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School-Based Disaster Resilience: A Mixed-Methods Study of Student Responses to Wildfire Hazards

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ABSTRACT

Wildfires in peatland areas have disrupted not only ecological systems but also educational continuity in Indonesia, particularly for students living in high-risk zones. This study aims to measure the resilience of senior high school students in Muaro Jambi Regency and explore the role of schools in supporting disaster preparedness and psychosocial well-being. Using a mixed-methods approach, the research integrates quantitative data from 343 students across three wildfire risk zones: high, medium, and low, with qualitative insights from semi-structured interviews with principals of three public senior high schools representing each zone. Resilience was assessed using the Disaster Resilience Scale for Individuals (DRSi), covering six dimensions: knowledge and skills, adaptive capacity, psychological endurance, social connectivity, physical health, and financial capability. Descriptive analysis showed slightly higher resilience scores in high-risk zones, but ANOVA results indicated no statistically significant differences across zones. The qualitative analysis used six thematic indicators: curriculum integration, supporting facilities, teacher roles, external collaboration, social support, and post-disaster recovery. Schools in high-risk zones demonstrated more proactive strategies, including disaster-themed projects, stakeholder coordination, and flexible learning during haze events. The study contributes to the field of education by affirming the relevance of whole-school approaches in disaster risk reduction and highlighting the need for localized, inclusive, and psychosocially responsive educational practices in wildfire-prone regions.

INTRODUCTION

Forest and peatland fires have emerged as a persistent environmental crisis in Indonesia, particularly in Sumatra and Kalimantan, driven by ecological vulnerability, prolonged droughts, and unsustainable land-use practices (Harrison et al., 2024; Schmidt et al., 2024). In Muaro Jambi Regency, recent data (BRIN, 2023) highlight high wildfire risk in districts such as Kumpeh and Kumpeh Ulu, where deep peat ecosystems are highly flammable and difficult to extinguish. These fires not only degrade ecosystems but also disrupt educational continuity, especially for adolescents in high-risk zones. The ecological consequences are severe, ranging from biodiversity loss and soil degradation to transboundary haze and increased carbon emissions (Maruddani et al., 2024).

Beyond environmental degradation, forest fires disrupt social systems, particularly in the Education sector. Students in affected areas frequently face respiratory illnesses, psychological stress, and disruptions to their learning, often resulting in school closures or shifts to remote instruction (Anhar et al., 2022; Saharjo & Hasanah, 2023). In regions where fires recur annually, students experience cumulative stress and uncertainty, which may erode their sense of safety and belonging within the school environment. Recent studies have shown that repeated exposure to disaster contexts can shape students' adaptive capacity, mainly when supported by institutional mechanisms such as psychosocial programs and disaster Education (Wang et al., 2025; Wiguna et al., 2024).

Despite their vulnerability, students hold transformative potential as agents of resilience, provided they are equipped with the knowledge, skills, and institutional support to navigate disaster contexts. Resilience, in this regard, is a dynamic and multidimensional construct encompassing psychological endurance, adaptive capacity, social connectivity, and institutional responsiveness (Kim & Yi, 2024; Matsukawa et al., 2024). In educational settings, resilience is shaped not only by individual traits such as emotional regulation, adaptive thinking, and personal motivation, but also by the school's institutional capacity to foster disaster preparedness, cultivate environmental awareness through curriculum and extracurricular activities, and provide sustained psychosocial support systems that address both immediate and long-term student well-being. Beyond their instructional role, schools act as stabilizing spaces that mitigate the effects of ecological stressors on students' well-being. Geography Education plays a pivotal role in enhancing disaster literacy and spatial risk understanding, enabling students to identify local hazards and co-develop mitigation strategies (Gustavo & Rakuasa, 2023; Pratama & Putranto, 2022). However, Sakurai (2025) argues that disaster Education must be integrated holistically through formal, non-formal, and informal approaches to ensure consistent and meaningful learning experiences across diverse school contexts. Moreover, school-based environmental programs such as Adiwiyata initiatives have been shown to strengthen student engagement in sustainability and disaster preparedness. These efforts contribute to a broader institutional culture that supports resilience and empowers students to respond effectively to ecological hazards. However, the integration of disaster Education into school curricula remains uneven, particularly in regions where geography is no longer a compulsory subject under the Emancipated Curriculum. This raises concerns about the consistency and depth of disaster-related knowledge among students, especially those in high-risk areas. Recent geographical studies in Indonesia have emphasized the importance of spatial analysis and local wisdom in disaster risk reduction. For instance, Amri et al., (2023) spatial multi-criteria evaluation was applied to assess tsunami susceptibility in coastal areas, demonstrating how geospatial tools can identify localized vulnerabilities and inform preparedness strategies. In Muaro Jambi, the threat of forest fires is not evenly distributed across the region. Spatial data reveal significant disparities in fire exposure across subdistricts, with Kumpeh and Kumpeh Ulu classified as high-risk zones, Mestong as a medium-risk area, and Sungai Gelam and Sekernan as low-risk areas (BRIN, 2023). These spatial variations raise critical questions about how environmental exposure influences student resilience. Paradoxically, students in high-risk zones may develop stronger coping mechanisms due to repeated exposure. In contrast, those in medium-risk zones may suffer from ambiguous threat perception and a lack of institutional urgency. This aligns with recent spatial Education research that highlights how uneven hazard exposure can Influence students' psychological and behavioral responses to disaster (Sakti et al., 2022; Zahl-thanem & Rye, 2024).

