analysis was described and discussed in the following subsections.

4.1.1. Performance Analysis

The analysis was used to demonstrate the growth in the publication and citation of research on disaster literacy and its mitigation over the previous ten years. Figure 3 shows the development of disaster literacy studies' publication and citation trends as well as its mitigation.

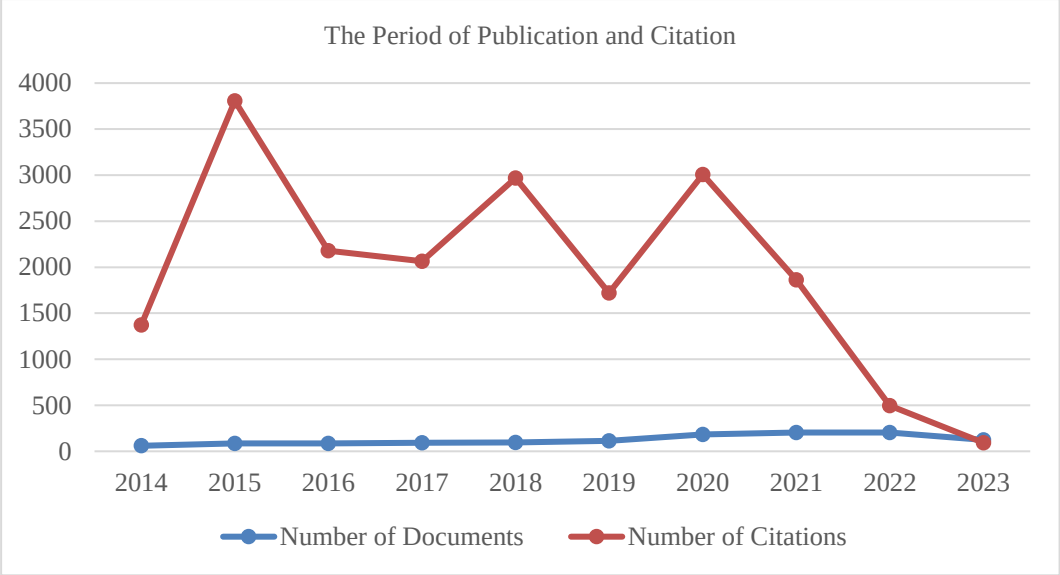

Figure 3. The development of publication and citation regarding disaster literacy studies and its mitigation in one last decade

During one last decade, a lot of electronical journals had published 60 documents related to disaster literacy studies and its mitigation in 2014, followed by 85 documents in 2015, 86 documents in 2016, 92 documents in 2017; 97 documents in 2018, 113 documents in 2019, 183 documents in 2020, 204 documents in 2021, 204 documents in 2022, and 124 documents in 2023. This presents that the development of publications of disaster literacy studies and its mitigation slightly increased from 2014 to 2023. This means that disaster literacy and its mitigation is a research topic adequately interested by lots of researchers in the fields, such as social sciences, environmental sciences, earth and planetary sciences, arts and humanities, and multidisciplinary. Meanwhile, in the period of 2014 – 2023, the documents regarding disaster literacy studies and its mitigation had been cited as many as 1,373 times in 2014, followed by no citation in 2002, 101 times in 2003, 282 times in 2004, 46 times in 2005, 19 times in 2006, 3,806 times in 2015, 2,179 times in 2016, 2,063 times in 2017, 2,969 times in 2018, 1,722 times in 2019, 3,008 times in 2020, 1,863 times in 2021, 495 times in 2022, and 93 times in 2023. This shows that the development of citations of documents which studied disaster literacy and its mitigation relatively fluctuated. This indicates that the influence of published documents does not undergo consistently on disaster literacy studies and its mitigation in one last decade.

4.1.2. Co-word Analysis

The distribution of appearing keywords and frequently emerging terms in relation to disaster literacy studies and its mitigation in the current period was shown using co-word analysis. Moreover, at least it provided the novelty or the research gap as future directions for developing disaster mitigation-based science learning model. The network visualization analysis was conducted for showing the most frequent emerging keywords regarding disaster literacy studies and its mitigation. The minimum number of occurrences of a keyword as many as three occurrences were selected, so 71 interconnected keywords appeared (See Figure 4).

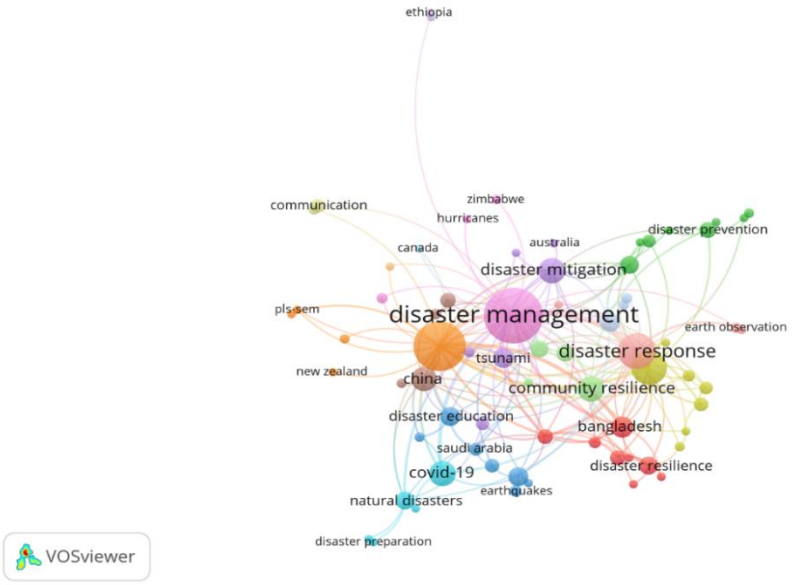

Figure 4. The network visualization of emerging keywords on disaster literacy studies and its mitigation

Subsequently, thematic analysis was conducted to group some similarly emerging keywords into a theme (See Table 5).

Table 5. The theme of emerging keywords regarding disaster literacy studies and its mitigation education

Theme	Keyword	Frequency
Disaster Type	Climate Change	47
	COVID-19	27
	Tsunami	18
	Floods	15
	Natural disasters	14
	Landslides	14
	Earthquakes	6
	Coastal Hazards	4
	Extreme Weather	4
	Hurricanes	3
	Typhoon	3
	Wildfire	3
	Seismic Hazard	3
Country Which Often Happened Disaster	China	25
	Bangladesh	20
	Indonesia	12
	Philippines	12
	Nepal	10

	Japan	7
	Saudi Arabia	7
	India	7
	Pakistan	6
	Thailand	5
	South Africa	5
	Malaysia	5
	Italy	4
	Mexico	3
	United States	3
	Serbia	3
	New Zealand	3
	Fiji	3
	Ghana	3
	Myanmar	3
	Australia	3
	Zimbabwe	4
	Ethiopia	3
	Uganda	3
	Canada	3
Learning Environment in Disaster Mitigation Education	Machine Learning	9
	Deep Learning	5
	Social Learning	3
The Ways to Mitigate Disasters	Collaboration	8
	Communication	8
	Coordination	7
	Simulation	5
	Earth Observation	5
	Early Warning	3
	Storytelling	3
Methodology	Survey	3
	Qualitative Research	3
	Structural Equation Model	3
	PLS-SEM	3
	Case Study	3
Disaster and Its Mitigation	Disaster Preparedness	129

Disaster Response	102
Disaster Mitigation	53
Disaster Management	28
Community Resilience	27
Disaster Education	15
Disaster Planning	15
Disaster Resilience	14
Disaster Prevention	11
Disaster Recovery	10
Crisis Management	8
Disaster Knowledge	6
Disaster Awareness	4
Climate Adaptation	4
Stakeholder Engagement	4
Disaster Preparation	3
Adaptive Capacity	3
Psychological Preparedness	3

Thematic analysis shows that at least there were six mainly emerging themes regarding disaster literacy studies and its mitigation, such as disaster type, country which often happened disasters, learning environment in disaster mitigation education, the ways to mitigate disasters, methodology, and disaster & its mitigation.

