



SCHOOL-BASED EDUCATION FOR LANDSLIDE DISASTER PREPAREDNESS: A SYSTEMATIC REVIEW OF LEARNING PROCESSES, OUTCOMES, AND INFLUENCING FACTORS

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Abstract

Disaster education provides significant opportunities to enhance students' preparedness for disaster risks, particularly through school-based landslide education programs. However, previous studies have mainly examined learning processes, preparedness outcomes, or influencing factors separately, leaving limited integrative evidence regarding school-based landslide preparedness education. Therefore, this study addresses three main questions concerning: (1) the implementation of learning processes in school-based landslide education, (2) students' preparedness outcomes, and (3) factors influencing program effectiveness. This study employed a PRISMA-compliant systematic literature review using the Scopus and Google Scholar databases. Literature searches were conducted using keywords related to school-based education, disaster preparedness, landslides, and students, covering publications from 2015–2025. From 522 identified studies, 21 articles met the inclusion criteria after screening and eligibility assessment. The findings indicate that school-based education improves students' understanding of landslide risks, preparedness attitudes, risk awareness, and disaster response behavior through contextual and experiential learning approaches. Integrative learning processes, including STEAM-D approaches, disaster simulations, and field-based activities, were found to enhance students' engagement and contextual understanding of disaster risks. Program effectiveness is influenced by curriculum integration, teacher capacity, environmental awareness, policy support, and resource availability. Despite its strong potential, challenges remain, including limited learning materials and insufficient institutional support. This study is among the first PRISMA-based systematic literature reviews to integrate learning processes, preparedness outcomes, and influencing factors in school-based landslide education.

Keywords: School-based education; Disaster education; Landslide disaster; Students' preparedness; Learning processes; Preparedness outcomes; Influencing factors

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INTRODUCTION

مقدمة

In recent years, disaster education has undergone significant transformation, particularly in efforts to improve student preparedness for natural disasters through a school-based approach (Kabir, 2024; Cvetković et al., 2024). This transformation is increasingly visible through the integration of disaster risk reduction (DRR) concepts into the formal education system, where schools play a strategic role in building student awareness, knowledge, and preparedness for various disasters, including landslides (Ghale et al., 2025; Ronggowulan et al., 2024).

As part of this shift, various school-based learning approaches have shown significant potential in improving the quality of learning and student engagement in disaster education (Kurt

et al., 2026; Saryono et al., 2026). Approaches such as STEAM-D-based learning, simulations, educational games, and experiential activities like workshops and fieldwork enable students to understand disaster concepts in a more contextual and applicable way (Marahatta et al., 2024; Groch et al., 2024). These approaches not only increase student engagement but also support conceptual understanding and provide more meaningful learning experiences (Chaturvedi et al., 2018)

The use of school-based education in a disaster context has been shown to significantly impact student preparedness. Integrating disaster education into the curriculum allows educators to implement more interactive and student-centered learning approaches, ultimately improving the overall quality of education (Astuti et al., 2025). Furthermore, research shows that disaster education interventions can significantly improve students' risk perception, awareness, and preparedness actions, both in the short and long term (Yildiz et al., 2024; Asih et al., 2026). Furthermore, integrating disaster education into learning also contributes to the development of sustainable learning practices. Through understanding disaster risks, students can develop critical thinking and decision-making skills in emergency situations (Dewi et al., 2022; de Mendonça et al., 2025). By studying various disaster scenarios and mitigation strategies, students can understand the relationship between environmental phenomena, disaster risks, and the importance of preparedness in everyday life (Yildiz et al., 2023; Fauziyah et al., 2022).

The success of school-based education in improving student preparedness is also influenced by various complex factors. Factors such as knowledge level, disaster experience, socioeconomic conditions, and support from the school environment and educational policies play a crucial role in determining the effectiveness of disaster education (Saputra et al., 2021; Cvetković et al., 2024). Furthermore, challenges remain in implementing disaster education in schools, such as limited learning modules, students' low understanding of disaster preparedness school programs, and a lack of institutional support (Astuti et al., 2025; Ronggowulan et al., 2024).

However, although school-based education has been widely studied in the context of disasters, research specifically integrating the learning process, preparedness outcomes, and influencing factors within a comprehensive framework remains limited. Most previous studies tend to focus on a single aspect, such as the effectiveness of learning interventions (Yildiz et al., 2024), the influence of knowledge on preparedness (Fauziyah et al., 2022), or social factors influencing preparedness (Ghale et al., 2025), without examining the relationship between the three in an integrated manner. This indicates a research gap that underscores the urgency of this study to examine school-based education in improving student preparedness for landslides more comprehensively. Therefore, this study aims to identify, review, and integrate existing research on school-based education in improving students' preparedness for landslides by reviewing the learning process, preparedness outcomes, and influencing factors through a systematic literature review approach. This study is expected to provide a clearer picture of the current state of research, identify gaps in the existing literature, and contribute to the development of innovative learning approaches in school-based disaster education.

Based on the visualization of Indonesian disaster data in the image, 826 disasters were recorded, dominated by floods (387 incidents), followed by extreme weather (257 incidents), forest and land fires (90 incidents), and landslides (72 incidents). Although the number of landslide incidents is not as large as floods, their distribution indicates that this disaster remains a serious threat in various regions of Indonesia, especially in areas characterized by hilly topography and high rainfall. The map shows several areas in the medium to high risk category,

indicating that vulnerability to landslides is geographically distributed and has the potential to affect residential environments and educational units. This condition emphasizes that preparedness for landslides needs to be an important part of the education system, especially through school-based disaster education. Schools have a strategic role in building students' understanding of potential disasters in their area, so that students not only have theoretical knowledge but also practical readiness in dealing with emergency situations. Thus, the disaster incident data in the image reinforces the urgency of developing school-based disaster education as a preventive effort to increase students' preparedness for landslide risks in Indonesia.



Figure 1. Visualization of Indonesian disaster incident data

Based on the identified research gap, this study addresses the following research questions: 1) What are the trends in research publications related to school-based education in improving student preparedness for landslide disasters? 2) RQ2. How is the learning process implemented in school-based education to improve students' preparedness for landslide disasters? 3) RQ3. How does school-based education contribute to students' preparedness outcomes in facing landslide disasters? 4) RQ4. What are the factors that influence the effectiveness of school-based education in increasing students' preparedness for landslide disasters? 5) RQ5. What are the challenges and research gaps in the implementation of school-based education related to landslide disaster preparedness that still need to be developed?

Based on the identified research gap and the increasing urgency of strengthening disaster preparedness education in disaster-prone areas, this study seeks to provide a comprehensive synthesis of the existing literature related to school-based education in improving students' preparedness for landslide disasters. By integrating discussions on learning processes, preparedness outcomes, and influencing factors within a single analytical framework, this study is expected to contribute theoretically to the development of disaster education research and practically to the implementation of more contextual, effective, and sustainable disaster preparedness learning in schools. Accordingly, this study addresses the following research questions

METHOD | **منهج**

This research was conducted by following the following stages: (1) formulating research questions and determining research objectives and focus, (2) determining inclusion and exclusion criteria, (3) developing a literature search strategy, (4) selecting literature based on inclusion and exclusion criteria, and (5) data extraction and synthesis.

