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Review of Natural Disaster Risk Management in Schools

Xiomara Marjorie Ayala Gomez [1], Wilfredo Humberto Carcausto Calla [2], Ketty Veronica Gomez Bautista [3], Yomayra Jacinto Leiva [4]

Universidad César Vallejo, Perú [1,2,4]
Email: xayalago24@ucvvirtual.edu.pe
Universidad Nacional de Educación
Enrique Guzmán y Valle [3]

Natural disasters pose significant risks to schools, impacting both educational continuity and the well-being of students and staff. This review explores the current state of research on natural disaster risk management in educational institutions, emphasizing strategies for preparedness, mitigation, and resilience building. Through a scoping review of publications from 2016 to 2024, this study identifies key actions implemented by schools globally, such as the integration of disaster education in curricula, participatory approaches involving communities, and the development of frameworks for school resilience. Findings highlight the importance of inclusive policies, educational innovation, and psychosocial support to foster a culture of prevention and strengthen the capacity of schools to respond to disasters effectively. The study underscores the critical role of education in enhancing disaster literacy and resilience among students and communities.

Keywords: Natural disaster risk management, Disaster education, School resilience, Preparedness and mitigation strategies, Psychosocial support, Disaster risk reduction (DRR).

1. Introduction

Natural disasters represent a significant global hazard, with a high incidence of catastrophic events that disrupt the normal development of society and pose a threat to public health and safety. Furthermore, it impedes the functionality of institutions (United Nations Disaster Risk Reduction Organization [UNDRR], 2023). Currently, a number of strategies are being proposed at the global level with the aim of addressing the consequences of these disasters and promoting a culture of prevention (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2023). Similarly, school systems play a pivotal role in fostering environmental awareness and developing disaster risk reduction management strategies, thereby cultivating communities that are more aware and prepared for such events (United Nations Children's Fund [UNICEF], 2023).

The process of risk management in the school environment is comprehensive and involves several key steps. Initially, the problem must be identified, after which its consequences must be assessed. Following this, vulnerable areas of attention must be prioritized in a systematic way that considers potential risks. Finally, the process culminates in the coordinated and cost-

effective organization of human, economic, and material resources (Rodriguez). (2022) with

the objective of minimizing, monitoring, and supervising the repercussions or impact of adverse events, while seeking to maximize the realization of opportunities that may arise and strengthen the resilience of the education system (World Bank [WB, 2020]).

The development of management strategies to address environmental issues comprises specific dimensions of strategic action within a process of risk identification and assessment (Castillo et al., 2022). This process entails a comprehensive analysis of potential hazards, threats, and vulnerabilities that may affect the normal functioning of educational institutions. The objective is to prioritize those risks that require more urgent attention and action (Álvarez et al., 2023). Furthermore, planning and decision-making processes entail the formulation of coordinated strategies and action plans aimed at preventing, mitigating, or responding effectively to identified risks. This entails the assignment of responsibilities and resources in an appropriate manner (Rojas and Bartesaghi, 2023). The implementation and monitoring of risk management strategies are essential components of any effective risk reduction plan. Planned measures and actions must be put into practice and monitored for their effectiveness, with adjustments made as necessary. A review and continuous improvement process is also crucial. This involves evaluating the performance and results of risk management, identifying lessons learned, and identifying opportunities for improvement. The goal of this process is to strengthen the resilience and preventive culture of schools in the future (Pardo et al., 2023).

The advancement of risk reduction management in education on a global scale is a constructive and indispensable phenomenon in the present circumstances (Aguilar, 2022). The implementation of best practices and standards for prevention, preparedness, and response to various hazards has been instrumental in strengthening educational institutions and communities (Espinoza et al., 2022).

However, it is important to recognize that there are still challenges and areas of opportunity (Wiwik, et al.2021). The improvement in protection and crisis response capabilities is not uniform globally, and there are gaps and disparities between different regions and countries. Furthermore, risk management must go beyond the technical and operational aspects, and also address the social, emotional, and mental health dimensions that impact students, teachers, and educational staff (Torani et al,.2019).