4.2. Meta-Analysis

4.2.1. Publication Bias

The funnel plot was used to describe the distribution of effect size data (See Figure 5). From Figure 5, it could be stated that a set of effect size data in the plot was symmetrical. This means that the statistical data used to calculate the effect size does not have the indication of publication bias. In a literature, Fuadi et al. (2021) argued that the symmetrical distribution of a set of effect size data in the funnel plot indicates that there is no publication bias to statistical data.

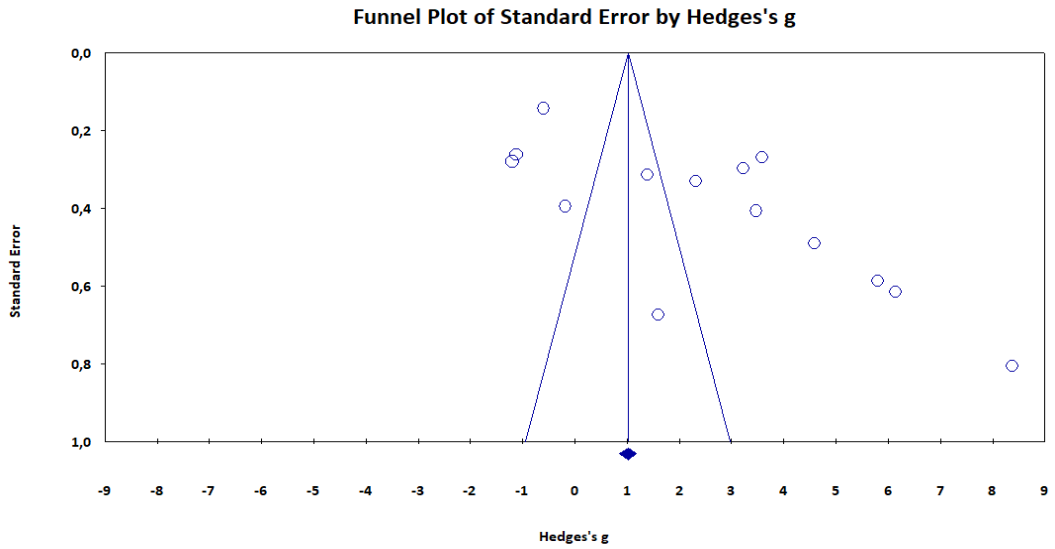

Figure 5. The results of funnel plot analysis

Moreover, the fill and trim test was used to justify the symmetry of a set of effect size data in the funnel plot (See Table 6).

Table 6. The results of fill and trim test

	Studies Trimmed	Effect Size in g Unit	Q-value
Observed Values		2.6146 [1.3224; 3.9069]	739.1354
Adjusted Values	0	2.6146 [1.3224; 3.9069]	739.1354

From Table 6, it can be seen that there was no data of effect size that had to be excluded from the set of effect size data. It means that absolutely the distribution of effect size data in the funnel plot is indeed symmetrical. This provides strong evidence that the statistical data involved in this recent study to measure the effect size is eluded from the phenomenon of publication bias.

4.2.2. Estimated Effect Size and Its Significance

The calculation of the statistical data using the Hedge's formula generated several heterogeneous effect sizes, from negative to positive, from no significant to significant, and from weak to strong (See Table 7).

Table 7. The results of summary and estimation of effect size

Authors	Effect Size in g Unit	Z-value	P-value
Nurfalah et al. (2022)	1.599 [0.278; 2.920]	2.373	0.018
Atmojo et al. (2018)	8.374 [6.795; 9.954]	10.392	0.000
Noviana et al. (2021)	3.594 [3.067; 4.121]	13.363	0.000
Juhadi et al. (2021)	4.585 [3.624; 5.545]	9.356	0.000
Rahayuni et al. (2022)	3.232 [2.650; 3.814]	10.888	0.000
Nugroho and Daniamiseno (2022)	6.139 [4.932; 7.346]	9.972	0.000
Septaria and Dewanti (2021)	2.313 [1.665; 2.962]	6.990	0.000
Rifai (2018)	5.798 [4.647; 6.950]	9.870	0.000
Rusilowati et al. (2012)	3.477 [2.679; 4.275]	8.542	0.000
Nurcahyo and Winanti (2021)	-1.121 [-1.635; -0.607]	-4.276	0.000

Mahmudah and Fauzia (2022)	-0.175 [-0.949; 0.599]	-0.444	0.657
Proulx and Aboud (2019)	-0.597 [-0.877; -0.317]	-4.178	0.000
Ilyasa et al. (2020)	1.391 [0.775; 2.007]	4.427	0.000
Suharini and Baharsyah (2020)	-1.195 [-1.743; -0.648]	-4.276	0.000
Estimated effect size	2.615 [1.322; 3.907]	3.966	0.000

From Table 7, it can be stated that the estimated effect of disaster mitigation education on students' disaster knowledge was 2.615 in which this means that disaster mitigation education has positive strong effect on students' disaster knowledge. Moreover, the estimated significance value of the Z test was less than 0.05. This shows that disaster mitigation education significantly enhances students' disaster knowledge. In another word, it indicates that disaster mitigation education applying some learning models, such as thematic learning, problem-based learning, and project-based learning assisted by e-book, educational games, pocket book, and innovative booklet is effective in enhancing students' disaster knowledge or students' disaster literacy.

4.3. Meta-Synthesis

4.3.1. Descriptive Analysis in Percentage

Four studies carried out by Atmojo (2021), Najid et al. (2021), M. I. Shofa et al. (2021), and Sahidu et al. (2021) provided the information related to the profile of students' disaster knowledge (See Table 8).

Table 8. The profile of students' disaster knowledge

Documents	Percentage	Category
Atmojo (2021)	51.50%	Enough
Najid et al. (2021)	44.85%	Less
M. I. Shofa et al. (2021)	73.33%	Enough
Sahidu et al. (2021)	78.80%	Enough
Average	62.12%	Enough

From Table 8, it can be stated that the average of students' disaster knowledge was 62.12% and it was categorized as enough knowledge. This indicates that overall, students relatively have enough disaster knowledge. As a consequence, the practical and effective disaster mitigation education is really required to enhance students' disaster knowledge.