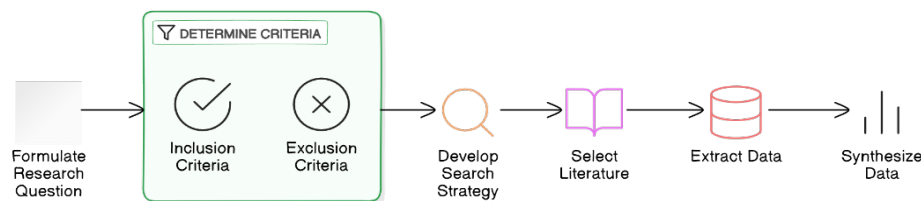


Figure 1. Research steps

Research Objectives and Questions

The purpose of this study is to review and analyze existing literature related to the implementation of school-based education in improving student preparedness for landslides. Various studies have shown that disaster education in schools plays a crucial role in shaping student preparedness through diverse learning processes and is influenced by various supporting factors (Asih et al., 2026; Yildiz et al., 2024; Fauziyah et al., 2022). Specifically, this study aims to identify the learning processes used, analyze the preparedness outcomes obtained by students, and explore factors that influence the effectiveness of school-based education programs (Saryono et al., 2026; Marahatta et al., 2024; Cvetković et al., 2024).

The systematic analysis in this study aims to answer several research questions. Therefore, this study formulates several research questions as follows (Table 1).

Table 1. Research Questions

Research Questions	Question
RQ1	What are the trends in research publications related to school-based education in improving student preparedness for landslide disasters?
RQ2	How is the learning process implemented in school-based education to improve students' preparedness for landslide disasters?
RQ3	How does school-based education contribute to students' preparedness outcomes in facing landslide disasters?
RQ4	What are the factors that influence the effectiveness of school-based education in increasing students' preparedness for landslide disasters?
RQ5	What are the challenges and research gaps in the implementation of school-based education related to landslide disaster preparedness that still need to be developed?

Inclusion and Exclusion Criteria

One potential problem in systematic literature reviews is selection bias, which can arise if inclusion and exclusion criteria are not clearly defined (Fauziyah et al., 2022). Therefore, it is important to establish objective and systematic criteria to ensure the quality and relevance of the studies analyzed. This study established the inclusion and exclusion criteria as presented in Table 2.

Table 2. Inclusion and Exclusion Criteria

Category	Inclusion	Exclusion	Reason
Study Content	A study that focuses on school-based education in the context of disaster preparedness, especially landslides.	Studies that discuss disaster education in general without focusing on the school context or are not related to landslides	Maintaining relevance with research focus on school-based education and landslide disasters
Educational Context	Studies that address learning processes, preparedness outcomes, or influencing factors in a student/school context	Studies that do not focus on students or formal educational contexts (e.g., general community)	Ensuring appropriateness to the student's educational context

Publication Type	Relevant peer-reviewed journal articles and conference proceedings (Scopus indexed)	Books, book chapters, editorials, opinion pieces, project reports, or documents that have not undergone a peer-review process	Ensuring the quality and credibility of data sources
Time Span	Studies published in 2015–2025	Studies published before 2015	Ensuring the novelty and relevance of research
Publication Language	Studies published in English or Indonesian	Study in languages other than English and Indonesian	Ensuring understandability and accuracy of analysis
Literature Source	Studies indexed in the Scopus database	Studies not indexed by Scopus	Ensuring international quality standards

Literature Search

A comprehensive literature search was conducted using the Publish or Perish application. The Scopus database was used to ensure the quality and credibility of the literature sources. Google Scholar was also used to ensure broader search coverage. The search process was conducted using keywords relevant to the research topic, namely school-based education, disaster preparedness, and landslides.

The search strings used were: ("school-based education" OR "disaster education" OR "disaster risk reduction") AND ("disaster preparedness" OR preparedness) AND ("landslide" OR "landslide disaster") AND (students OR "school students")

Table 3. Literature Search

String	Meaning	Reason
"school-based education" OR "disaster education" OR "disaster risk reduction"	Covers various terms related to school-based education and disaster education	Accommodate the variety of terms used in the literature
AND	Connecting keyword groups	Ensuring search results are relevant to all aspects of the research
"disaster preparedness" OR preparedness	Focusing on the concept of disaster preparedness	Filtering studies that discuss preparedness outcomes
AND	Connecting with the type of disaster	Narrowing the search according to the research context
"landslide" OR "landslide disaster"	Referring to the landslide disaster	Ensuring relevance to the research focus

In the literature search process, it is important to identify the main keywords, understand the variations of terms and synonyms that may be used, and relate these keywords with Boolean operators to obtain relevant search results.

Literature Selection

The initial search results were used as the basis for the literature selection process, which aimed to minimize potential bias. This selection process was conducted using Covidence software to facilitate systematic reference management. The initial stage involved identifying and removing duplicate articles based on predetermined inclusion criteria. To ensure accuracy, the duplication identification process was also performed manually.

Each remaining article was then evaluated through two main stages. The first stage was a review of the title and abstract to determine its initial relevance to the research topic, namely school-based education in improving student preparedness for landslides. The second stage was a full-text review to ensure the article met the predetermined inclusion criteria. Articles that met

these criteria were then further analyzed to assess their quality and suitability to the research objectives.

Data Extraction and Synthesis

Data for this study were extracted using a Microsoft Excel spreadsheet that included key information, such as author(s), article title, year of publication, research objectives, methods, sample size, and key findings. Furthermore, Mendeley software was used to facilitate reference management and capture basic metadata, such as author(s), title, and year of publication.

The collected data was then systematically synthesized by grouping the research findings into three main categories: learning processes, preparedness outcomes, and influencing factors. This synthesis process aimed to identify patterns, relationships, and research gaps relevant to school-based education in improving student preparedness for landslides.

RESULT | نتائج

This section presents the results of a Systematic Literature Review (SLR) aimed at examining the role of school-based education in improving student preparedness for landslide disasters, by examining in-depth the learning process, preparedness outcomes, and influencing factors. The analysis was conducted on selected articles that had gone through a systematic selection process, resulting in a comprehensive, structured, and relevant synthesis of findings to the research focus.

The findings in this study are organized into three main focuses, namely: (1) learning processes which include approaches, strategies, and learning models used in disaster education in schools, (2) preparedness outcomes which reflect the increase in students' knowledge, attitudes, and skills in facing landslides, and (3) influencing factors which include internal and external aspects that influence the level of student preparedness, such as individual characteristics, experience, school environment, and policy support. These three aspects are important indicators in assessing the effectiveness of the implementation of school-based disaster education in building student preparedness in a sustainable manner. However, before discussing the results of the synthesis further, it is necessary to first explain the PRISMA flow used in the article search and selection process.

PRISMA Flow in Article Search

This review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines for study identification, screening, selection, and inclusion. This approach was used to ensure that the literature search process was systematic, transparent, and replicable. The PRISMA flowchart illustrates the overall stages of article selection conducted in this study.

During the identification stage, 522 articles were obtained through a systematic search of the Scopus database using a combination of keywords related to school-based education , disaster education , landslide , preparedness , and student preparedness . Additional searches were conducted through citation tracking to ensure the completeness of relevant sources. All obtained articles were then compiled and checked to identify potential duplication. After the duplication removal process, the number of articles was reduced to 438, which then entered the screening stage . At this stage, titles and abstracts were reviewed to assess their initial suitability to the research focus, namely school-based education in improving student preparedness for landslides. Irrelevant articles, such as those not addressing the educational context, not focusing on disaster preparedness, or not relevant to students, were eliminated at this stage.