Despite growing global attention to disaster resilience Education, recent international studies have predominantly focused on curriculum content and emergency response protocols in high-income or urban contexts (A. Amri et al., 2024; Ho et al., 2025; Shaw et al., 2021). A critical gap remains in understanding how schools in rural, hazard-prone regions, particularly in the Global South, cultivate student resilience through psychosocial and institutional mechanisms. Moreover, few studies have examined how resilience varies across risk zones within the same locality. Responding to these gaps, this study investigates student resilience in wildfire-prone areas of Muaro Jambi, Indonesia. It explores the role of schools as adaptive systems that mediate ecological risk through Education, social connectivity, and institutional support. To guide this inquiry, the study draws on two complementary

frameworks: the Disaster Resilience of Place (DROP) Model and the Disaster Resilience Scale for Individuals (DRSi). The DROP Model, widely applied in disaster research, assesses community-level resilience by integrating spatial vulnerability and adaptive capacity, and continues to inform recent studies on localized preparedness and educational resilience (Kim & Yi, 2024; Matsukawa et al., 2024).

In contrast, the DRSi framework focuses on individual resilience, capturing psychological, social, and physical dimensions. Together, these models enable a multi-scalar analysis of student resilience across varying wildfire risk zones. Within this structure, schools are examined as institutional anchors shaping adaptive capacity through curriculum design, psychosocial support, environmental Education, and sustained collaboration with surrounding communities. Building on this framework, the role of schools in disaster resilience becomes particularly salient in the Indonesian context, where educational institutions often serve as frontline responders during ecological crises. In addition to providing shelter and information, schools are expected to maintain continuity of learning and offer psychosocial support to students who have been affected by the disaster. Research from other disaster-prone countries such as Japan and the Philippines has shown that school-community partnerships, teacher training, and student-led initiatives can significantly enhance resilience outcomes (Carrasco & O'Brien, 2018; Noviana et al., 2020). These findings suggest that schools are not passive recipients of disaster impacts but active agents in shaping recovery and adaptation.

This study is situated in Muaro Jambi, a region characterized by documented wildfire vulnerability and the presence of school-based environmental Education initiatives. Employing a mixed-methods approach, the research captures both quantitative patterns and qualitative narratives to provide a comprehensive analysis of student resilience. Specifically, it seeks to measure resilience levels across spatial hazard zones and explore the role of schools in shaping adaptive capacity. The findings are expected to inform educational policy, school-based disaster preparedness programs, and broader efforts to integrate resilience into the everyday practices of teaching and learning.

Ultimately, this study contributes to a more nuanced understanding of resilience within the context of climate-induced hazards, emphasizing the importance of localized, student-centered strategies that integrate ecological awareness, institutional responsiveness, and psychosocial support. By highlighting the role of schools as both educational and protective spaces, the research underscores the potential of Education systems to foster resilience not only in response to disasters but as a proactive and transformative force in building sustainable futures. This study offers a novel integration of spatial risk analysis and institutional resilience frameworks to assess student responses to wildfire hazards. It contributes to the international discourse by centering on student voices, highlighting school-based strategies, and proposing a localized, inclusive model of disaster Education that is both psychosocially responsive and policy-relevant.

RESEARCH METHODS

Research Design

This study adopted a mixed-methods design to investigate student resilience in wildfire-prone areas of Muaro Jambi Regency. The approach integrated quantitative and qualitative techniques to capture both measurable trends and contextual depth. The quantitative strand served as the primary method, employing a structured questionnaire grounded in the Disaster Resilience Scale for Individuals (DRSi).

This study is conceptually grounded in two complementary models: the Disaster Resilience Scale for Individuals (DRSi) and the Disaster Resilience of Place (DROP) Model. The DRSi provides the basis for measuring individual student resilience across six dimensions (knowledge and skills, adaptive capacity, psychological endurance,

social connectivity, physical health, and financial capability). At the same time, the DROP Model informs the spatial and institutional context of disaster risk and adaptive capacity. Together, these frameworks enable a multi-layered analysis of resilience, integrating personal attributes with environmental and institutional factors. The research framework positions student resilience as an outcome influenced by spatial risk exposure (wildfire-prone zones), institutional support (school preparedness and psychosocial programs), and individual capacities (as measured by DRSi). This conceptual structure guides both the formulation of research instruments and the interpretation of findings, ensuring alignment between theoretical constructs and empirical data.