4.3.2. Thematic Analysis

Six studies worked by Ihsan et al. (2022), Noviana et al. (2021), Ayub et al. (2021), Opilah et al. (2023), Pradina and Pratama (2021), and Oktaria et al. (2023) provided the qualitative information related to disaster mitigation education and disaster knowledge (See Table 9).

Table 9. The qualitative information

Documents	Qualitative Results
Ihsan et al. (2022)	The steps to mitigate the disaster consist of (1) the concept of the situation, (2) mitigation practices, (3) knowledge of evacuation routes, and (4) cooperation in mitigation practices.
Noviana et al. (2021)	Students perceive disaster mitigation as an endeavor to lessen risks and the effects of disasters, identify both natural and non-natural disasters, and highlight disaster management practices.

Ayub et al. (2021)	Disaster mitigation tools in learning environment significantly contributes on students' disaster knowledge.
Opilah et al. (2023)	There is no exist of physics materials integrated in disaster mitigation education so that it affects students' low disaster knowledge.
Pradina and Pratama (2021)	Disaster mitigation education using pocket booklet is one of the strategies for enhancing students' disaster knowledge.
Oktaria et al. (2023)	Students' disaster literacy skills in designing materials in disaster mitigation education is low.

5. Discussion

5.1. Global Trends and Mainly Emerging Themes in Disaster Literacy Studies and Its Mitigation Education

The trends of research publications related to disaster literacy and mitigation slightly increased from 2014 to 2023. This shows that disaster literacy and mitigation are research topics that are of great interest to many researchers. In line with Fitriah et al. (2021), the trend of studies related to disaster risk reduction education also shows the development of publications which tends to increase in the 2017-2022 period. In addition, Saputri (2020) revealed that the development of publications related to natural disaster education in schools had increased quite significantly from 2015 to 2019. Furthermore, Sharma and Rao (2021) revealed that the number of publications on disaster risk reduction increased from time to time, especially between 2017 and 2020. Salam et al. (2018) also revealed that the results of their analyses showed a rapid increase in the last 20 years in the number of documents related to climate change literacy, particularly in the period of 2013 – 2021. These reports show that the trend of publications related to disaster literacy and mitigation has continued to increase in the last decade. Essentially, disaster literacy and its mitigation have a very important role for students in dealing with disasters. These reasons support why the trend of research publications related to disaster literacy and mitigation has continued to increase in the last decade. On the other hand, document citations related to disaster literacy and mitigation slightly decreased in the period of 2014 - 2023. This shows that the longer a document is published, the more citations the document will receive. In line with this, Salam et al. (2018) stated that the trend of citations for studies related to climate change literacy decreased between 2018 and 2021. This means that the influence and contribution of documents to various scientific fields greatly determine the number of citations on these documents. This reflects that the most influential documents having the highest contribution to disaster literacy and mitigation will support the development of other studies citing these documents.

Hierarchical clustering analysis shows that there are at least six main themes that emerge regarding the study of disaster literacy and mitigation. The first theme relates to the types of disasters such as climate change, Covid-19, tsunamis, floods, natural disasters, landslides, earthquakes, extreme weather, storms, typhoons, fires and seismic hazards. A study carried out by Kesumaningtyas et al. (2022) indicated a substantial correlation between students' behavioral responses to disaster literacy and the danger of earthquakes. Additionally, the degree to which disaster literacy affects students' readiness to mitigate tsunami events also has a significant impact (Aziz & Hidayati, 2019). The second theme relates to countries where disasters often occur, such as China, Bangladesh, Indonesia, the Philippines and Nepal. Research on disaster literacy in China revealed that pupils' overall disaster literacy scores fell into the low range (S. Zhang et al., 2021). In the same vein, in Indonesia, after students take part in science environment technology and society (SETS) based learning, students' disaster literacy is in the high category (Mustadi & Atmojo, 2020). As a result, it is a crystal clear that pupils need to receive disaster literacy

education. Thus, families, communities, schools, institutions, and the government must emphasize disaster literacy education for children.

The third theme relates to the learning environment in disaster mitigation education such as machine learning, deep learning, and social learning. Machine learning is a technological innovation that has been widely applied in various areas of life and can also be used to improve disaster mitigation such as floods (Riza et al., 2020). Moreover, deep learning has also been used for various types of disasters including earthquakes, hurricanes, landslides, etc. (Linardos et al., 2022). Research related to social learning has also been carried out, namely by exploring opportunities for applying social learning to reduce disaster risk (Murti & Mathez-Stiefel, 2019). Hence, countries with more disaster mitigation innovations have fewer fatalities (Miao, 2017). The fourth theme relates to disaster mitigation methods such as collaboration, communication, coordination, simulation, earth observation, early warning, and storytelling. After disaster literacy and disaster mitigation efforts have been carried out, the community also needs to build preparedness by accessing early disaster warnings, either in local media such as kentongan or digital media which can be accessed via cell phone (Prakoso et al., 2021).

The fifth theme relates to the methodology used in conducting disaster literacy studies where there are several analyzes carried out to analyze data such as surveys, qualitative research, structural equation models, PLS-SEM, and case studies. Surveys are mostly applied in several studies to determine the extent of integration of disaster literacy into learning in schools (Mufit et al., 2020), while qualitative research has also been carried out in several studies to determine students' behavior in facing disasters through disaster literacy (Fauziah & Caswita, 2020). This shows that analysis is becoming a trend in conducting disaster literacy studies. The sixth theme is related to disasters and their mitigation, such as disaster management and disaster preparedness. The results of the study confirmed that maximizing school literacy movement that promote disaster literacy can improve community understanding, disaster preparedness, and disaster risk reduction. Three stages—habituation, development, and learning activities—are included in the strategy and pattern for putting the school literacy movement into practice. The family's role will contribute to disaster literacy in which it offers community experience and knowledge based on their living conditions. Technology advancements can also benefit society by giving literacy resources and quick access to information about natural disasters (Triyanto et al., 2021).

5.2. The Effect of Disaster Mitigation Education on Students' Disaster Knowledge

Disaster education for young learners (childhood) is very important to reduce the risk of disasters. The large number of victims is caused by a lack of knowledge about disaster mitigation efforts. All disaster impacts have resulted in distress and sadness for many people which lead to the need for the preparedness of facing disasters. The aim of the disaster education program is not only to transfer knowledge by teachers to students, but also to change the students' mindset. With this disaster education program, it is expected that teachers will be able to teach disaster learning well and correctly so that students are able to prepare for the threat of disasters in the school environment. The importance of disaster education has a great influence on students' knowledge in order to make students knowing how to behave and act when a disaster occurs (Eka, 2020).