The results of the screening process showed that 112 articles met the initial criteria and proceeded to the eligibility assessment stage. At this stage, a thorough review of the full text of the articles was conducted to ensure compliance with the established inclusion and exclusion criteria, including a focus on the learning process, preparedness outcomes, and factors influencing student preparedness.

Furthermore, a number of articles were excluded because they did not meet the criteria, such as not specifically discussing school-based disaster education, not directly examining student preparedness, or not providing sufficient empirical data for in-depth analysis. In the final stage, namely inclusion, 21 articles were obtained that met all criteria and were deemed relevant for further analysis. These articles were then used as the basis for the thematic synthesis and comprehensive analysis process in this study.

This multistep selection process aims to ensure that the analyzed studies are of high quality and strongly relevant to the focus of the study. Thus, the results provide an accurate and in-depth picture of the role of school-based education in improving student preparedness for landslides, particularly in terms of the learning process, outcomes achieved, and influencing factors.

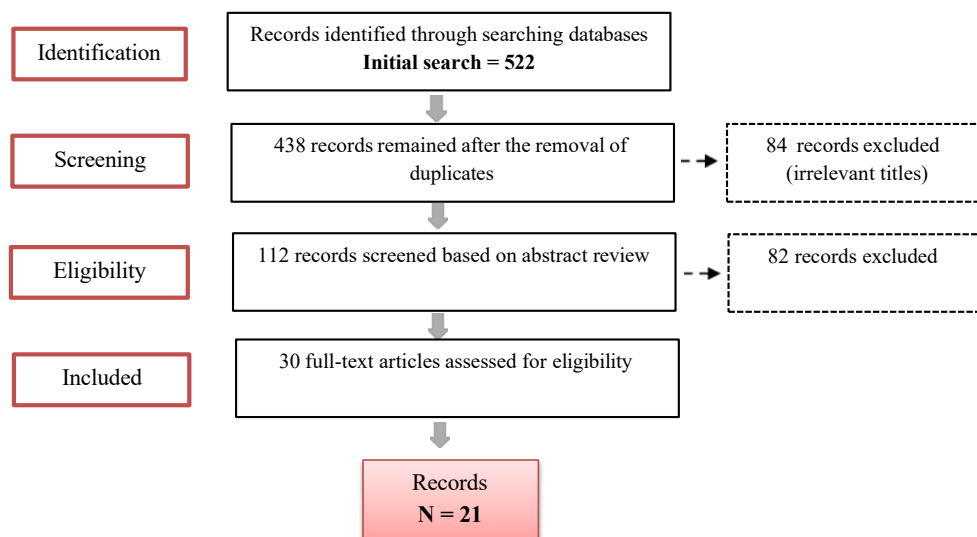


Figure 1. PRISMA Flow in Article Search

Note. Adapted from Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement by Moher, D., Liberati, A., Tetzlaff, J., & Altman, D.G., 2009, *BMJ*, p. 339 (<https://doi.org/10.1136/bmj.b2535>)

Bibliographic Information of Included Articles

Table 4 presents bibliographic information for the 21 studies included in the final review. These studies specifically examine the role of school-based education in improving student preparedness for landslides, focusing on how learning processes are implemented, the resulting preparedness outcomes, and the various influencing factors. The selected articles were selected from over 500 initial publications, which were then systematically screened to obtain the most relevant and high-quality studies for in-depth analysis.

The studies analyzed came from various countries and covered various educational levels, from primary to secondary. This diversity demonstrates that school-based disaster education can be widely implemented in various educational contexts. Several studies emphasize the importance of integrating disaster education into the formal curriculum and strengthening environmental awareness as part of the learning process (Acevedo et al., 2022; Hays & Reinders,

2020). Furthermore, other research indicates that disaster education plays a significant role in enhancing students' knowledge of disaster risks and mitigation strategies (Ghale et al., 2025; Kabir, 2024).

In terms of methodology, the studies analyzed employed various research designs, including quantitative, qualitative, experimental, and case study approaches. This diversity provides a comprehensive overview of the effectiveness of school-based disaster education. Several studies have shown that the use of simulations and hands-on experiences can significantly improve students' understanding of disaster risk (Chaturvedi et al., 2017). Furthermore, contextual and experiential learning approaches have also been shown to help students understand disaster situations more deeply (Groch et al., 2024).

Furthermore, the articles reviewed demonstrate various implementations of the learning process in disaster education. Strategies used include disaster simulations, experiential learning, and school-based activities relevant to local conditions. Disaster preparedness school programs are also a widely used approach to improving student preparedness through active engagement in learning activities (Asih, 2026; Ronggowulan et al., 2024). Furthermore, the role of teachers is crucial in integrating disaster material into meaningful and contextual learning (Saryono et al., nd).

In terms of preparedness outcomes, most studies show that school-based disaster education can improve students' knowledge, attitudes, and skills in disaster preparedness. This improvement includes understanding of landslide risks, the ability to respond to emergency situations, and readiness to take appropriate action (Fauziyah et al., 2022; Dewi et al., 2022). Furthermore, factors such as environmental awareness and risk perception also influence students' preparedness levels (Cvetković et al., 2024; Saputra et al., 2021).

However, several studies have also identified various factors influencing the effectiveness of disaster education implementation in schools. These factors include limited resources, teacher preparedness, policy support, and students' environmental conditions. Furthermore, there is still a need to develop more contextualized learning materials tailored to disaster-prone areas, particularly landslides (Astuti et al., 2025; de Mendonça et al., 2025).

Overall, the diverse characteristics of the studies analyzed provide a comprehensive overview of the development of research related to school-based education in improving student preparedness for landslides. These studies emphasize that the success of disaster education is determined not only by the learning process but also by the results achieved and the various factors that influence them. Thus, this study provides a strong foundation for developing more effective, contextualized educational strategies oriented toward improving student preparedness for facing real-life disaster risks. The following is a bibliographic information table for the included articles.

Table 4. Bibliographic Information of Included Articles

Author/Year	Journal	Summary of Findings
Asih (2026)	Gaceta Médica de Caracas	The disaster preparedness school program improves students' preparedness behavior in schools.
Kurt et al. (2026)	Psychology, Health & Medicine	The STEAM-D approach effectively improves disaster preparedness in children through experience-based learning.
Ghale et al. (2025)	BMC Public Health	Students' knowledge about disaster risk reduction still needs to be improved through formal education.
Saryono et al. (nd)	Educational Horizon	Physical education teachers play a strategic role in integrating disaster education through experience-based learning.