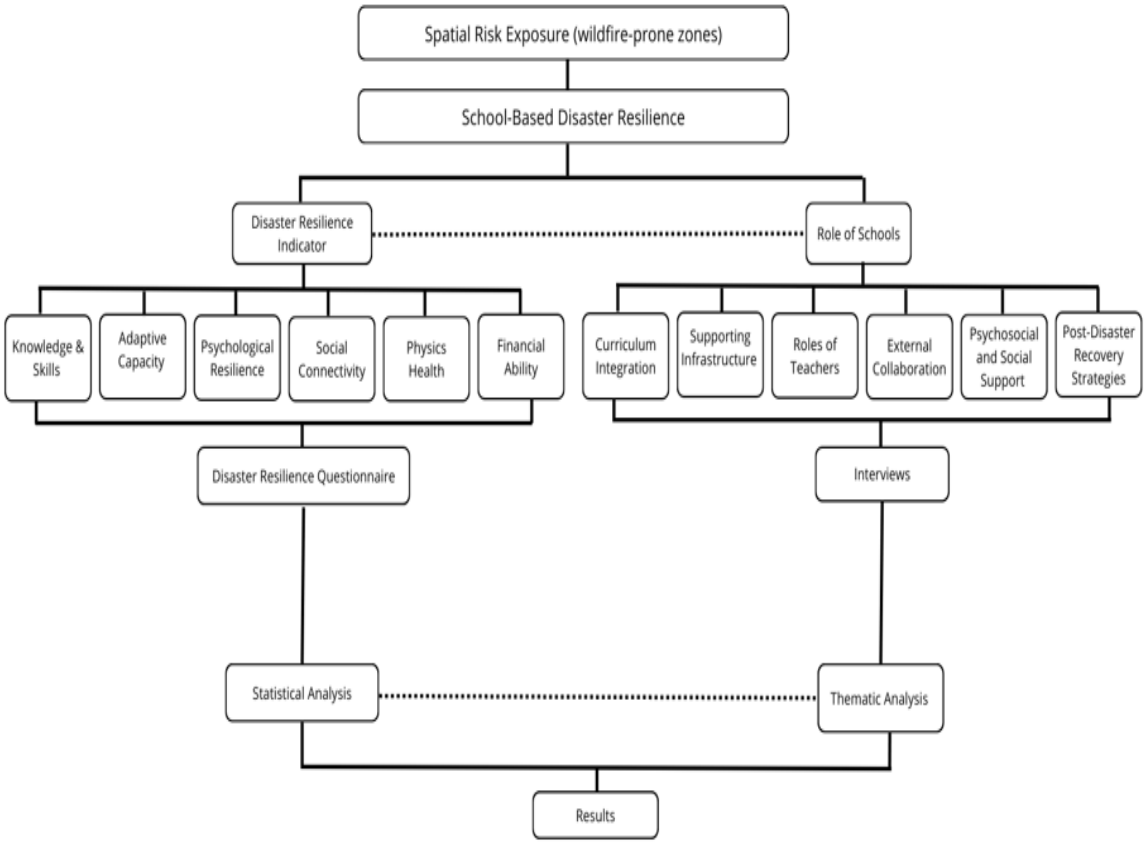

Figure 1. Research Framework (Source: Research Data, 2025)

Location

The research was conducted in Muaro Jambi Regency, located in Jambi Province, Sumatra, Indonesia. Geographically, the regency lies at approximately 1°38'25" South and 103°44'38" East, encompassing an area of 5,264 square kilometers. Topographically, Muaro Jambi is characterized by lowland terrain ranging from 0 to 300 meters above sea level. The regency encircles Jambi City—the provincial capital—and shares borders with Tanjung Jabung Barat and Tanjung Jabung Timur to the north, Banyuasin and Musi Banyuasin Regencies to the south, and Batanghari Regency to the west. Administratively, Muaro Jambi comprises 11 districts and 155 villages. These areas have experienced recurring wildfires, resulting in ecological degradation, health impacts, and educational disruptions. Students in these regions are especially vulnerable, facing both physical and psychological challenges, as well as interruptions to their learning environments.

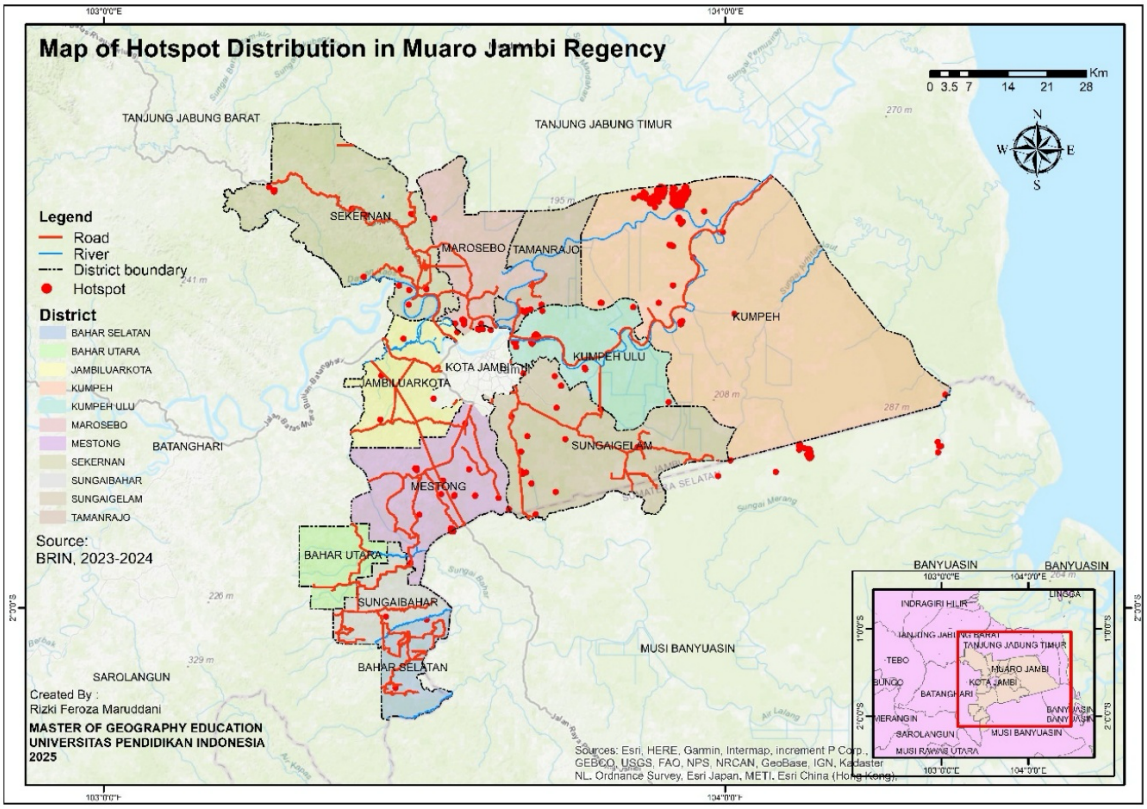

Figure 2. Map of Hotspot in Muaro Jambi Regency 2023-2024 (Source: Research Data, 2025)

Participants

The target population in this study consisted of all Grade XI students enrolled in public senior high schools across Muaro Jambi Regency. This grade level was selected based on developmental considerations, as students aged 15–18 are undergoing significant cognitive, affective, and social growth. At this stage, they begin to demonstrate abstract and critical thinking skills, as well as a greater capacity for reflection in responding to environmental issues. They also tend to be more actively engaged in school and community activities, positioning them as potential change agents in fostering environmentally conscious behavior (Balundė et al., 2020).