Students' understanding of how to act in a self-protective behavior during a disaster can be improved by taking part in disaster education. Mostly, disaster education will only be conducted if a disaster has already happened and gradually decreases when a disaster has not come for a long time. As a result, communities that are vulnerable to disasters become less prepared. Here, preparedness refers to any action enabling governments, organizations, society, communities, and individuals to be able to respond to a disaster situation rapidly and appropriately. Preparedness comprises several issues including preparing disaster management, maintaining resources, and personal training (Widjanarko & Minnafiah, 2018). Furthermore, Kurniawati and Suwito (2019) stated that the greater

the students' knowledge of disasters, the higher their preparedness would be. Therefore, training and education should be carried out regularly for the purpose of making student preparedness to be always in an optimal level.

5.3. The Profile of Students' Disaster Knowledge and the Construction to Develop Disaster Mitigation-based Science Learning Model

To create a culture of safety and resilience for all aspects, disaster risk reduction priorities need to be applied in the form of knowledge, innovation, and education. This is because school elements such as teachers, students, learning processes, facilities and infrastructure were affected by the disaster. As a means of enhancing students' preparedness for facing disasters, schools play an important role in disaster management initiatives. Here, disaster education must begin since the early ages. Socialization becomes one of the activities that can be carried out to reduce the impact of disasters (Mariamah et al., 2021). Socialization is conducted to enhance the awareness and preparedness toward disasters. Also, it improves students' knowledge in managing disasters (Ernawati et al., 2021).

Other activities that can be carried out to increase students' disaster knowledge are related to learning process. Atmojo (2021) conducted studies demonstrating how students' knowledge of disaster management may be reconstructed and increased through the use of Science, Environment, Technology, and Society (SETS) thematic learning blended with local wisdom. The necessity for disaster mitigation education to be taught in schools is a result of awareness of living in disaster-prone areas and understanding the severity of the danger of disaster consequences (Sahidu et al., 2021). Research conducted by Najid et al. (2021) shows that the level of students' knowledge on mitigating natural disasters in wetlands is in the appropriate category, namely 44.85%. Based on the previous research, understanding natural disaster mitigation includes several aspects including knowledge, emergency response planning, disaster warning, and resource mobilization. Furthermore, A. Shofa et al. (2021) obtained research results that the average level of teacher achievement in science learning integrated with disaster mitigation showed a score of 73.33%, indicating in a sufficient category (enough knowledge).

The current condition of disaster education shows that (1) teachers' lack of knowledge and understanding related to disaster risk reduction and (2) lack of distributed teaching guides, syllabi, and teaching materials resulting to the low capacity and skills integrating disaster risk reduction into in the curriculum. Disaster risk reduction can be integrated into subject matter, one of which is science subject. Yet, the integration of the two elements (disaster risk reduction and science subject) has not been conducted by many teachers at schools though students already learn about disasters in the science subject in general. Therefore, developing a science learning model based on disaster mitigation is very necessary for the sake of increasing students' disaster knowledge.

6. Conclusion and Implication

This research provides bibliometric information, meta-analysis, and meta-synthesis related to disaster literacy and its mitigation education. In the 2014-2023 period, disaster literacy and its mitigation education has become a research topic that is quite popular with many researchers from a number of fields, such as social sciences, environmental sciences, earth and planetary sciences, arts and humanities, and multidisciplinary. There are several big themes that emerge related to disaster literacy, such as types of disasters, countries where disasters often occur, the learning environment in disaster mitigation education, ways to mitigate disasters, methodology, and disasters and their mitigation. From the meta-analysis carried out, it is known that disaster mitigation education has a positive and strong influence on students' disaster knowledge. Furthermore, the meta-synthesis showed that overall, students had relatively sufficient knowledge of disasters.

There are many ways used to increase students' disaster literacy. One of them is

implementing disaster mitigation education programs that may give positive effects to students' disaster knowledge. Thus, researchers can develop innovative and effective disaster literacy interventions including strategies, approaches, and teaching activities to improve students' disaster literacy. One program that can be carried out to increase students' knowledge of disasters is by implementing a science learning model based on disaster mitigation which applies not only to some disasters, but to all disasters. To develop the learning model, this present study proposes four steps in mitigating disaster risks, such as: (1) situation concept, (2) mitigation practices, (3) knowledge of evacuation routes, and (4) cooperation in mitigation practices.

References

Ajar, S. B., & Ronggowulan, L. (2022). Disaster literacy level of teachers and students in secondary school case study in Surakarta City, Indonesia. IOP Conference Series: Earth and Environmental Science, 986(1), 1–6. https://doi.org/10.1088/1755-1315/986/1/012017

Asshiddiqi, M. R., Vitasari, M., & Biru, L. T. (2021). Validity of disaster e-book to improve disaster literacy skills at junior high school. Jurnal Pena Sains, 8(2), 79–87. https://doi.org/10.21107/jps.v8i2.12204

Atmojo, S. E. (2021). Natural disaster mitigation on elementary school teachers: Knowledge, attitude, and practices. JPI (Jurnal Pendidikan Indonesia), 10(1), 12–22. https://doi.org/10.23887/jpi-undiksha.v10i1.25060

Atmojo, S. E., Rusilowati, A., Dwiningrum, S. I. A., & Skotnicka, M. (2018). The reconstruction of disaster knowledge through thematic learning of science, environment, technology, and society integrated with local wisdom. Jurnal Pendidikan IPA Indonesia, 7(2), 204–213. https://doi.org/10.15294/jpii.v7i2.14273

Ayub, S., Kosim, K., & Gunada, I. W. (2021). Penerapan teknik moderasi terhadap implementasi model pembelajaran mitigasi bencana di Sekolah Dasar. ORBITA: Jurnal Kajian, Inovasi Dan Aplikasi Pendidikan Fisika, 7(2), 415–422. https://doi.org/10.31764/orbita.v7i2.6362

Aziz, H. E., & Hidayati, N. (2019). Analisis kemampuan penalaran matematis siswa SMP pada materi teorema Phytagoras. Jurnal Educatio FKIP UNMA, 8(1), 386–395. https://doi.org/10.31949/educatio.v8i1.1996

Brown, L. M., Haun, J. N., & Peterson, L. (2014). A proposed disaster literacy model. Disaster Medicine and Public Health Preparedness, 8(3), 267–275. https://doi.org/10.1017/dmp.2014.43

Çallşkan, C., & Üner, S. (2021). Disaster literacy and public health: A systematic review and integration of definitions and models. In Disaster Medicine and Public Health Preparedness (Vol. 15, Issue 4, pp. 518–527). https://doi.org/10.1017/dmp.2020.100

Chung, S.-C. C., & Yun, C.-J. (2016). Disaster prevention literacy among school administrators and teachers: A study on the plan for disaster prevention and campus network deployment and experiment in Taiwan. Journal of Life Sciences, 10(4), 203–214. https://doi.org/10.17265/1934-7391/2016.04.006

Cohen, L., Manion, L., & Morrison, K. (2018). Research Methods in Education (8th ed.). Routledge Taylor & Francis Group.