While there are reviews on the development of natural disaster risk management in education such as the systematic review of multi-hazard and school education literature to explore hazard-induced disruptions in school education and importance in disaster risk reduction (DRR) and management at local, regional and global levels for resilience building in school education (Pal et al., 2023). Also, the systematic review on school-based education programs to prepare children for natural hazards, covering methods used for health emergency preparedness for children of different ages (Seddighi et al., 2022).Or the systematic literature review on Evaluations of disaster education programs for children, analyzing how scholars and practitioners currently measure and judge the effectiveness of disaster education programs for children through evaluation (Johnson et al., 2014). Also, the literature review on communicating with children and families about disasters, defining that schools and mindful parenting can play a relevant role in the development and process of psychological understanding and resilience (Wisner et al., 2018). There are not enough reviews in which risk management in schools has obtained favorable results in the course of implementing strategies

for disaster preparedness and mitigation.

Therefore, the following research question was formulated: What is the status of publications on natural disaster risk management in schools in Scopus databases?

In that sense, through the research objective we sought to analyze the status of primary publications on the status of publications on natural disaster risk management. Also, to describe the characteristics of primary research during the year 2016 to 2024. Identify the actions for preparedness, mitigation and response to natural disasters implemented by schools and identify strategies for education and preparedness for Disasters in the School Context.

2. Methodology

According to the objective of the present research, a scoping review of primary research was carried out, therefore, a bibliographic search was executed in scientific databases, then inclusion and exclusion criteria of the literature were used followed by the selection, evaluation, quality and analysis, using the procedures and recommendations (Arksey and o malley, 2005, Grant and booth209).

Eligibility criteria

By following the protocol in the research of the scientific articles presented, the inclusion criteria of the opted scientific articles are manifested, a choice was made from the following: a) primary articles on natural disaster risk management in schools; b) published in English; C) between the years 2016 and 2024; d) open access and full text; f) articles belonging to Scopus database. The exclusion criteria did not consider opinion articles, conference papers, technical reports, letters to the editor, essays, theses, books; b) publications of educational level other than basic; c) other language than English; d) private or limited access through closed and with viewing cost.

Search strategy

The collection of information was established by reviewing open access articles in Scopus from July 2016 to September 2024. The search was performed by combining keywords (natural OR environmental AND disaster AND risk AND management AND in AND schools) from which 218 documents were obtained.