According to the 2025 Education Database, the total population of Grade XI students in the region was 2,403. To determine the appropriate sample size, Slovin's formula was applied, using a 95% confidence level and a 5% margin of error, which resulted in a sample of 343 students. A stratified random sampling technique was employed, guided by ecological risk zoning, which categorizes school locations into high, medium, and low wildfire risk zones. Two schools were randomly selected from each zone, and the sample was distributed proportionally to ensure balanced representation of student experiences across varying hazard exposures.

Data Collection and Instrument

Data collection employed both survey and interview methods to capture a comprehensive understanding of student resilience and institutional preparedness. The questionnaire consisted of 28 items measured on a five-point Likert scale. It was validated through expert review and demonstrated high internal consistency, with Cronbach's Alpha coefficients exceeding 0.94. These items represented six dimensions of student resilience: knowledge and skills, adaptive capacity, psychological endurance, social connectivity, physical health, and financial capability. The use of a structured questionnaire aligns with the quantitative paradigm, which emphasizes measurable indicators and statistical generalization (Creswell & Creswell, 2017). Moreover, the six dimensions were

operationalized based on resilience Theory and adapted to the educational context to ensure construct validity and contextual relevance.

Semi-structured interviews were also conducted with principals from three schools, each located in a distinct wildfire risk zone. These interviews examined institutional contributions to disaster preparedness and student resilience, using six thematic domains as analytical lenses: the integration of disaster Education into the curriculum, the adequacy of supporting infrastructure, teacher and staff engagement, collaboration with external stakeholders, the provision of psychosocial support, and post-disaster recovery strategies.

This qualitative component was grounded in a phenomenological approach, allowing for the exploration of lived experiences and institutional practices in disaster-prone settings. The thematic domains were derived from existing literature on school-based disaster risk reduction and resilience frameworks, ensuring theoretical coherence and analytical depth (Huyler & McGill, 2019; UNDRR, 2017).

Data Analysis

Quantitative data were analyzed using descriptive statistics to summarize student responses and identify patterns in resilience scores. To further examine whether spatial exposure influences resilience, a one-way Analysis of Variance (ANOVA) was conducted to test for statistically significant differences in resilience levels among students from high-, medium-, and low-wildfire risk zones. This statistical approach is widely applied in educational research to compare group means across categorical variables and assess contextual effects (Strunk & Mwavita, 2020).

Qualitative data were analyzed thematically, with coding and categorization based on predefined indicators. This process aimed to uncover institutional practices, challenges, and best practices in school-based disaster preparedness. Thematic analysis was conducted using Braun and Clarke's framework, adapted for educational contexts and informed by recent methodological guidance (Kushnir, 2025). The integration of both data strands facilitated a comprehensive understanding of student resilience and the role of schools in shaping adaptive capacity. This mixed-methods approach reflects a pragmatic paradigm, emphasizing methodological complementarity to address complex educational challenges (Foster et al., 2025). The convergence of statistical and thematic insights strengthens the validity of findings and supports the development of context-sensitive, evidence-based recommendations.

RESULTS AND DISCUSSION

Student Resilience Across Wildfire Risk Zones

This study examined student resilience across wildfire risk zones by analyzing 28 questionnaire items aligned with six core dimensions: knowledge and skills, adaptive capacity, psychological endurance, social connectivity, physical health, and financial capability. Scores for each dimension were calculated and categorized to reflect overall resilience levels. Descriptive statistics and inferential analysis using One-Way ANOVA were employed to examine differences across groups. Quantitative findings revealed subtle variations in student resilience across wildfire risk zones in Muaro Jambi Regency.

Table 1. Descriptive Statistics of Student Resilience Scores by Wildfire Risk Zone

Risk Zone	Mean	N	Std. Deviation	Min	Max
Low	97,07	114	12,07	46	123
Medium	96,87	114	11,02	68	136
High	98,55	115	9,48	76	126
Amount	292,5	343	32.57	190	385

(Source: Research Results, 2025)

As shown in Table 1, students in high-risk areas reported the highest mean resilience score (Median = 98.55, SD = 9.48), followed by those in low-risk (Mean = 97.07, SD = 12.07) and medium-risk zones (Median = 96.87, SD = 11.02). However, one-way ANOVA results showed no statistically significant differences among the three groups (F = 0.813, p = 0.444), suggesting that geographic exposure alone does not account for variations in resilience. This finding reinforces the argument that resilience is not merely a function of environmental risk, but emerges from the interaction of psychological, social, and institutional factors (Kim & Yi, 2024; Matsukawa et al., 2024). The absence of significant differences may reflect the compensatory role of school-based interventions and community support in high-risk zones. Students in these areas may have developed stronger coping mechanisms through repeated exposure, structured preparedness programs, and heightened risk awareness. Protection Motivation Theory supports this interpretation, positing that individuals exposed to frequent threats are more likely to adopt adaptive behaviors when they perceive the risk as severe and believe in their efficacy to respond (Balla & Hagger, 2025).

Further analysis examined the relationship between school-level vulnerability, defined by environmental to exposure and infrastructure fragility, and student resilience scores. As summarized in **Table 2**, students in high-vulnerability schools reported the highest resilience scores, while those in medium-vulnerability schools showed the lowest. This counterintuitive pattern suggests that institutional adaptation may play a more decisive role than baseline vulnerability. Schools in high-risk zones may have prioritized resilience-building initiatives, such as curriculum integration, stakeholder collaboration, and psychosocial support, thereby enhancing students' ability to adapt.