Cooper, H. M., Patall, E. A., & Lindsay, J. J. (2013). Research synthesis and meta-analysis. In L. Bickman & D. J. Rog (Eds.), The SAGE handbook of applied social research methods (pp. 344–370). Sage Publications Inc. https://doi.org/https://dx.doi.org/10.4135/9781483348858

Cummins, P. R. (2017). Geohazards in Indonesia: Earth science for disaster risk reduction - introduction. Geological Society Special Publication, 441(1), 1–7. https://doi.org/10.1144/SP441.11

Ding, Y., Yan, E., Frazho, A., & Caverlee, J. (2013). PageRank for ranking authors in co-citation networjs. Journal of the American Society for Information Science and Technology, 64(July), 1852–1863. https://doi.org/10.1002/asi

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. Journal of Business Research, 133(April), 285–296. https://doi.org/10.1016/j.jbusres.2021.04.070

Eka, T. V. (2020). Pengaruh pendidikan kebencanaan terhadap perilaku kesiapsiagaan bencana gempa bumi di MTs Muhammadiyah 6 Bayat. JPIG (Jurnal Pendidikan Dan Ilmu Geografi), 5(1), 23–32. https://doi.org/10.21067/jpig.v5i1.3994

Ernawati, R., Dirdjo, M. M., & Wahyuni, M. (2021). Peningkatan pengetahuan siswa terhadap mitigasi bencana di SD Muhammadiyah 4 Samarinda. Journal of Community Engagement in Health, 4(2), 393–399.

Esposito, M., Palma, L., Belli, A., Sabbatini, L., & Pierleoni, P. (2022). Recent advances in internet of things solutions for early warning systems: A review. Sensors, 22(6), 1–39. https://doi.org/10.3390/s22062124

Fadli, A., & Irwanto. (2020). The effect of local wisdom-based ELSII learning model on the problem solving and communication skills of pre-service islamic teachers. International Journal of Instruction, 13(1), 731–746. https://doi.org/10.29333/iji.2020.13147a

Fauziah, S., & Caswita. (2020). The analysis of students' mathematical critical thinking skills in term of gender. International Conference on Progressive Education (ICOPE 2019), 422, 127–131. https://doi.org/10.2991/assehr.k.200323.104

Finfgeld-Connett, D. (2018). A guide to qualitative meta-synthesis. Routledge.

Firaina, R., Apriani, M. F., Husniyah, R., & Asrizal. (2019). Analisis e-book IPA kelas IX berdasarkan pada aspek literasi bencana. Pillar of Physics Education, 12(3), 593–600.

Fitriah, L., Ma'Rifah, E., & Misbah, M. (2021). Developing a physics textbook based on the local wisdom of Hulu Sungai Selatan regency to train rakat mufakat characters. In P. E., S. A., & D. U.A. (Eds.), Young Scholar Symposium on Science Education and Environment 2020, YSSSEE 2020 (Vol. 1796, Issue 1). IOP Publishing Ltd. https://doi.org/10.1088/1742-6596/1796/1/012001

Fuad, M., Suyanto, E., Sumarno, Muhammad, U. A., & Suparman. (2022). A bibliometric analysis of technology-based foreign language learning during the COVID-19 pandemic : Direction for Indonesia language learning. International Journal of Information and Education Technology, 12(10), 983–995. https://doi.org/10.18178/ijiet.2022.12.10.1710

Fuadi, D. S., Suparman, S., Juandi, D., & Avip Priatna Martadiputra, B. (2021). Technology-assisted problem-based learning against common problem-based learning in cultivating mathematical critical thinking skills: A meta-analysis. ACM International Conference Proceeding Series, 162–168. https://doi.org/10.1145/3510309.3510335

Genc, F. Z., Yildiz, S., Kaya, E., & Bilgili, N. (2022). Disaster literacy levels of individuals aged 18–60 years and factors affecting these levels: A web-based cross-sectional study. International Journal of Disaster Risk Reduction, 76, 1–9. https://doi.org/10.1016/j.ijdrr.2022.102991

Gunada, I. W., Ayub, S., Doyan, A., Taufik, M., & Kosim, K. (2019). Development of disaster mitigation learning structures. Jurnal Penelitian Pendidikan IPA, 6(1), 69–74. https://doi.org/10.29303/jppipa.v6i1.324

Helsa, Y., Suparman, Juandi, D., Turmudi, & Ghazali, M. B. (2023). A meta-analysis of the utilization of computer technology in enhancing computational thinking skills : Direction for mathematics learning. International Journal of Instruction, 16(2), 735–758.

Hoffmann, R., & Blecha, D. (2020). Education and disaster vulnerability in Southeast Asia: Evidence and policy implications. Community, Environment and Disaster Risk Management, 21, 17–37. https://doi.org/10.1108/S2040-726220200000021002

Ihsan, H. M., Putri, D. P., Insani, H. M., Redo, A., & Bratanegara, A. S. (2022). Utilization of fun games as earthquake disaster mitigation efforts for inclusive children. Tunas Geografi, 11(2), 89–98. https://doi.org/10.24114/tgeo.v11i2.39739

Ikeda, M., Nagata, T., Kimura, R., Yi, T. Y., Suzuki, S., Nagamatsu, S., Oda, T., Endo, S., Hatakeyama, M., Yoshikawa, S., Adachi, S., Miura, S., & Take, J. (2021). Development of disaster management education program to enhance disaster response capabilities of

schoolchildren during heavy rainfall – implementation at elementary school in nagaoka city, niigata prefecture, a disaster-stricken area. Journal of Disaster Research, 16(7), 1121–1136. https://doi.org/10.20965/jdr.2021.p1121

Ilyasa, F., Rahmayanti, H., Muzani, M., Ichsan, I. Z., & Suhono, S. (2020). Environmental education for prevent disaster: A survey of students knowledge in beginning new normal of COVID-19. International Journal on Advanced Science, Education, and Religion, 3(2), 1–8. https://doi.org/10.33648/ijoaser.v3i2.60

Jaya, A., & Suparman, S. (2021). The use of CABRI software in mathematics learning for cultivating geometrical conceptual understanding: A meta-analysis. ACM International Conference Proceeding Series, 37–44. https://doi.org/10.1145/3510309.3510316

Juandi, D., Suparman, Martadiputra, B. A. P., Tamur, M., & Hasanah, A. (2022). Does mathematics domain cause the heterogeneity of students ' mathematical critical thinking skills through problem- based learning ? A meta-analysis Does Mathematics Domain Cause the Heterogeneity of Students ' Mathematical Critical Thinking Skills throu. AIP Conference Proceedings, 070028(December), 1–8. https://doi.org/https://doi.org/10.1063/5.0102714

Juandi, D., Tamur, M., Martadiputra, B. A. P., Suparman, & Kurnila, V. S. (2022). A meta-analysis of a year of virtual-based learning amidst the COVID-19 crisis: Possible solutions or problems? AIP Conference Proceedings, 2468, 1–7. https://doi.org/10.1063/5.0102715

Juhadi, 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

Kaban, P. A., Kurniawan, R., Caraka, R. E., Pardamean, B., Yuniarto, B., & Sukim. (2019). Biclustering method to capture the spatial pattern and to identify the causes of social vulnerability in Indonesia: A new recommendation for disaster mitigation policy. Procedia Computer Science, 157, 31–37. https://doi.org/10.1016/j.procs.2019.08.138