de Mendonça et al. (2025)	Natural Hazards	Effective educational interventions increase students' understanding of landslide risks.
Chaturvedi et al. (2017)	NHESS Discussions	Interactive simulations with experiential feedback enhance understanding of disaster risk.
Fauziyah et al. (2022)	IOP Conference Series	Disaster knowledge influences student preparedness.
Yildiz et al. (2022)	Risk Analysis	There is a relationship between knowledge, risk perception, and student preparedness.
Dewi et al. (2022)	IOP Conference Series	Learning increases students' understanding of natural disasters.
Cvetković et al. (2024)	Preprints	Environmental awareness and safety knowledge influence student preparedness.
Kabir (2024)	Springer (Book Chapter)	Education and risk awareness are the main factors in disaster mitigation.
Saputra et al. (2021)	IOP Conference Series	Socio-demographic factors and experience influence disaster preparedness.
Astuti et al. (2025)	Journal of Ecohumanism	Disaster mitigation-based social studies modules are needed in the curriculum.
Groch et al. (2024)	Revista Notas Históricas and Geográficas	Experience-based education is effective in reducing landslide risk.
Ronggowulan et al. (2024)	IOP Conference Series	Disaster-prone schools need strengthening of disaster education.
Tuna & Stone (2026)	Nutrition Bulletin	Climate change awareness influences the sustainable behavior of the younger generation.
Yaumi et al. (2019)	Indonesian Journal of Science Education	Issue-based learning improves scientific literacy related to climate change.
Renzi et al. (2025)	Discourse Studies	Climate change has an impact on the psychological aspects of students.
O'Hara et al. (2025)	Wilderness & Environmental Medicine	Sustainability education is important in an interdisciplinary context.
Røkenes et al. (2025)	Futures	Learning narratives build social awareness and sustainability.
Bašić & Davidsson (2025)	International Journal of Science Education	Collaboration with professionals increases student engagement and understanding.
Author/Year	Journal	Summary of Findings
Asih (2026)	Gaceta Médica de Caracas	The disaster preparedness school program improves students' preparedness behavior in schools.
Kurt et al. (2026)	Psychology, Health & Medicine	The STEAM-D approach effectively improves disaster preparedness in children through experience-based learning.

Bibliographic Information of Included Articles

Publication data was searched through the Scopus database using keywords related to disaster education, disaster preparedness, natural hazards, and the context of school-based education. Based on search parameters limited to the 2015–2024 period, approximately 500–800 documents relevant to the research topic were obtained. The subsequent selection process focused on suitability with the focus of the study, namely student preparedness for landslides. Therefore, screening was carried out to eliminate irrelevant articles, such as studies that did not focus on the educational context, did not involve students, or did not discuss aspects of disaster preparedness. After going through this process, several articles were obtained that met the inclusion criteria and were used as the main dataset in this study.

Based on the publication trends in Figure 2, the number of publications in the initial period (2015–2019) was relatively limited and gradually increased year after year. Entering 2020, the number of publications showed a fairly clear increase, then remained at a high level until 2023, before reaching its peak in 2024. This pattern indicates that attention to the topic of school-based disaster education has been growing in recent years.

The increasing number of publications since 2020 indicates that this topic is beginning to receive broader attention in academic studies, particularly in the context of improving students'

disaster preparedness. This aligns with growing global awareness of the importance of disaster mitigation education as part of sustainable development (Hays & Reinders, 2020; Acevedo et al., 2022). Furthermore, the increasing incidence of natural disasters also emphasizes the need to strengthen community knowledge and preparedness from school age (Kabir, 2024; Cvetković et al., 2024).

Furthermore, the development of these publications also demonstrates that research is no longer solely focused on knowledge, but is beginning to address broader learning outcomes, such as attitudes, risk awareness, and emergency response skills. Several studies have shown that school-based disaster education can improve student understanding and foster preparedness behaviors (Fauziyah et al., 2022; Dewi et al., 2022). Other factors, such as learning experiences and environmental conditions, also influence students' preparedness levels (Saputra et al., 2021; Groch et al., 2024).

Thus, the growing trend in publications indicates that school-based disaster education, particularly in the context of landslide preparedness, is a growing and relevant field. This also underscores the importance of considering the learning process, preparedness outcomes, and factors influencing the effectiveness of its implementation in educational contexts.

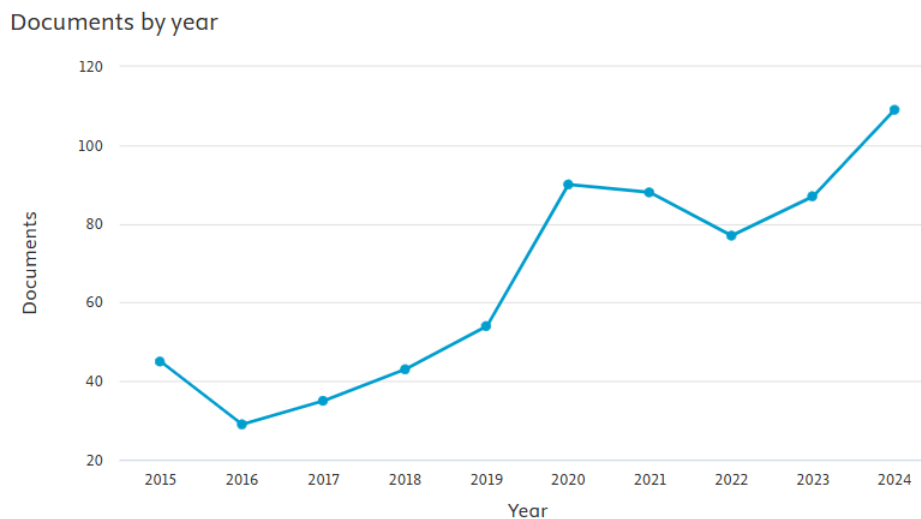


Figure 2. Trend of increasing number of publications (2015-2025)

Visualization of Research Bibliometric Networks

Based on the results of the bibliometric network visualization using VOSviewer, three main clusters were identified that represent the structure and direction of research development related to school-based education to enhance students' preparedness for landslide disasters. Each cluster shows the relationship between concepts that form the focus of the study on the learning process, student preparedness outcomes, and influencing factors in the context of disaster education in schools. In general, this map shows that research does not only focus on the technical aspects of disasters, but also on the integration of education, learning experiences, and student characteristics in building preparedness.

Cluster 1, shown in red, focuses on keywords such as disaster management, disaster risk reduction, climate change, risk assessment, vulnerability, and landslide. This cluster reflects a primary focus on the conceptual and contextual aspects of disaster risk, particularly landslides, which form the basis for developing school-based education. The dominance of these keywords indicates that understanding risk, vulnerability, and climate change is a crucial foundation for

building student preparedness. This aligns with research emphasizing the importance of disaster literacy and risk understanding as key prerequisites for improving student preparedness (Kabir, 2024; Yildiz et al., 2022). Furthermore, landslide-related educational interventions have been shown to significantly increase students' awareness and understanding of disaster risk (de Mendonça et al., 2025; Groch et al., 2024).

Cluster 2, shown in blue, focuses on the learning process in the school environment, with keywords such as education , learning , teaching , schools , preparedness , earthquake , and Indonesia . This cluster demonstrates that school-based education is the primary medium for transforming disaster knowledge to students. Learning approaches such as experiential learning , simulations, and flipped classrooms play a crucial role in enhancing students' conceptual understanding and preparedness for disasters (Jensen et al., 2018; McLean et al., 2016). Furthermore, the use of interactive simulations has proven effective in helping students understand landslide risks through more contextual learning experiences (Chaturvedi et al., 2017; Lord et al., 2025). This is supported by research showing that increasing disaster knowledge through school learning directly contributes to improved student preparedness (Dewi et al., 2022; Fauziyah et al., 2022).