Table 2. Resilience Scores by Vulnerability Level

No	Vulnerability Level	Resilience Score
1	Low	97,07
2	Medium	96,87
3	High	98,55

(Source: Research Results, 2025)

From a scientific perspective, these findings challenge linear assumptions within spatial vulnerability models and underscore the need for multi-scalar frameworks that incorporate institutional agency and student perception. They also extend the applicability of the DROP and DRSi models by demonstrating that resilience can be cultivated even in structurally disadvantaged settings, provided that schools function as proactive and responsive systems.

Practically, the results highlight the importance of investing in school-level resilience strategies regardless of hazard classification. Medium-risk zones, often overlooked in policy prioritization, may require targeted interventions to address ambiguity in threat perception and institutional preparedness. Policymakers should consider allocating resources not only based on environmental exposure but also on institutional capacity and community engagement. Strengthening teacher training, embedding psychosocial support into daily routines, and fostering school–community partnerships are crucial steps toward building equitable resilience.

To examine whether resilience scores varied significantly across geographic risk zones, a one-way ANOVA was conducted. As shown in **Table 3**, the results revealed no statistically significant differences among the three groups (F = 0.813, p = 0.444). This finding suggests that geographic exposure alone does not account for variations in student resilience. Instead, contextual factors such as school culture, peer support,

and prior disaster experience may exert a more substantial Influence on adaptive capacity.

Conversely, students in medium-risk zones may experience a form of *ambiguous threat*, wherein the perceived danger is insufficient to activate protective behaviors. This aligns with **Protection Motivation Theory (PMT)**, which posits that threat appraisal must reach a certain threshold to elicit adaptive responses (Balla & Hagger, 2025). In such cases, moderate exposure may lead to complacency or delayed preparedness, as observed in disaster Education research (Cabello et al., 2021).

In low-risk zones, the broader distribution of scores and presence of outliers suggest that vulnerability persists among certain students. This may stem from limited experiential knowledge, low institutional emphasis on disaster Education, or insufficient self-efficacy factors central to PMT's coping appraisal component (Japalaghi et al., 2025). These findings underscore the need for inclusive disaster Education strategies that transcend geographic classifications. As Reimers & Schleicher (2020) emphasized, equitable access to risk-related learning opportunities is essential for cultivating systemic resilience, particularly in regions increasingly affected by climate-induced hazards.

Table 3. One-Way ANOVA: Resilience Score Differences Across Risk Zones

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	193.642	2	96.821		
Within Groups	40476.102	340	119.047	0.813	0.444
Amount	40669.743	342			

(Source: Research Results, 2025)

Following the analysis of students' resilience across socioeconomic, environmental, governance, and physical dimensions, it is important to situate these findings within the broader landscape of disaster Education research. Afrian et al., (2025) Investigated the use of Problem-Based Learning combined with Root Cause Analysis to enhance disaster literacy among university students, emphasizing instructional strategies and cognitive development. In contrast, the present study adopts a measurement-oriented approach, operationalizing resilience through context-specific indicators at the high school level in Muaro Jambi. This methodological distinction enables a more nuanced understanding of students' preparedness capacities within their immediate school and community environments. By offering a locally grounded, multidimensional assessment, this research complements prior studies and provides a practical foundation for strengthening disaster Education in vulnerable regions.

The Role of Schools in Fostering Resilience

Qualitative insights were derived from semi-structured interviews with principals of three public senior high schools located in wildfire-prone areas categorized as high, medium, and low risk. These interviews revealed contextually rich perspectives on how schools operate as institutional pillars in disaster preparedness and student well-being. To complement the quantitative findings, this qualitative strand has highlighted the strategic responses, constraints, and lived experiences of school leaders as they navigated recurring haze events and broader ecological disruptions, underscoring the embedded role of educational institutions in shaping community resilience.

Thematic analysis was guided by six core indicators that capture the multifaceted role of schools in fostering disaster resilience: (1) curriculum and pedagogical integration, (2) supporting infrastructure and resources, (3) roles of teachers and school personnel, (4) external collaboration, (5) psychosocial and social support

mechanisms, and (6) post-disaster recovery strategies. These thematic domains were informed by both national policy directives and global scholarship on Education in emergencies, enabling a structured yet context-sensitive interpretation of school-level practices. The subsequent sections detail findings across each thematic dimension, drawing attention to both shared patterns and zone-specific divergences in how schools prepare for and respond to ecological hazards.

1) Curriculum & Pedagogical Approaches

Across the three wildfire risk zones, schools demonstrated varying degrees of integration of disaster-related content into their educational programs. In the high-risk zone, wildfire awareness was embedded into Projek Penguatan Profil Pelajar Pancasila (P5), emphasizing sustainable land management and student-led advocacy campaigns. "*We usually integrate it into specific activities, not yet into classroom subjects,*" noted a principal in a high-risk zone, highlighting the informal nature of DRR Education in high-exposure contexts. The medium-risk zone school contextualized disaster themes through local wisdom and school values, primarily via extracurricular activities and thematic assemblies. "*We integrate disaster values into P5, especially those related to local wisdom like land management,*" explained a principal in a medium-risk zone, indicating a culturally grounded pedagogical approach. In contrast, the low-risk zone school incorporated hazard-related topics into geography and biology lessons, though without structured follow-up or formal assessment mechanisms. "*We include wildfire topics in subjects like Biology and Geography, especially during dry seasons,*" stated a principal in a low-risk zone, suggesting a seasonal and subject-specific integration.