Kesumaningtyas, M. A., Hafida, S. H. N., & Musiyam, M. (2022). Analysis of disaster literacy on student behavioral responses in efforts to reduce earthquake disaster risk at SMA Negeri 1 Klaten. IOP Conference Series: Earth and Environmental Science, 986(1), 1–9. https://doi.org/10.1088/1755-1315/986/1/012013

Kurniawan, E., & Trimasukmana, D. J. (2020). Korean drama as geography's audio-visual learning media of disaster mitigation. Universal Journal of Educational Research, 8(5), 2184–2190. https://doi.org/10.13189/ujer.2020.080558

Kurniawati, D., & Suwito, S. (2019). Pengaruh pengetahuan kebencanaan terhadap sikap kesiapsiagaan dalam menghadapi bencana pada mahasiswa program studi Pendidikan Geografi Universitas Kanjuruhan Malang. JPIG (Jurnal Pendidikan Dan Ilmu Geografi), 2(2), 135–142. https://doi.org/10.21067/jpig.v2i2.3507

Lamina, O. G. (2017). School-community cooperation in natural disaster education and preparedness in Barangay Dolores, Taytay, Rizal, Philippines. Higher Education Forum, 12(1), 129–144.

Linardos, V., Drakaki, M., Tzionas, P., & Karnavas, Y. L. (2022). Machine learning in disaster management: Recent developments in methods and applications. Machine Learning and Knowledge Extraction, 4(2), 446–473. https://doi.org/10.3390/make4020020

Mahmudah, S., & Fauzia, F. (2022). Penerapan model simulasi tentang pembelajaran mitigasi bencana alam gempa bumi berbasis video animasi untuk meningkatkan hasil belajar siswa. Jurnal Basicedu, 6(1), 633–645. https://doi.org/10.31004/basicedu.v6i1.1974

Mardiatno, D., Malawani, M. N., Annisa, D. N., & Wacano, D. (2017). Review on tsunami risk reduction in Indonesia based on coastal and settlement typology. Indonesian Journal of Geography, 49(2), 186–194. https://doi.org/10.22146/ijg.28406

Mariamah, Muslim, Amrullah, Prayitno, S., & Badu Kusuma, A. (2021). Geometry from Lambitu tribe Etnomatematics. In J. A., Y. W.N., U. R., & P. P.W. (Eds.), 3rd National Seminar of Mathematics and Mathematics Education, SEMADIK 2020 (Vol. 1778, Issue 1). IOP Publishing Ltd. https://doi.org/10.1088/1742-6596/1778/1/012015

Maryani, E. (2021). The role of education and geography on disaster preparedness. IOP Conference Series: Earth and Environmental Science, 683(1), 1–9. https://doi.org/10.1088/1755-1315/683/1/012043

McHugh, M. L. (2012). Interrater reliability : the kappa statistic. Biochemica Medica, 22(3), 276–282.

Miao, Q. (2017). Technological innovation, social learning and natural hazard mitigation: Evidence on earthquake fatalities. Environment and Development Economics, 22(3), 249–273. https://doi.org/10.1017/S1355770X1700002X

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. BMJ (Online), 339(7716), 332–336. https://doi.org/10.1136/bmj.b2535

Mubarak, A. F., Amiruddin, R., & Gaus, S. (2019). The effectiveness of disaster prevention and mitigation training for the students in disaster prone areas. IOP Conference Series: Earth and Environmental Science, 235(1), 1–7. https://doi.org/10.1088/1755-1315/235/1/012055

Mufit, F., Asrizal, Hanum, S. A., & Fadhilah, A. (2020). Preliminary research in the development of physics teaching materials that integrate new literacy and disaster literacy. Journal of Physics: Conference Series, 1481(1), 1–13. https://doi.org/10.1088/1742-6596/1481/1/012041

Muhammad, U. A., Fuad, M., Ariyani, F., & Suyanto, E. (2022). Bibliometric analysis of local wisdom-based learning : Direction for future history education research. International Journal of Evaluation and Research in Education, 11(4), 2209–2222. https://doi.org/10.11591/ijere.v11i4.23547

Murti, R., & Mathez-Stiefel, S. lan. (2019). Social learning approaches for ecosystem-based disaster risk reduction. International Journal of Disaster Risk Reduction, 33, 433–440. https://doi.org/10.1016/j.ijdrr.2018.09.018

Mustadi, A., & Atmojo, S. E. (2020). Student's disaster literation in 'sets' (Science environment technology and society) disaster learning. Elementary Education Online, 19(2), 667–678. https://doi.org/10.17051/ilkonline.2020.693118

Najid, A. A., Rahmawati, Y., & Yusmaniar. (2021). Developing students' attitudes towards chemistry learning through culturally responsive transformative teaching (CRTT). AIP Conference Proceedings, 2331, 1–8. https://doi.org/10.1063/5.0041989

Noviana, E., Kurniaman, O., Sb, N. S., Nirmala, S. D., & Dewi, R. S. (2021). How to prepare disaster mitigation knowledge for prospective teachers in elementary school? AL-ISHLAH: Jurnal Pendidikan, 13(2), 1123–1134. https://doi.org/10.35445/alishlah.v13i2.496

Nugroho, A. S., & Daniamiseno, A. G. (2022). Pengembangan e-book mitigasi bencana gunung api berbasis prinsip-prinsip desain pesan pembelajaran untuk siswa sekolah menengah pertama. Jurnal Inovasi Teknologi Pendidikan, 9(1), 114–122. https://doi.org/10.21831/jitp.v9i1.21690

Nugroho, H. Y. S. H., Savitri, E., Wahyuningrum, N., Sudiana, N., Indrajaya, Y., & Christanto, N. (2022). Citizen science: Realizing a participatory rain data management for flood disasters early warning systems and building disaster awareness from a very young age. IOP Conference Series: Earth and Environmental Science, 1109(1), 1–13. https://doi.org/10.1088/1755-1315/1109/1/012015

Nurcahyo, A. D., & Winanti, E. T. (2021). Pengaruh model problem-based learning terintegrasi pendekatan induktif terhadap kemampuan berpikir spasial dan pengetahuan siswa pada materi mitigasi bencana. Jurnal Pendidikan Geografi, 26(1), 41–47. https://doi.org/10.17977/um017v26i12021p041

Nurfalah, I., Maryanti, R., Wulandary, V., & Irawan, A. R. (2022). Earthquake disaster mitigation explanation to prepare a disaster response generation for students in 3th-grade of elementary school. ASEAN Journal of Science and Engineering Education, 2(2), 147–152. https://doi.org/10.17509/ajsee.v2i2.38687

Nurwin, G. S., Rudianto, N. T. R. S. D., Elvera, E. D. J. A. M. A. T. D., Kertapati, I., Hidayati, K. P. S. N. B. D. S. N., Meiwanty, I., (Kerlip), E. N. (World B. I. N. (Plan I. J. M., & Indonesia),

M. H. (UNICEF) Y. T. (Plan. (2015). Pilar 3 - Pendidikan Pencegahan dan Pengurangan Risiko Bencana. Pendidikan Pencegahan Dan Pengurangan Risiko Bencana.