Cluster 3, shown in green, relates to preparedness outcomes and influencing factors, with keywords such as disaster preparedness , disaster planning , training , humans , questionnaire , curriculum , and psychology . This cluster emphasizes evaluation aspects, student characteristics, and psychological and social factors that influence preparedness. The presence of keywords such as training and curriculum demonstrates the importance of integrating disaster education programs into the school curriculum to systematically improve student preparedness (Asih, 2026; Astuti et al., 2025). Furthermore, individual factors such as knowledge, experience, and sociodemographic characteristics also play a role in determining students' preparedness levels (Saputra et al., 2021; Ghale et al., 2025). Experiential learning and authentic assessment approaches have also been shown to improve students' self-efficacy, critical thinking skills, and preparedness in dealing with emergency situations (Habib et al., 2021; Oroh et al., 2025; Chong et al., 2016).

Overall, the results of this analysis indicate that research on school-based education to improve student preparedness for landslide disasters is developing in three main directions, namely: (1) strengthening understanding of disaster risks and contexts, (2) optimizing experiential learning processes in schools, and (3) improving student preparedness outcomes influenced by curriculum factors, training, and individual characteristics. The interrelationships between clusters indicate that student preparedness is not only determined by knowledge alone, but also by authentic learning experiences, appropriate learning strategies, and the support of an integrated education system. Thus, a school-based education approach that combines cognitive, experiential, and contextual aspects is key to improving student preparedness for landslide disasters in a sustainable manner.

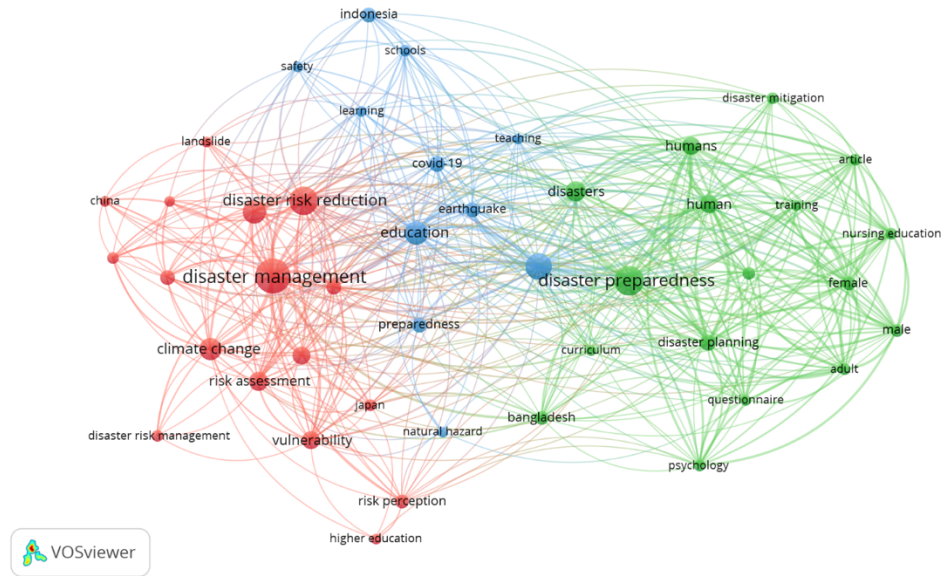


Figure 3. Visualization of Research Bibliometric Networks

Research Key Network Visualization

Overlay visualization is used to analyze development patterns and novelty trends in school-based education research to enhance students' preparedness for landslide disasters. This analysis aims to identify shifts in research focus based on the publication year of the analyzed scientific articles. In the overlay map generated by VOSviewer, color gradations indicate publication time, where darker colors (blue–green) represent older research, while lighter colors (yellow) indicate newer or emerging research topics.

Based on the visualization results, it can be seen that most of the nodes in the network are dominated by the color yellow, indicating that research related to school-based education in improving student preparedness for landslides has experienced rapid development in recent years. Some keywords that appear with the brightest colors and relatively large node sizes include disaster preparedness, disaster management, disaster risk reduction, education, training, and humans. The emergence of these keywords as new topics indicates that the current research direction is increasingly focused on strengthening student preparedness through the integration of disaster education in schools, increasing individual capacity, and experience-based training. This finding is in line with research showing that school-based disaster education and increased knowledge have a significant role in improving student preparedness (Asih, 2026; Fauziyah et al., 2022; Ghale et al., 2025).

Furthermore, the correlation between the keywords education, schools, learning, and teaching, also displayed in bright colors, indicates that the learning process is a primary focus in recent research trends. This indicates a shift toward a more contextual and experience-based learning approach in disaster education. Approaches such as experiential learning, simulations, and interactive learning have proven effective in improving students' understanding of landslide risks and preparedness (Chaturvedi et al., 2017; Habib et al., 2021; Dewi et al., 2022). Furthermore, curriculum integration and innovative learning strategies are also a concern in optimizing disaster learning outcomes in schools (Astuti et al., 2025).

On the other hand, several keywords displayed in darker shades, such as risk assessment, vulnerability, climate change, and risk perception, indicate that these topics have already been developed and become foundational in disaster research. These topics focus on conceptual

Learning Processes in School-Based Education for Landslide Disaster Preparedness

The literature analysis shows that learning processes in school-based education programs for landslide disaster preparedness have undergone significant development. This development is marked by a shift from informative and one-way programs to programs systematically designed to actively engage students through contextual, participatory, and practice-based learning experiences. Thus, the learning process is no longer a mere classroom activity but is integrated into the design of school programs specifically aimed at building disaster preparedness.

Within the program context, learning processes are designed as a series of structured activities that connect students' knowledge, skills, and attitudes to landslide risk. The program not only includes the delivery of disaster material but also includes evacuation simulations, emergency response training, and student involvement in school-based mitigation activities. This demonstrates that learning within the disaster preparedness program has transformed into a real-world-oriented learning process, thereby enhancing student preparedness more comprehensively.

One of the key characteristics of the learning processes in this program is the application of an experiential learning approach that is directly integrated into program activities. For example, disaster preparedness school programs often include landslide simulations, regular evacuation drills, and the use of interactive media to visualize disaster risks. Studies show that integrating simulations into the program can improve students' understanding of evacuation procedures and decision-making in emergency situations (Chaturvedi et al., 2017; Sung et al., 2018; Lord et al., 2025). Thus, the learning processes in the program are not only theoretical but also train students' practical responses.

Furthermore, program development is also marked by the use of technology as an integral part of the learning process. In some programs, technologies such as virtual reality (VR) and digital platforms are used to support immersive disaster simulations. This technology allows the programs to present complex landslide scenarios that are difficult to replicate directly in the field, thereby enriching students' learning experiences (Li et al., 2022; Renganayagalu et al., 2021). Thus, technology in the programs serves as a means to improve the quality of learning processes while expanding the scope of learning experiences. The program's learning processes are developed through the integration of various innovative learning strategies designed within the framework of school activities.

The program does not rely solely on a single method, but combines various approaches such as flipped classrooms, project-based learning, and collaborative learning. In its implementation, students can learn basic concepts independently before participating in program activities such as simulations or group discussions, allowing program implementation time to be focused on applicable and reflective activities (Jensen et al., 2018; Koo et al., 2016; McLean et al., 2016; Velegol et al., 2015; Park & Howell, 2015).