These differentiated approaches reflect an emerging shift toward contextualized disaster Education, one that blends ecological awareness, indigenous knowledge, and climate adaptation within school curricula. UNESCO's *Greening Curriculum Guidance* (2024) advocates for pedagogical models that are action-oriented, justice-centered, and responsive to local environmental realities, aiming to equip learners with the capacity to navigate climate-induced challenges through meaningful and transformative learning experiences.

Despite these promising practices, the integration of disaster risk reduction (DRR) into formal curricula remains inconsistent and often informal. Many Indonesian schools face structural constraints, including limited resources, ambiguous policy mandates, and competing academic priorities (Septikasari et al., 2022). This challenge is not unique to Indonesia; UNESCO (2024) it underscores the global need for coherent, locally adapted curriculum frameworks that ensure learning continuity amid ecological disruptions.

Schools require structured guidance, intersectoral collaboration, and pedagogical innovation to advance curriculum-based resilience. Principles of ecological Education advocate for holistic, interdisciplinary, and experiential learning that transforms disaster Education from reactive content into proactive capacity-building. When meaningfully embedded, the curriculum serves not merely as a conduit for knowledge transmission but as a platform for cultivating adaptive reasoning, environmental stewardship, and collective agency (Cui & Lv, 2024).

2) Supporting Facilities

Basic protective measures, such as masks, clean water, and multivitamins, were provided across all schools, although the type and consistency of provision varied by risk zone. In the high-risk zone, masks and supplements were distributed during haze episodes, reflecting a targeted response to acute air quality deterioration. "*We support students with masks and multivitamins to help them stay healthy during haze,*" noted a principal in a high-risk zone, underscoring the school's role in immediate health protection. The medium-risk zone school prioritized access to clean water and essential health supplies. In contrast, the low-risk zone school relied on external

donations from health agencies and private partners to supply masks. "*We received masks from the health department and private donors during the dry season,*" explained a principal in a low-risk zone, highlighting the reliance on external aid.

While these interventions align with public health recommendations and demonstrate institutional commitment to student well-being, none of the schools possessed specialized infrastructure such as air filtration systems or isolation rooms. This gap underscores the limitations of school-based disaster preparedness, particularly in rural and resource-constrained settings. Evidence suggests that consistent mask wearing can significantly reduce pollution-related symptoms among vulnerable populations, including students exposed to prolonged haze conditions as observed in Muaro Jambi, where such events may persist for weeks (Tultrairatana & Phansuea, 2022).

The dual imperative of physical protection and learning continuity is central to effective disaster-responsive Education. Schools that ensure basic health safeguards are better equipped to sustain attendance, reduce absenteeism, and support psychosocial stability during environmental disruptions (Reimers & Schleicher, 2020). However, the absence of advanced infrastructure reflects broader systemic challenges in embedding resilience within educational environments.

Supporting facilities play a foundational role not only in mitigating immediate physical risks but also in fostering psychological safety and institutional trust. Their presence signals responsiveness and care, critical components of a resilient school culture. Strengthening such facilities, especially in high-risk zones, is essential for advancing an equitable and adaptive Education system capable of withstanding recurring ecological hazards.

3) Teacher Roles

Teachers played a pivotal role in disseminating disaster-related information and sustaining daily routines that promote student health and awareness. In the high-risk zone school, prior simulation experiences and informal peer knowledge-sharing among staff contributed to institutional preparedness. "*We have learned from past haze events that teachers share tips and routines to keep students safe,*" noted one teacher, reflecting the value of experiential learning and collegial exchange. The medium-risk zone school emphasized daily reminders and preventive habits, while the low-risk zone school relied on repeated messaging during assemblies and classroom sessions. "*We remind students every morning to drink water and wear masks if needed,*" said a teacher in the medium-risk zone, illustrating the integration of health practices into daily routines. These practices highlight the importance of teacher agency in cultivating a culture of resilience.

Teachers function as activators, initiating preparedness activities; collaborators, engaging with external stakeholders; and culture builders, embedding safety values into the school's everyday ethos. Through consistent messaging, modeling adaptive behavior, and integrating disaster themes into instruction, they help cultivate a resilient mindset among students, one that extends beyond emergency response into long-term awareness and community engagement. In the Indonesian context, teachers assume multifaceted roles in post-disaster settings, offering both psychoeducational and logistical support. Their contributions, from encouraging school attendance to facilitating aid distribution, are instrumental in promoting psychosocial recovery and community resilience (Parrott et al., 2025). These findings underscore the importance of recognizing and enhancing teacher capacity in disaster risk reduction, particularly in under-resourced environments where institutional support may be limited.

4) Multi-Sectoral Collaboration

All participating schools engaged with external stakeholders, including health centers, fire departments, and local government agencies, though the scope, frequency, and institutionalization of these collaborations varied across risk zones. The

high-risk zone school exhibited the most robust and systematic coordination, utilizing digital platforms such as WhatsApp groups and school websites to maintain real-time communication with disaster management agencies and health officials during haze events. This digital integration facilitated rapid response, targeted resource deployment, and timely dissemination of health advisories.

In contrast, the medium-risk zone school maintained periodic partnerships with local health centers and village authorities, primarily for outreach activities such as health Education and mask distribution. The low-risk zone school collaborated with local fire departments and received donations from private organizations; however, it lacked formal protocols or sustained engagement mechanisms, resulting in more reactive and fragmented support.

These practices align with the principles of the Pentahelix model, which emphasizes multi-sectoral collaboration in disaster risk reduction by mobilizing five key actors: government, academia, business, media, and civil society (Windiani, 2021). When effectively implemented, such collaboration enhances institutional capacity, community participation, and the legitimacy of disaster-related interventions, particularly when schools function as community anchors (Arfani, 2022).