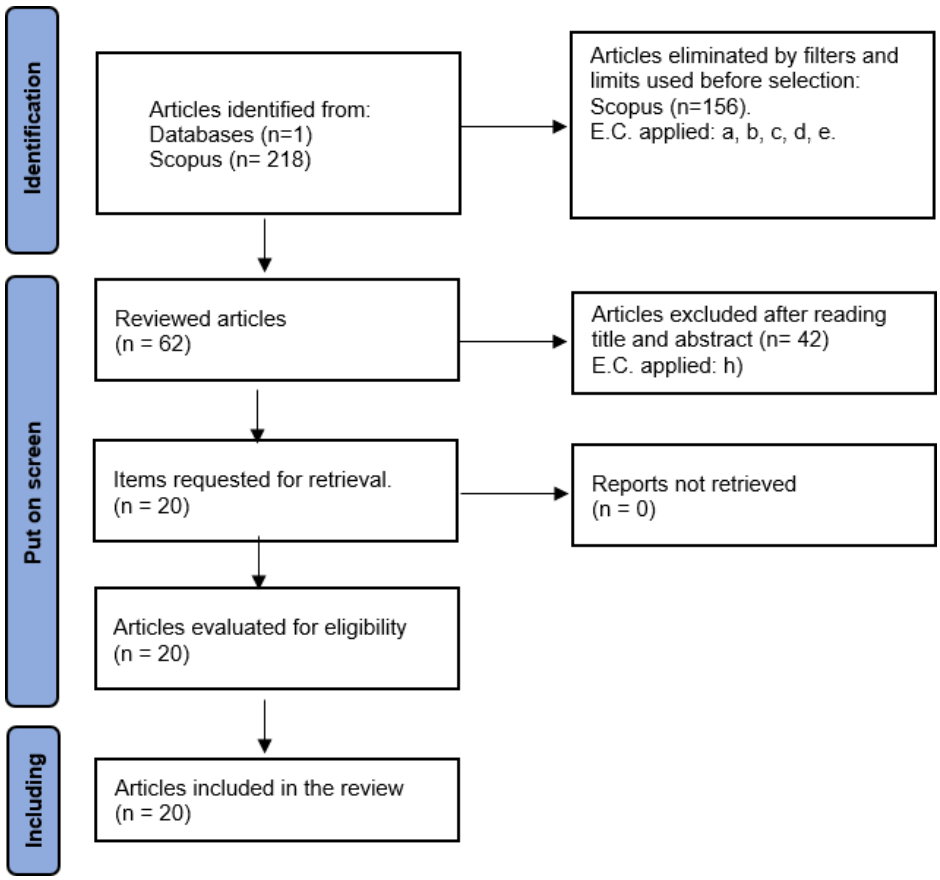

Figure 1. PRISMA flow diagram

3. Results

Table 1: Characteristics of primary research during 2016 to 2024.

ID	Author/year	Title	Technique/ Instrument	Countries
1	Opabola, E.A., Galasso, C. 2024.	"Informing disaster risk management policies for educational infrastructure using scenario-based recovery analysis."	Survey/questionnaire.	Indonesia
2	(Kimura & Aikawa, 2024)	"Proposal for a disaster management drill program for high school students who have never experienced a disaster to foster a sense of "awareness that disaster affects everyone "	Survey/questionnaire	Japón
3	(Jaffar et al., 2024)	"Inclusion of disaster risk education in the classroom and extracurricular activities: a case from rural Balochistan, Pakistan"	Survey/questionnaire	Las zonas rurales de baluchistán, pakistán

4	(Agarwal et al., 2023)	"Safer and more resilient schools in seismic regions: a systems perspective"	Survey/questionnaire	Nepal
5	(Nagata et al., 2022)	"Development of a Tsunami Disaster Risk Reduction Education Program for children with no experience of earthquake disasters: practice and verification in Shichigahama City, Miyagi Prefecture"	Survey/questionnaire	Malasia.
6	(Muzani et al., 2022)	"The obstacles of implementing disaster preparedness in schools in the Mount Sinabung area, Indonesia"	Observation, interviews and surveys	Indonesia
7	(Córdova et al. 2022)	"Disaster risk management and preventive culture in education in Metropolitan Lima"	Observation, interviews and surveys	Perú
8	(Nakum et al., 2022)	"Development of a framework on school resilience for risk-informed decision making"	Interviews and surveys	Japón
9	(Zhong et al., 2021)	"An impact assessment of disaster education on children's flood risk perceptions in China: policy implications for adaptation to climate extremes"	Surveys/ interviews	China
10	(Hamid, 2021)	Developing a disaster education model to improve students' disaster mitigation literacy.	Surveys/ interviews	Pakistán
11	(Gong et al., 2021)	"Disaster risk reduction education in school geography curriculum."	Survey/ interviews	China
12	(Ribeiro et al., 2021)	"Educational practices for disaster risk management in non-formal education: an investigation involving students and teachers from a school participating in the Junior Civil Defense Agent project in Blumenau"	Questionnaire/ interviews	Brasil
13	Shah et al., 2020)	"Measuring the resilience of the education sector to flood disasters in Pakistan: an index-based approach"	Survey/ interviews	Pakistán
14	(Mirzaei et al.,2020).	Assessing school resilience in disasters.	Questionnaire/ interviews	Irán
15	(Meyer et al., 2018) 2019	"Participatory action research: tools for disaster resilience education"	Interviews and surveys	EEUU
16	(Sheffield et al., 2017)	"Climate change and schools: environmental hazards and resilience USA"	Surveys/ interviews	IRAN
17	(Amri et al., 2017)	"Disaster risk reduction education in Indonesia: challenges and recommendations for scaling-up"	Questionnaire/Interviews	Indonesia
18	(Nagata & Kimura, 2017)	"Proposing a multi-hazard approach to disaster management education to improve children's lives: Developing disaster management education programs that teachers will practice"	Survey/questionnaire	JAPON
19	(Thi & Shaw, 2016)	"School-based disaster risk reduction education in primary schools in Da Nang City, Central Vietnam."	Survey/questionnaire	Vietnam
20	(Musacchio et al., 2016)	"Education: can a bottom-up strategy help earthquake disaster prevention?"	Survey/questionnaire	Portugal e italia

In Table 1, we have the characteristics of the primary research during the year 2016 to 2024.