Within the program framework, project-based learning is also a crucial component supporting learning processes. Programs often involve students in real-world projects such as developing school evacuation plans, mapping landslide-prone areas, or conducting disaster preparedness campaigns. These activities demonstrate that learning occurs not only in the classroom but also through students' direct involvement in activities relevant to the school environment. This strengthens the connection between learning and the real-world contexts students encounter.

Social interaction is also an important part of the program's learning processes . Many disaster preparedness programs are designed as group-based programs, where students collaborate in simulations, discussions, and projects. This approach not only enhances understanding but also fosters coordination, communication, and cooperation, which are crucial in emergency situations (Calvo-Sastre, 2020). Thus, the program fosters not only individual but also collective preparedness.

The role of teachers within the program context has also undergone significant changes. Teachers act as facilitators and program managers responsible for designing, implementing, and evaluating learning processes . Teachers not only deliver material but also ensure that each activity within the program provides meaningful learning experiences relevant to the risk conditions in the school environment (Saryono et al., nd). Furthermore, teachers also play a role in integrating preparedness programs into the school curriculum to ensure sustainable learning. The program's learning processes have begun to integrate sustainability values and environmental awareness. The program focuses not only on disaster response but also on mitigation and prevention efforts through environmentally friendly behaviors. This demonstrates that disaster preparedness programs have evolved into a broader educational framework, namely education for sustainability (Acevedo et al., 2022).

Overall, learning processes in school-based education programs for landslide preparedness demonstrate a shift toward a more structured, integrative, and experience-based approach. The programs serve not only as a platform for imparting knowledge but also as a learning system designed to foster students' cognitive readiness, practical skills, and social awareness. Therefore, the development of disaster preparedness programs in schools needs to continue to be directed toward innovative, adaptive and contextual learning processes to address the challenges of future disaster risks.

Preparedness Outcomes in School-Based Education

In terms of preparedness outcomes , the literature shows that school-based education makes a significant contribution to comprehensively improving students' preparedness for landslides. This preparedness extends beyond knowledge alone to changes in attitudes, risk awareness, and practical skills in responding to emergency situations. Therefore, learning outcomes in the context of school-based disaster education are multidimensional, involving the integration of cognitive, affective, and skills as an inseparable whole.

From a cognitive perspective, school-based education has proven effective in improving students' understanding of the risks, causes, and impacts of landslides. Students exposed to disaster education are better able to identify factors that trigger landslides, such as geographic conditions, high rainfall, and human activities that contribute to environmental vulnerability. This knowledge serves as an important foundation for developing preparedness, as a good understanding of risk enables students to make more informed decisions in emergency situations (Dewi et al., 2022; Fauziyah et al., 2022; Ghale et al., 2025). Furthermore, improving disaster literacy is also related to students' ability to understand the relationship between environmental change and the potential for disasters, including its link to climate change issues (Cvetković et al., 2024; Tuna & Batu, 2026).

Furthermore, this improvement in cognitive aspects also contributes to students' critical thinking skills in dealing with uncertain situations. Students not only retain information but are also able to analyze environmental conditions, evaluate risk levels, and determine the most appropriate course of action based on the situation at hand. This is especially important in the

context of landslides, which often occur suddenly and require a rapid and appropriate response. In terms of affective aspects, school-based education plays a crucial role in developing students' mental and emotional preparedness for disasters. Learning that involves hands-on experiences, such as simulations and preparedness exercises, can increase self-confidence, reduce panic, and strengthen students' psychological preparedness when facing emergency situations (Renzi et al., 2025; Alwafi, 2025). Furthermore, active involvement in the learning process also fosters a sense of responsibility for the safety of oneself and others.

This affective aspect also includes increased risk awareness and environmental awareness. Students become more sensitive to the early signs of landslides and understand the importance of preventative measures. This awareness encourages students to be more proactive in mitigating disasters, not just reactive to them, but also proactive in implementing mitigation efforts, both within the school and in the community. Thus, school-based education not only shapes individuals who are prepared to face disasters but also agents of change who play a role in reducing disaster risk in their communities.

In terms of skills, school-based disaster education has been shown to improve students' practical abilities in responding effectively to emergency situations. These skills include the ability to evacuate independently, understand and follow evacuation routes, conduct emergency communications, and make quick and accurate decisions in crisis situations. Disaster preparedness school programs have shown that students who receive structured training and learning have higher levels of preparedness than those who do not receive similar interventions (Asih, 2026; Groch et al., 2024; de Mendonça et al., 2025).

Furthermore, a training-based approach also contributes to improving students' self-efficacy, which is their confidence in their abilities to deal with disaster situations. Students with high levels of self-efficacy tend to be more prepared to take action, able to control their emotions, and more adaptable to emergency situations (de Sousa Mata et al., 2021). This suggests that preparedness is determined not only by knowledge and skills but also by psychological factors that influence individual behavior in crisis situations. The results of school-based education are also evident in students' improved ability to work together and collaborate in disaster response. Learning activities involving group work and collaborative simulations help students understand the importance of coordination, communication, and the role of each individual in an emergency situation. These skills are crucial, given that disaster management generally involves effective teamwork and coordination.

Overall, the preparedness outcomes of school-based education demonstrate that this approach can lead to a holistic improvement in student preparedness. The integration of knowledge, attitudes, and skills enables students not only to understand disaster risks but also to act appropriately and confidently when faced with emergencies. Therefore, school-based education plays a strategic role in developing a disaster-resilient generation, particularly in the context of landslides, which pose a high risk in various regions.

Influencing Factors in Student Preparedness for Landslide Disasters

Although school-based education has demonstrated a positive impact in improving students' landslide preparedness, the literature also identifies various factors that influence this success. These factors are multidimensional and interconnected, encompassing individual, social, environmental, and educational system aspects. The success of disaster education is determined not only by the learning process itself, but also by the students' internal conditions and the surrounding external context.

One of the main factors is students' level of knowledge and risk perception regarding disasters. A good understanding of the risks, causes, and impacts of landslides will increase students' preparedness to take appropriate and swift action when facing an emergency (Kabir, 2024; Yildiz et al., 2022). A high risk perception tends to make students more alert, responsive, and more likely to prepare more seriously. Conversely, a low risk perception can lead to apathy and a lack of preparedness in the face of disasters. Therefore, developing an accurate risk perception is a crucial aspect of school-based disaster education.

Furthermore, sociodemographic characteristics also influence students' levels of preparedness. Factors such as age, gender, educational background, and previous disaster experience can determine how students understand and respond to risks (Saputra et al., 2021). Students who are more mature or have direct disaster experience tend to have higher levels of preparedness compared to students who have not been exposed. Gender differences can also influence how students respond to risks, both emotionally and behaviorally, so these factors need to be taken into account when designing disaster education programs.

Another equally important factor is curriculum design and the level of integration of disaster education into school learning. A curriculum that systematically integrates disaster mitigation and sustainability issues will be more effective in shaping student preparedness than a partial or incidental approach (Astuti et al., 2025; Hays & Reinders, 2020). This integration allows students to understand disaster concepts in a sustainable and contextual way, rather than simply as supplementary material. Furthermore, a learning approach that links disaster education to everyday life can also increase student relevance and understanding.