However, findings from Muaro Jambi reveal that while external engagement is present, it remains uneven and often informal. Schools in lower-risk zones tend to rely on ad hoc support, whereas those in high-risk zones are more likely to institutionalize partnerships and embed them into school routines. This disparity reflects broader systemic issues in collaborative governance, where leadership, trust-building, and shared accountability are often lacking (Dwirahmadi et al., 2023). To strengthen external collaboration, schools require clear mandates, standardized communication protocols, and targeted capacity-building initiatives that empower educators to engage meaningfully with stakeholders beyond the school environment. "*We need training to know who to contact and how to work together,*" said a principal in a medium-risk zone, pointing to the need for institutional support. Formalizing these partnerships can enhance the sustainability and scalability of school-based disaster preparedness, ensuring that resilience is cultivated not only within classrooms but across the broader community ecosystem.

5) Social Support

Communication channels such as WhatsApp groups, school bulletin boards, and community networks played a pivotal role in facilitating timely information exchange and fostering parental involvement across all zones. In high-risk areas, the school's *Paguyuban* group exemplified inclusive communication by engaging parents, counselors, and village leaders in discussions on haze-related health risks, school closures, and psychosocial support. "*We use WhatsApp and Paguyuban meetings to keep parents informed and involved,*" explained a teacher, highlighting the integration of formal and informal platforms to enhance coordination and trust. These mechanisms not only improved responsiveness but also reinforced the social fabric that underpins community resilience (Pangestu & Fedryansyah, 2023).

Informal platforms such as parent-teacher WhatsApp groups and neighborhood forums proved critical in maintaining student engagement and emotional stability during periods of disruption. In medium-risk zones, teachers routinely updated parents on student health and attendance, while in low-risk zones, schools leveraged community radio and religious gatherings to disseminate safety messages. These adaptive practices demonstrate how schools tailor communication strategies to local contexts, utilizing existing social structures to extend their reach and Influence.

Two-way communication between schools and families fosters shared responsibility and adaptive capacity, particularly in rural settings where institutional resources may be limited. When

parents are not merely informed but actively involved in preparedness and decision-making processes, a sense of ownership and collective vigilance emerges. Reciprocal relationships among teachers, students, and parents contribute to educational continuity and emotional resilience, especially when communication is empathetic, consistent, and culturally attuned (Haines et al., 2022).

Social support networks within schools, such as peer mentoring, counseling services, and teacher-led reflection sessions, also play a vital role in promoting students' psychological well-being. In high-risk zones, teachers initiated informal check-ins with students who were affected by haze-related illnesses or displacement. Though often undocumented, these relational efforts reflect a deeper dimension of resilience: the capacity of school communities to care, connect, and respond collectively in times of uncertainty. When communication is rooted in trust and shared responsibility, it becomes more than a reactive tool; it evolves into a proactive force that binds schools and communities in navigating ecological disruptions.

6) Post-Disaster Recovery

Recovery in Education must address both physical infrastructure and psychosocial rehabilitation to ensure long-term well-being and continuity of learning (Syugiarto et al., 2022). Recovery strategies varied across schools, shaped by their exposure level and institutional capacity. In high- and medium-risk zones, schools implemented classroom cleaning routines, adjusted learning schedules, and provided rest periods to mitigate student stress and fatigue during haze events. "*We let students rest more during haze days and clean the rooms together,*" a principal in a high-risk zone shared, illustrating how routine adjustments and relational care support emotional recovery. These measures were often complemented by informal counseling and teacher-led reflection sessions, supporting emotional recovery and relational care.

In contrast, the low-risk zone school has been less affected in recent years. It focuses on preventive strategies such as environmental Education and scouting activities. These programs aim to cultivate ecological awareness and preparedness skills through experiential learning, reinforcing long-term resilience.

Such efforts align with the Sendai Framework's emphasis on recovery as a transformative phase of resilience-building, not merely a return to normalcy, but an opportunity to strengthen systems and reduce future vulnerabilities. In low and middle-income contexts, recovery-centered practices must include community-based interventions, caregiver involvement, and emotional support systems to restore students' social roles and psychological stability (Tripathi, 2025). Previous research about post-earthquake recovery efforts in North Lombok highlights the role of spatial planning, infrastructure rehabilitation, and community involvement in rebuilding resilience. Their study underscores the importance of integrating geographic vulnerability assessments into disaster response strategies. Although focused on post-disaster recovery rather than school-based Education, the findings offer valuable insights into localized resilience mechanisms that can inform educational preparedness frameworks, particularly in regions with high environmental risk exposure (Bakti & Nurmandi, 2020).

In Muaro Jambi, recovery is not a one-time event but an ongoing process. Schools that embed recovery strategies into their culture through rituals, reflection, and relational care are better positioned to foster adaptive capacity and collective resilience. These practices demonstrate that when recovery is holistic and community-driven, it becomes a foundation for educational continuity and psychosocial well-being.

Comparative Insights and Policy Relevance

Interview findings revealed distinct patterns of preparedness and recovery across zones, shaped by varying levels of risk exposure and institutional capacity. Schools in high-risk areas demonstrated more proactive and integrated strategies, including multi-stakeholder coordination

and psychosocial support mechanisms. In contrast, schools in medium- and low-risk zones engaged in recovery efforts with less consistency, often constrained by limited resources and external support. These disparities reflect localized dynamics of risk governance, where institutional urgency and community engagement Influence the depth and coherence of school-based resilience practices.