It is evidenced that 2 articles are from the year 2016, 3 are from 2017, 1 from 2019, 6 from 2020, 2 from 2021, 2 from 2022, 1 from 2023 and 4 from 2024. Likewise, the use of observation techniques, interviews and surveys is evidenced, also the instruments are mostly are questionnaires. They include the educational levels in schools.

Table 2. Actions for preparedness, mitigation and response to natural disasters implemented by schools.

Author/year	Important information	Preparedness AND mitigation actions
(Kimura & Aikawa, 2024) (Nagata et al., 2022)(Zhong et al., 2021) (Ribeiro et al., 2021) (Meyer et al., 2018) (Córdova et al. 2022)	Educational proposals for disaster risk management in students are presented, focusing on programs that include technological tools. These initiatives include drills to promote disaster awareness, and evaluations of the impact on the perception of risk. They also address non-formal education through youth civil defense projects and the use of participatory research to strengthen resilience. They highlight the importance of education in disaster awareness and adaptation.	Contextualized educational programs that integrate strategies with technological tools.
(Jaffar et al., 2024)(Mirzaei et al.,2020). (Nagata & Kimura, 2017)	The evaluation of educational programs for disaster risk management in children, promoting a preventive culture in education. It also proposes a multi-hazard approach to improve school resilience and develop programs that teachers practice to strengthen disaster response capacity.	Development of educational programs, constant evaluation and training in disaster resilience.
(Agarwal et al., 2023) Muzani et al., 2022) (Nakum et al., 2022)(Hamid, 2021) Opabola, E.A., Galasso, C. 2024.	making schools safer and more resilient in seismic regions, highlighting the obstacles to disaster preparedness in high-risk areas. It proposes a school resilience framework for risk-based decisions and suggests developing an educational model that improves student literacy in disaster mitigation. In addition, it seeks to inform educational infrastructure risk management policies through scenario-based recovery analysis.	Curricular adaptation and educational cooperation to prevent natural disasters.
(Shah et al., 2020) (Sheffield et al., 2017) (Amri et al., 2017) (Thi & Shaw, 2016) (Musacchio et al., 2016)	Plans for measuring the resilience of the education sector to disasters, such as floods, using an index-based approach. It also explores environmental risks and resilience in schools, as well as challenges and recommendations for disaster risk reduction education. In addition, it examines whether a bottom-up strategy can help in earthquake disaster prevention.	Educational improvement: planning, curriculum modification and didactic strategies.

Table 2 presents the actions for preparedness, mitigation, and response to natural disasters that schools have implemented. It is evident that the actions considered are predominantly those that involve modifying educational policies to address these disasters, as well as the citizen strategy framework. Similarly, educational awareness programs that engage all stakeholders, including students, and are designed with clear implementation plans, can effectively raise awareness about these issues. It is also noteworthy that technological advancement is becoming an increasingly prominent factor in addressing challenges, particularly in raising awareness among schoolchildren.

Table 3. Strategies for Disaster Education and Preparedness in the School Context

Topics	Relevant information	Author(s) and Year
Awareness and Education	- Development of awareness of the universal impact of disasters - Understanding of community-specific risks - Integration of disaster education with school subjects and local wisdom - Use of ICTs and experiential learning - Children's desire to learn more about safety and risk reduction	Córdova et al. (2022) Hamid (2021) Amri et al. (2017)
Policy and Planning	- Need to review and improve existing policies - Development of comprehensive action plans - Improvement of the school selection process - Need for increased federal and state oversight - Prevention strategies that encompass child and adult education.	Muzani et al. (2022)Nakum et al. (2022)Sheffield et al. (2017)Musacchio et al. (2016)
Collaboration and Participation	- Synergy between disaster managers, educational sectors, school personnel, students and parents. - Participatory, multidisciplinary and holistic approach. - Parent-child interaction in risk education - Resident participation in resilience planning	Agarwal et al. (2023)Zhong et al. (2021)Meyer et al. (2018, 2019)
Evaluation and Improvement	- Implementation and verification of programs with students - Evaluation of program effectiveness - Identification of meaningful outcome indicators - Evaluation of the level of resilience of schools	Nagata et al. (2022)Mirzaei et al. (2020)
Infrastructure and Location	- Importance of school location and infrastructure. - Specific considerations for schools in coastal and urban areas.	Thi & Shaw (2016)
Challenges and Opportunities	- Gap between the education system and disaster management - Need for more research and monitoring - Opportunities for participatory projects	Nakum et al. (2022)Meyer et al. (2018, 2019)Sheffield et al. (2017)
Results and Recommendations	- Improving Disaster Mitigation Literacy - Recommendations for stakeholders - Identification of key issues for DRR education implementation	Jaffar et al. (2024)Ribeiro et al. (2021)Shah et al. (2020)Nagata & Kimura (2017)Amri et al. (2017)