Furthermore, integrating sustainability values and environmental awareness into learning contributes to shaping long-term preparedness behaviors. Education that instills environmental awareness, such as maintaining slope stability and avoiding activities that could potentially trigger landslides, will help students not only be prepared for disasters but also play a role in mitigation efforts (Acevedo et al., 2022; O'Hara et al., 2025). Thus, preparedness is understood not only as a response to disasters but also as part of ongoing preventive behavior.

Technological developments are also a crucial factor in increasing the effectiveness of school-based education in the context of disasters. The use of technologies such as digital simulations, virtual reality, and generative AI enables more interactive, immersive, and contextual learning experiences (González-Marcos et al., 2016; Salinas-Navarro et al., 2024). This technology helps students understand disaster scenarios more realistically without having to experience the event directly. Furthermore, technology also allows for more adaptive and personalized material delivery, tailoring it to the needs and level of understanding of each student.

On the other hand, school environmental factors and institutional support also play a significant role in determining the success of disaster education. Schools with policies, programs, and supporting facilities, such as evacuation routes, regular simulations, and preparedness training, are better able to develop students who are prepared for disasters. Support from teachers and principals, as well as collaboration with external parties such as the government and disaster agencies, are also crucial factors in strengthening the implementation of school-based disaster education programs.

However, various challenges can hinder the effectiveness of school-based disaster education. Limited resources, including facilities, learning time, and teacher competency, are major obstacles to optimal program implementation. Not all schools have equal access to

technology or disaster training, creating disparities in student preparedness. Furthermore, teacher readiness to integrate disaster materials into learning is also a crucial factor influencing program success. Students' psychological factors also influence their level of preparedness. Anxiety or fear of disasters can have a dual impact, increasing alertness while also hindering students' ability to think clearly and make decisions during emergencies (Renzi et al., 2025). Therefore, it is important for disaster education to focus not only on knowledge and skills but also on students' mental preparedness through a supportive and non-traumatic approach.

Overall, the factors influencing student preparedness in school-based education demonstrate that the success of disaster education relies heavily on the interaction of various complex factors. Individual factors, curriculum, technology, the school environment, and students' psychological well-being all contribute to achieving optimal levels of preparedness. Therefore, a holistic, integrative, and sustainable approach is needed in designing and implementing disaster education in schools to produce students who are not only prepared for disasters but also possess the awareness and capacity to contribute to future disaster risk mitigation efforts.

CONCLUSION | خاتمة

This systematic literature review demonstrates that research on school-based education in improving students' preparedness for landslide disasters continues to develop toward more contextual, experiential, and student-centered approaches. Regarding RQ1, publication trends indicate increasing attention to disaster education as part of disaster risk reduction efforts in formal education settings. Regarding RQ2, the findings show that learning processes have shifted from conventional instruction toward experiential approaches, such as simulations, experiential learning, field-based activities, and technology-assisted learning, which enhance students' engagement and contextual understanding of disaster risks. Regarding RQ3, school-based education contributes significantly to improving students' preparedness outcomes, including knowledge, risk awareness, preparedness attitudes, decision-making abilities, and disaster response skills. Regarding RQ4, the effectiveness of disaster education programs is influenced by interconnected factors, including students' knowledge and risk perception, curriculum integration, teacher capacity, technological support, institutional policies, and resource availability. Regarding RQ5, the review identifies several remaining challenges and research gaps, particularly the limited integration of disaster education within school curricula, unequal institutional support, and the need for more context-specific and empirically validated learning models.

Overall, this study highlights that the effectiveness of school-based landslide education depends not only on the delivery of disaster-related content but also on the integration of meaningful learning experiences, institutional support, and contextual preparedness strategies. Importantly, this SLR provides one of the first integrated frameworks linking learning processes, preparedness outcomes, and influencing factors in school-based landslide education, thereby offering a comprehensive foundation for future intervention design, curriculum development, and disaster preparedness policy implementation in educational settings. This integrative framework represents the main contribution of the study by synthesizing fragmented findings into a holistic understanding of how school-based disaster education can effectively strengthen students' preparedness for landslide risks.

Future research should employ mixed-methods designs to examine the causal impact of experiential and simulation-based learning on specific preparedness indicators, such as

evacuation response speed, risk perception accuracy, decision-making skills, and emergency preparedness behavior through pre–post assessments. Further studies are also recommended to develop and evaluate context-based disaster education models that are adapted to the environmental, social, and institutional characteristics of disaster-prone regions.

BIBLIOGRAPHY

مراجع

- Acevedo, B., Malevicius, R., Fadli, H., & Lamberti, C. (2022). Aesthetics and education for sustainability. *Culture and Organization*, 28 (3–4), 263–278. <https://doi.org/10.1080/14759551.2022.2028147>
- Alwafi, E.M. (2025). The impact of AI-assisted peer review on students' AI-feedback literacy, motivation and self-esteem: Integrating experiential learning and self-determination theory. *Learning and Motivation*, 92, 102215. <https://doi.org/10.1016/j.lmot.2025.102215>
- Asih, SW (2026). Implementation of the disaster-safe school disaster program on students' preparedness behavior in schools. *Gaceta Médica de Caracas*, 134 (S1). <https://doi.org/10.47307/GMC.2026.134.S1.2>
- Astuti, A., Banowati, E., Prajanti, SDW, & Rusdarti. (2025). Analysis of the need for social studies teaching modules for religious moderation based on entrepreneurship and disaster mitigation. *Journal of Ecohumanism*, 4 (1), 3284–3297.
- Calvo-Sastre, A. (2020). Teaching social education with and through groups. *Social Work With Groups*, 43 (3), 227–240. <https://doi.org/10.1080/01609513.2019.1593918>
- Chaturvedi, P., Arora, A., & Dutt, V. (2017). Learning in an interactive simulation tool against landslide risks: The role of amount and availability of experiential feedback. *Natural Hazards and Earth System Sciences Discussions*. <https://doi.org/10.5194/nhess-2017-297>
- Chong, E. J. M., Lim, J. S. W., Liu, Y., Lau, Y. Y. L., & Wu, V. X. (2016). Improvement of learning domains of nursing students with the use of authentic assessment pedagogy in clinical practice. *Nurse Education in Practice*, 20, 125–130. <https://doi.org/10.1016/j.nepr.2016.08.002>
- Cvetković, V. M., Sudar, S., Ivanov, A., & Lukic, T. (2024). Exploring environmental awareness, knowledge, and safety: A comparative study among students in Montenegro and North Macedonia. *Preprints*. <https://doi.org/10.20944/preprints202405.0216.v1>
- de Mendonça, MB, Fortuna, ITMP, & de Castro, SO (2025). Education on landslides: Assessing interventions in Rio de Janeiro. *Natural Hazards*, 121, 21705–21725. <https://doi.org/10.1007/s11069-025-07661-x>
- de Sousa Mata, Á. N., de Azevedo, KPM, Braga, LP, de Medeiros, GCBS, de Oliveira Segundo, VH, et al. (2021). Training in communication skills for self-efficacy of health professionals: A systematic review. *Human Resources for Health*. <https://doi.org/10.1186/s12960-021-00574-3>
- Dewi, RP, Suharjo, S., Dahroni, D., & Sujalwo, S. (2022). Improving natural disaster understanding of junior high school students. *IOP Conference Series: Earth and Environmental Science*, 986 (1), 012010. <https://doi.org/10.1088/1755-1315/986/1/012010>
- Fauziah, ARS, Sugandi, D., & Ruhimat, M. (2022). The role of disaster knowledge in the preparedness of students in West Bandung Regency. *IOP Conference Series: Earth and Environmental Science*, 1089 (1), 012069. <https://doi.org/10.1088/1755-1315/1089/1/012069>