Oktaria, R., Windah, A., Nurhaida, I., Putra, P., & Haerudin, N. (2023). Pembelajaran mitigasi bencana berbasis literasi informasi untuk meningkatkan disaster self-awareness AUD. Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini, 7(2), 2109–2122. https://doi.org/10.31004/obsesi.v7i2.3430

Opilah, B. S., Karyadi, B., & Johan, H. (2023). Analisis pengintegrasian pendidikan mitigasi bencana pada pembelajaran fisika di pulau Enggano. Jurnal Pendidikan Tambusai, 7(1), 1795–1799.

Pinar, A. (2017). What is secondary school students' awareness on disasters? A case study. Review of International Geographical Education Online, 7(3), 315–331.

Pradina, A. T., & Pratama, M. M. A. (2021). Peningkatan literasi mitigasi bencana gempa bumi melalui booklet ringkas inovatif bagi siswa SDN Wonoayu Kecamatan Wajak Kabupaten Malang. Jurnal Pasopati, 3(3), 168–176.

Prakoso, B., Widana, I. D. K. K., & Subiyanto, A. (2021). Pendidikan dan literasi bencana dalam kerangka tri sentra pendidikan untuk generasi tangguh bencana. Jurnal Manajemen Bencana, 7(1), 59–76. https://doi.org/10.33172/jmb.v7i1.705

Pranata, S., Widodo, S., Vranada, A., Machmudah, & Mariyam, M. (2021). How to prepare a school based disaster preparedness in Indonesia. Proceedings of the 4th International Conference on Sustainable Innovation 2020–Health Science and Nursing (ICoSIHSN 2020), 33, 528–533. https://doi.org/10.2991/ahsr.k.210115.103

Proulx, K., & Aboud, F. (2019). Disaster risk reduction in early childhood education: Effects on preschool quality and child outcomes. International Journal of Educational Development, 66(10), 1–7. https://doi.org/10.1016/j.ijedudev.2019.01.007

Rahayuni, N. W. A., Mertha, I. M., & Rasidin, I. G. A. (2022). Edukasi dengan media permainan teka-teki silang dan pengetahuan kesiapsiagaan siswa. Jurnal Gema Keperawatan, 15(1), 68–78.

Rifai, M. H. (2018). Pengaruh penggunaan media audio visual terhadap pemahaman konsep mitigasi bencana pada mahasiswa pendidikan geografi. Jurnal Pendidikan Dan Pembelajaran, 3(1), 62–69.

Riza, H., Widi Santoso, E., Tejakusuma, I. G., Prawiradisastra, F., Prihartanto, D., Pengkajian dan Penerapan Teknologi, B., & Teknologi Reduksi Risiko Bencana TPSA BPPT Jl H Thamrin No, P. M. (2020). Meningkatkan mitigasi bencana banjir. Jurnal Sains Dan Teknologi Mitigasi Bencana, 15(1), 1–11.

Rogayan, D. V., & Dollete, L. F. (2020). Disaster awareness and preparedness of barrio community in Zambales, Philippines: Creating a baseline for curricular integration and extension program. Review of International Geographical Education Online, 10(2), 92–114. https://doi.org/10.33403/rigeo.634564

Ronan, K. R., Haynes, K., Towers, B., Alisic, E., Ireland, N., Amri, A., Davie, S., & Petal, M. (2016). Child-centred disaster risk reduction: Can disaster resilience programs reduce risk and increase the resilience of children and households? Australian Journal of Emergency Management, 31(3), 49–58.

Rusilowati, A., Supriyadi, Binadja, A., & Mulyani, S. (2012). Mitigasi bencana alam berbasis pembelajaran bervisi science environment technology and society. Jurnal Pendidikan Fisika Indonesia, 8(1), 51–60.

Sahidu, H., Kosim, K., Ayub, S., 'Ardhuha, J., & Gunawan, G. (2021). Sosialisasi mitigasi bencana gempa bumi pada guru dan siswa di SDN 1 Cakranegara Kota Mataram. Jurnal Pengabdian Masyarakat Sains Indonesia, 3(2), 1–5. https://doi.org/10.29303/jpmsi.v3i2.155

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

Salam, M. T., Muhamad, N., Leong, V. S., Jamal, A., Sharifuddin, J., Izberk-Bilgin, E., Nakata, C. C., Abd Rahman, A., Asrarhaghighi, E., Ab Rahman, S., Muhamad, N., Leong, V. S., Md Isa, N., Bashir, A. M., Bayat, A., Olutuase, S. O., Abdul Latiff, Z. A., Yener, D., Takeshita, S., … Toland, M. D. (2018). Factors affecting intention to adopt halal practices: Case study of Indonesian small and medium enterprises. Journal of Islamic Marketing, 2(2), 1–39.

Salwa Salsabila, W., & Rafa Dinda, R. (2021). Pembelajaran mitigasi bencana di Sekolah Dasar dengan metode demonstrasi. Proceedings Series on Social Sciences & Humanities, 1, 115–120. https://doi.org/10.30595/pssh.v1i.83

Sampurno, P. J., Sari, Y. A., & Wijaya, A. D. (2015). Integrating STEM (Science, Technology, Engineering, Mathematics) and Disaster (STEM-D) Education for Building Students' Disaster Literacy. International Journal of Learning, 1(1), 73–76. https://doi.org/10.18178/IJLT.1.1.73-76

Saputri, S. W. (2020). Developing English teaching materials based local wisdom: Is it effective to improve student's learning outcomes at SMKN 1 Cinangka? Asian EFL Journal, 27(5.2), 91–96.

Septaria, K., & Dewanti, B. A. (2021). Implementation of project-based learning on student reasoning on Covid-19 disaster mitigation. Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram, 9(1), 20–27. https://doi.org/10.33394/j-ps.v9i1.2951

Septaria, K., Dewanti, B. A., & El Afidah, M. I. (2020). Development of module disaster mitigation based on STEM for secondary schools. Jurnal Penelitian Pendidikan IPA, 5(2), 61–68.

Setyastuti, Y., Hanief, L., & Shafira, A. (n.d.). Media and disaster mitigation literacy. January 2022.

Sharma, R., & Rao, P. (2021). Climate vulnerability assessment and livelihood resilience of coastal communities: A Review of trends and Linkages. Ecology, Environment and …, 27, 452–458.