Table 3 presents a summary of the key topics and information presented in the articles. The initial topic addresses disaster awareness and education through the use of information and communication technologies (ICTs) and community participation. The second theme encompasses policy and planning through the implementation of continuous improvement, monitoring, and action plans for educational initiatives. The third theme addresses the issue of collaboration and community participation in the context of disaster education. The fourth theme addresses the evaluation and improvement of educational programs through the implementation and assessment of resilience-building initiatives within academic institutions. The fifth theme pertains to the management of infrastructure and the location of facilities. The sixth theme presents the results and recommendations for enhancing literacy and improving

disaster risk reduction (DRR) education.

4. Discussion

Research on natural disaster risk management in schools in recent decades provides various benefits at a general level, being essential to safeguard lives, protect infrastructure and guarantee educational progress in face of disaster risks. Schools must be prepared and be a model of prevention and effective response to possible catastrophic events (Gómez et al., 2021).

The purpose of this scoping review was to analyze the status of primary publications on natural disaster risk management in schools. The search found there are evaluations in bibliographic reviews worldwide but that they cover more general aspects of attention by organizations to families and community centers. Likewise, the role of schools in managing their strategies and addressing environmental problems that threaten the continuity of education and emotional stability in students.

The most notable research is which was evident in 2023, mentioning Pal et al. (2023) in which their literature review reveals that the participation of schoolchildren in the formation of a preventive culture is generally weak. This is mainly due to the authoritarian tendency of society as there is a lack of confidence in the ability of children to participate meaningfully in DRR. Likewise, the interruption of education due to damage to infrastructure causes prolonged school closures, which interrupts continuity of education. Also, the review highlights the lack of policies for implementation of the Comprehensive School Safety Framework: The need to develop clear policies in this area is identified, as well as the importance of social networks to foster resilience in schools. Future research should provide clear guidelines to improve children's participation in disaster risk reduction and explore the relationship between school disruptions and structural damage due to disasters.

Analyzing primary research from 2024, positive aspects are evident, such as prioritizing reconstruction of schools by modifying the framework of the citizen strategy to ensure the continuity of inclusive education at the community level after a disaster. Likewise, disaster education for children with the intervention in disaster education, through discussions, visual materials and interactive teaching on emergency management, is adequately conceived to improve children's awareness and knowledge about natural hazards and disaster risk reduction. In addition, the participation of the school community through school assemblies, children's clubs and activities designed by the school and social organizations in educational disaster risk reduction (DRR) is a strength. Also how fundamental is psychosocial support of school staff: The recognition of the role of teachers and school management in psychosocial support during disasters and pandemics is relevant.

After analyzing and comparing the articles provided, the following key differences can be highlighted: Pal et al. (2023) focuses on the weak aspects of children’s participation in disaster risk reduction (DRR), highlighting the authoritarian tendency of society, disruption of education due to infrastructure damage, and lack of clear policies. The 2024 primary articles also focus on the positive aspects, such as prioritizing school reconstruction, disaster education for children, and school community engagement in DRR. They also address issues such as

continuity of inclusive education, improving children's awareness and knowledge about natural hazards and DRR, and psychosocial support from school staff. Pal et al. (2023) focus on factors limit children's participation in DRR.

Pal et al. (2023) suggest the need to develop clear policies and provide guidelines to enhance children's participation in DRR, as well as explore the relationship between school disruptions and structural damage.