- Fergusson, L., van der Laan, L., Imran, S., & Danaher, P. A. (2022). Authentic assessment and work-based learning: The case of professional studies in a post-COVID Australia. *Higher Education, Skills and Work-Based Learning*, 12 (6), 1189–1210. <https://doi.org/10.1108/HESWBL-03-2022-0074>
- Ghale, A., Jnawali, K., & Paneru, D. (2025). Knowledge on disaster risk reduction among secondary level students of public schools of Pokhara metropolitan city of Nepal. *BMC Public Health*, 25 (1). <https://doi.org/10.1186/s12889-025-23332-9>
- González-Marcos, A., Alba-Elías, F., Navaridas-Nalda, F., & Ordieres-Meré, J. (2016). Student evaluation of a virtual experience for project management learning. *Computers & Education*, 102, 172–187. <https://doi.org/10.1016/j.compedu.2016.08.005>
- Groch, D., Rizzo, C.I., Rovila, L.C., & Cogliati, M.G. (2024). Experiencias educativas para la reducción del riesgo de deslizamientos en Argentina. *Revista Notas Históricas y Geográficas*. <https://doi.org/10.58210/nhyg564>
- Habib, M. K., Nagata, F., & Watanabe, K. (2021). Mechatronics: Experiential learning and the stimulation of thinking skills. *Education Sciences*, 11 (2), 46. <https://doi.org/10.3390/educsci11020046>
- Hays, J., & Reinders, H. (2020). Sustainable learning and education: A curriculum for the future. *International Review of Education*, 66, 29–52. <https://doi.org/10.1007/s11159-020-09820-7>
- Hussain, R. M. R., & Khamis, K. (2019). Students as designers of e-books for authentic assessment. *Malaysian Journal of Learning and Instruction*, 16 (1), 23–48.
- Jensen, J.L., Holt, E.A., Sowards, J.B., Ogden, T.H., & West, R.E. (2018). Investigating strategies for pre-class content learning in a flipped classroom. *Journal of Science Education and Technology*. <https://doi.org/10.1007/s10956-018-9740-6>
- Kabir, M. H. (2024). Landslide risk assessment, awareness, and risk mitigation. In *Landslide: Susceptibility, risk assessment and sustainability* (pp. 521–546). Springer. https://doi.org/10.1007/978-3-031-56591-5_20
- Koo, C.L., Demps, E.L., Farris, C., Bowman, J.D., Panahi, L., et al. (2016). Impact of flipped classroom design on student performance. *American Journal of Pharmaceutical Education*. <https://doi.org/10.5688/ajpe80233>
- Kurt, A., Tarhan, S., Ünal, F., & Gökkurt Özdemir, B. (2026). Strengthening disaster preparedness in young children through a STEAM-D-based education. *Psychology, Health & Medicine*. <https://doi.org/10.1080/13548506.2026.2638995>
- Li, Y., Ying, S., Chen, Q., & Guan, J. (2022). An experiential learning-based virtual reality approach. *Sustainability*, 14 (22), 15359. <https://doi.org/10.3390/su142215359>
- Lord, T., Horwitz, P., & Lore, C. (2025). Using simulations to support students' conceptual development. *Journal of Science Education and Technology*.
- McLean, S., Attardi, S. M., Faden, L., & Goldszmidt, M. (2016). Flipped classrooms and student learning. *Advances in Physiology Education*. <https://doi.org/10.1152/advan.00098.2015>
- O'Hara, G.N., Munjal, V., et al. (2025). Perspectives on climate change and sustainability education. *Wilderness & Environmental Medicine*. <https://doi.org/10.1177/10806032251387525>
- Oroh, E.Z., Ali, M.I., Pelenkahu, N., & Usman, H. (2025). Authentic assessment in higher education. *Studies in English Language and Education*, 12 (2), 827–844. <https://doi.org/10.24815/siele.v12i2.45077>

- Park, S. E., & Howell, T. H. (2015). Implementation of a flipped classroom model. *Journal of Dental Education* .
- Renganayagalu, S.K., Mallam, S.C., & Nazir, S. (2021). Effectiveness of VR head mounted displays. *Technology, Knowledge and Learning* . <https://doi.org/10.1007/s10758-020-09489-9>
- Renzi, B. G., Lepicovsky, M., & Napolitano, G. (2025). Climate change and anxiety. *Discourse Studies* . <https://doi.org/10.1177/14614456251324599>
- Ronggowulan, L., Nugraha, S., Wibowo, YA, & Saputro, H.D. (2024). Disaster-safe education knowledge. *IOP Conference Series* . <https://doi.org/10.1088/1755-1315/1314/1/012021>
- Salinas-Navarro, D. E., Vilalta-Perdomo, E., Michel-Villarreal, R., & Montesinos, L. (2024). Using generative AI tools. *Education Sciences*, 14 (1), 83. <https://doi.org/10.3390/educsci14010083>
- Saputra, PD, Rahmawati, C., Karuniakhalida, P., & Purnomo, SH (2021). Sociodemographic characteristics and preparedness. *IOP Conference Series* . <https://doi.org/10.1088/1755-1315/708/1/012049>
- Saryono, S., Nurkamto, J., Hidayatullah, MF, & Komarudin, K. (nd). Teaching for preparedness: Indonesian physical education teachers' roles in disaster education. <https://doi.org/10.21831/cp.v45i1.86259>
- Subheesh, N. P., & Sethy, S. S. (2020). Learning through assessment and feedback practices. *EURASIA Journal* . <https://doi.org/10.29333/ejmste/114157>
- Sung, H.-Y., Hwang, G.-J., Wu, P.-H., & Lin, D.-Q. (2018). 3D experiential gaming approach. *Interactive Learning Environments* . <https://doi.org/10.1080/10494820.2018.1437049>
- Tibrani, MM, Corebima, AD, Zubaidah, S., & Ghofur, A. (2017). The influence of authentic assessment on students' attitude and psychomotor.
- Tuna, T., & Stone, Z. (2026). Climate change awareness and sustainable behavior. *Nutrition Bulletin* . <https://doi.org/10.1111/nbu.70045>
- Velegol, S. B., Zappe, S. E., & Mahoney, E. (2015). The evolution of a flipped classroom. *Advances in Engineering Education* .
- Williams, J., & Parker, H. (2016). Experiential learning and leadership development. *Sport Management Education Journal* . <https://doi.org/10.1123/SMEJ.2015-0012>
- Yaumi, Y., Madlazim, M., & Taufikurohmah, T. (2019). Socio-scientific issues-based learning. *Indonesian Journal of Science Education*, 8 (2), 173–181.
- Yildiz, A., Dickinson, J., Priego-Hernández, J., & Teeuw, R. (2022). Disaster knowledge and preparedness. *Risk Analysis* . <https://doi.org/10.1111/risa.13937>