Shofa, A., Su'Ad, & Murtono. (2021). Development of Learning Media Technology Based on Natural Science Local Wisdom Materials. In S. M.W. (Ed.), 2nd UPY International Conference on Applied Science and Education, UPINCASE 2020 (Vol. 1823, Issue 1). IOP Publishing Ltd. https://doi.org/10.1088/1742-6596/1823/1/012080

Shofa, M. I., Pujianto, & Elviana, R. (2021). Natural science teacher perception on subject specific pedagogy integrated earthquake disaster mitigation. Proceedings of the 6th International Seminar on Science Education (ISSE 2020), 541, 603–608. https://doi.org/10.2991/assehr.k.210326.087

Suarmika, P. E., Putu Arnyana, I. B., Suastra, I. W., & Margunayasa, I. G. (2022). Reconstruction of disaster education: The role of indigenous disaster mitigation for learning in Indonesian elementary schools. International Journal of Disaster Risk Reduction, 72(10), 102874. https://doi.org/10.1016/j.ijdrr.2022.102874

Subarno, A., & Dewi, A. S. (2022). A systematic review of the shape of disaster education. IOP Conference Series: Earth and Environmental Science, 986(1), 1–12. https://doi.org/10.1088/1755-1315/986/1/012011

Suharini, E., & Baharsyah, M. N. (2020). Learning about landslide disaster mitigation based on a role-playing method assisted by the disaster education pocket book. Review of International Geographical Education Online, 10(4), 618–638. https://doi.org/10.33403/rigeo.767474

Suharini, E., Meliana, D., Sanjoto, T., & Kurniawan, E. (2020). The strategy of disaster mitigation literacy through problem-based learning (PBL) in the school prone to tidal floods. ICESI, 1–6. https://doi.org/10.4108/eai.18-7-2019.2290156

Sukadari, Prihono, E. W., Singh, C. K. S., Syahruzah, J. K., & Wu, M. (2020). The implementation of character education through local wisdom based learning. International Journal of Innovation, Creativity and Change, 4, 389–403.

Sulistiawati, Kusumah, Y. S., Dahlan, J. A., Juandi, D., Suparman, & Arifin, S. (2023). The trends of studies in technology-assisted inquiry-based learning: The pesrspective of bibliometric analysis. Journal of Engineering Science and Technology, 18(1), 69–80.

Sumarmi, Bachri, S., Irawan, L. Y., & Aliman, M. (2021). E-module in blended learning: Its impact on students' disaster preparedness and innovation in developing learning media. International Journal of Instruction, 14(4), 187–208. https://doi.org/10.29333/iji.2021.14412a

Suparman, & Juandi, D. (2022a). Upgrading mathematical problem-solving abilities through problem-based learning : A meta-analysis study in some countries. AIP Conference Proceedings, 080017(December), 1–8.

Suparman, Juandi, D., Martadiputra, B. A. P., Badawi, A., Susanti, N., & Yunita. (2022). Cultivating secondary school students ' mathematical critical thinking skills using technology-assisted problem-based learning : A meta-analysis. AIP Conference Proceedings, 070006(December), 1–7. https://doi.org/https://doi.org/10.1063/5.0102422

Suparman, Juandi, D., & Tamur, M. (2021a). Does problem-based learning enhance students' higher order thinking skills in mathematics learning? A systematic review and meta-analysis. The 4th International Conference on Big Data and Education, 44–51. https://doi.org/https://doi.org/10.1145/3451400.3451408

Suparman, Juandi, D., & Tamur, M. (2021b). Review of problem-based learning trends in 2010-2020 : A meta-analysis study of the effect of problem-based learning in enhancing mathematical problem-solving skills of Indonesian students. Journal of Physics: Conference Series, 1722(012103), 1–9. https://doi.org/10.1088/1742-6596/1722/1/012103

Suparman, S., & Juandi, D. (2022b). Self-efficacy and mathematical ability : A meta-analysis of studies conducted in Indonesia. Pedagogika, 147(3), 26–57. https://doi.org/https://doi.org/10.15823/p.2022.147.2

Suparman, S., Jupri, A., Musdi, E., Amalita, N., Tamur, M., & Chen, J. (2021). Male and female students' mathematical reasoning skills in solving trigonometry problems. Beta: Jurnal Tadris Matematika, 14(1), 34–52. https://doi.org/10.20414/betajtm.v14i1.441

Supriyadi, T., Saptani, E., Rukmana, A., Suherman, A., Alif, M. N., & Rahminawati, N. (2020). Students' technological literacy to improve academic writing and publication quality. Universal Journal of Educational Research, 8(11B), 6022–6035. https://doi.org/10.13189/ujer.2020.082238

Susiyanti, Y., Juandi, D., & Suparman. (2022). Does project-based learning have a positive effect on student' mathematical critical thinking skills? A meta-analysis. AIP Conference Proceedings, 2468, 1–7. https://doi.org/10.1063/5.0102486

Suyanto, E., Fuad, M., Antrakusuma, B., Suparman, & Shidiq, A. S. (2023). Exploring the research trends of technological literacy studies in education : A systematic review using bibliometric analysis. International Journal of Information and Education Technology, 13(6), 914–924. https://doi.org/10.18178/ijiet.2023.13.6.1887

Triyanto, Agustinova, D. A., & Syamsi, K. (2021). Strengthening disaster literacy as an effort to reduce the risk of disaster in D.I. Yogyakarta society. IOP Conference Series: Earth and Environmental Science, 884(1), 1–8. https://doi.org/10.1088/1755-1315/884/1/012032

Tsai, M. H., Chang, Y. L., Shiau, J. S., & Wang, S. M. (2020). Exploring the effects of a serious game-based learning package for disaster prevention education: The case of Battle of Flooding Protection. International Journal of Disaster Risk Reduction, 43(11), 101393. https://doi.org/10.1016/j.ijdrr.2019.101393

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

Vevea, J. L., Zelinsky, N. A. M., & Orwin, R. G. (2019). Evaluating coding decisions. In The handbook of research synthesis and meta-analysis (3rd ed., pp. 174–201). Russel Sage Foundation. https://doi.org/https://doi.org/10.7758/9781610448864

Whittaker, J., McLennan, B., & Handmer, J. (2015). A review of informal volunteerism in emergencies and disasters: Definition, opportunities and challenges. International Journal of Disaster Risk Reduction, 13, 358–368. https://doi.org/10.1016/j.ijdrr.2015.07.010

Widjanarko, M., & Minnafiah, U. (2018). Pengaruh pendidikan bencana pada perilaku kesiapsiagaan siswa. Jurnal Ecopsy, 5(1), 1–7. https://doi.org/10.20527/ecopsy.v5i1.4878

Yunita, Y., Juandi, D., Hasanah, A., & Suparman. (2022). Meta-analysis study: How effective is a project-based learning model on students' mathematical problem-solving abilities? AIP Conference Proceedings, 2468, 1–7. https://doi.org/10.1063/5.0102458

Zhang, D., Zhu, X., Zhou, Z., Xu, X., Ji, X., & Gong, A. (2021). Research on disaster literacy and affecting factors of college students in Central China. Disaster Medicine and Public Health Preparedness, 15(2), 216–222. https://doi.org/10.1017/dmp.2020.33

Zhang, S., Wijekumar, K., & Han, B. (2021). An analysis of grade 4 reading textbooks used in Mainland China: Do the texts and activities support higher order reading comprehension skills? In Technology, Knowledge and Learning (Vol. 26, Issue 2). Springer Netherlands. https://doi.org/10.1007/s10758-021-09504-7