Considering the above comparisons, the progress in methods of attention to these disasters is also highlighted, as mentioned by Johnson et al. (2014), who in their research in various articles states that although a positive change has been observed in children's knowledge about disasters, there is still very limited empirical evidence on how disaster education programs facilitate children's role in home preparation, their self-protection capabilities, and their likelihood of being prepared for disasters when they are adults. In addition, the need to identify and refine theory of programs and significant outcome indicators, the authors suggest there are other opportunities for future research in this field.

Similarly, primary articles from 2020 are mentioned, where an interesting and relevant proposal is presented to address school prevention in the face of risky situations. It highlights two key aspects: Development of a "School Selection Framework": This initiative seeks to analyze extrinsic and intrinsic factors associated with school selection and safety, covering academic aspects, physical and human resources, and natural conditions. The idea of having a quantifiable and holistic framework to measure the resilience of schools is valuable, as it allows for a comprehensive view of the elements influence the capacity of educational institutions to face and recover from disaster situations. Integration of disaster risk reduction (DRR) in management documents. The need to reconceptualize the term "disaster" beyond natural event, focusing on its impact and consequences on infrastructure and society. It proposes to incorporate more content relevant to DRR in the dimensions of action and participation, especially in the primary and secondary education stages.

This is essential, since the integration of DRR in the school curriculum can contribute to developing students' awareness, knowledge and skills to face and mitigate the effects of disasters.

In the two articles mentioned above, it is mentioned that (Johnson et al. 2014) points out that, although a positive change in children's knowledge about disasters has been observed, empirical evidence on how disaster education programs facilitate children's role in household preparedness, their self-protection capabilities, and their likelihood of being prepared for disasters as adults is still very limited. The authors suggest that there are opportunities for future research in this field, in order to identify and refine program theory and meaningful outcome indicators. Instead, the primary articles from 2020 present an interesting and relevant proposal to address school resilience to disasters. It also highlights two key aspects: Development of a "School Selection Framework": This initiative seeks to analyze the extrinsic and intrinsic factors associated with school selection and safety, with the aim of having a quantifiable and holistic framework to measure school resilience. Integrating disaster risk reduction (DRR) into the geography curriculum, incorporating more relevant content in the educational stages.

5. Conclusions

This study has demonstrated the breadth of research and methodologies employed in the field of disaster risk management education at the school level. The studies encompass a range of topics, including the incorporation of educational initiatives into disaster risk management strategies, the assessment of program effectiveness, the measurement of school resilience, and the analysis of children's risk perceptions and preparedness behaviors. A number of the papers concentrate on particular geographical contexts, including Pakistan, Indonesia, China, Malaysia, and Vietnam. Furthermore, novel methodologies, such as the integration of participatory action research and the utilisation of school resilience frameworks for risk-informed decision-making, are proposed. In sum, these studies contribute to a more nuanced understanding of the ways in which education can serve as a pivotal tool for preparing for and mitigating the impact of disasters at the school level.

It is evident that comprehensive disaster risk reduction education at both the school and community levels is of great importance. Educational programs have been demonstrated to be an effective means of enhancing children's awareness and knowledge of natural hazards and preparedness measures. Similarly, the participation of teachers, school administrators, and parents is of paramount importance in providing psychosocial assistance and fostering resilience. To enhance efficacy, it is imperative to meticulously integrate pertinent material on mitigating these occurrences into the academic curricula, particularly at the primary and secondary levels. Furthermore, the development of quantifiable and holistic frameworks for assessing school resilience can facilitate informed decision-making and the implementation of appropriate preventive measures. In conclusion, a comprehensive and inclusive approach is essential for enhancing preventive strategies and effective community actions in the context of potential disasters.

It is evident that several challenges and lessons have been learned with regard to the incorporation of disaster prevention education in low- and middle-income countries. The incorporation of disaster education was observed to enhance children's capacity to implement protective measures and to facilitate their comprehension of the hazards present in their immediate surroundings. In addition to the activities conducted within the school setting, a number of other factors were identified as playing a significant role, including previous experience of disasters, the role of teachers, and the social organization of communities. The findings of the study offer crucial guidance to a range of stakeholders, emphasizing the necessity to refine program theory and outcome indicators, prioritize the integration of disaster mitigation education, and enhance collaboration between the education system and disaster management.

Furthermore, it identifies potential avenues for enhancing the geography curriculum and developing a comprehensive disaster risk reduction curriculum.

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