This variation underscores a critical policy gap in the implementation of national frameworks such as *Permendikbud No. 33/2019* on Safe School Programs (*Satuan Pendidikan Aman Bencana*, SPAB). While some schools aligned with SPAB's pillars, facility readiness, risk management, and curriculum integration, others struggled to operationalize these components due to unclear mandates or insufficient capacity. Strengthening SPAB's implementation through context-sensitive training, sustained funding, and participatory monitoring could enhance disaster preparedness and recovery across diverse educational settings (Firdausya, 2025). Prior research in disaster Education has largely emphasized descriptive and participatory approaches. For example, Septikasari et al., (2022) a proposed conceptual model for disaster risk reduction (PRB) in elementary schools focuses on curriculum integration, teacher training, and institutional readiness. While their framework offers strategic direction, it remains normative mainly and lacks empirical differentiation across risk zones. Similarly, Aroyandini et al., (2022) explored the urgency and challenges of embedding disaster Education within science instruction, highlighting the role of teacher agency and community involvement. However, their study did not incorporate structured measurement tools or comparative analysis across school contexts. In contrast, the present research advances the field by combining quantitative profiling with qualitative insights from school principals, producing a multidimensional and locally grounded resilience assessment. This approach not only enhances diagnostic precision but also bridges the gap between policy discourse and on-the-ground implementation, an area that has often been underexplored in previous literature.

The findings also reinforce the practical relevance of the *Sendai Framework for Disaster Risk Reduction 2015–2030*, particularly its emphasis on inclusive, education-driven approaches to resilience. By positioning students and schools as active agents rather than passive recipients, the study contributes to both global and local efforts to embed disaster risk reduction within everyday educational practice. The integration of locally grounded strategies drawing on ecological awareness, cultural values, and community collaboration demonstrates how schools can serve as catalysts for long-term resilience, bridging policy aspirations with lived realities.

CONCLUSION

This study examined how spatial risk exposure, institutional practices, and psychosocial support in wildfire-prone regions of Muaro Jambi shape student resilience. By integrating quantitative and qualitative data across three risk zones, the research addressed its core objective: to explore the contextual factors that Influence educational resilience during ecological disruptions. Although students in high-risk zones reported slightly higher resilience scores, statistical analysis found no significant differences across zones. This suggests that resilience is not solely determined by proximity to hazards, but is closely linked to adaptive school practices and relational support systems.

The study contributes to the growing body of research on disaster resilience in Education by proposing a multidimensional framework that combines environmental, institutional, and emotional dimensions. It provides empirical support for national policy efforts, such as *Permendikbud No. 33/2019,* and aligns with the *Sendai Framework's* emphasis on inclusive, education-based resilience strategies. By highlighting the role of schools as active agents, not just service providers, the findings underscore the importance of context-responsive, whole-school approaches to preparedness and recovery.

The study's limitations include its focus on public senior high schools and the use of a cross-sectional design, which may not capture changes in resilience over time. Future research should adopt longitudinal methods, include private and informal Education sectors, and examine how digital technologies and community networks evolve as resilience-building tools.

Policy recommendations include expanding disaster Education beyond designated high-risk zones, embedding psychosocial support into routine school activities, and strengthening partnerships between schools, families, and local institutions. Investing in teacher capacity and ensuring equitable access to safe learning environments are essential steps toward building a more inclusive and sustainable Education system that can withstand future ecological challenges.

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REFERENCE LIST

Afrian, R., Utaya, S., Astina, I. K., & Bachri, S. (2025). Accelerating Young People's Disaster Literacy With Problem-Based Learning-Root Cause Analysis. Jurnal Geografi, 17(1), 1–14. https://doi.org/10.24114/jg.v17i1.56569

Amri, A., Akhirman, Zaharani, A., Rizki, C., Harianja, L. M., Prameswari, N., Vauzia, & Putri, W. N. (2024). Dampak Bencana Kebakaran Hutan Terhadap Lingkungan dan Upaya Penanggulangan di Indonesia. JRTI (Jurnal Riset Tindakan Indonesia), 9(2), 159–166.

Amri, I., Hikmasari, B. S., Nababan, C. A., Wijayanti, D. A., Ruslanjari, D., & Giyarsih, S. R. (2023). Tsunami Susceptibility Assessment Using Spatial Multi-Criteria Evaluation in Watukarung, Pacitan. Jurnal Geografi, 15(2), 195–207. https://doi.org/10.24114/jg.v15i2.41767

Anhar, I. P., Rina Mardiana, & Rai Sita. (2022). Dampak Kebakaran Hutan dan Lahan Gambut terhadap Manusia dan Lingkungan Hidup (Studi Kasus: Desa Bunsur, Kecamatan Sungai Apit, Kabupaten Siak, Provinsi Riau). Jurnal Sains Komunikasi Dan Pengembangan Masyarakat [JSKPM], 6(1), 75–85. https://doi.org/10.29244/jskpm.v6i1.967

Arfani, M. (2022). Kolaborasi Pentahelix dalam Upaya Pengurangan Risiko Bencana pada Destinasi Wisata Di Desa Kalanganyar Sidoarjo. Jurnal Syntax Transformation, 3(01), 104–120. https://doi.org/10.46799/jst.v3i1.497

Aroyandini, E. N., Rusilowati, A., Supriyadi, S., Hartono, H., Retnoningsih, A., Marianti, A., Hamid, N., Juhadi, J., & Ilmu Sosial, F. (2022). Urgensi dan Tantangan Mengajarkan Pendidikan Kebencanaan Melalui Pembelajaran

IPA. Prosiding Seminar Nasional Pascasarjana, 245–253. http://pps.unnes.ac.id/pps2/prodi/prosiding-pascasarjana-unnes

Bakti, H. K., & Nurmandi, A. (2020). Pemulihan Pasca Bencana Gempa Bumi Di Lombok Utara Pada Tahun 2018. Jurnal Geografi, 12(2), 137–151. https://doi.org/10.24114/jg.v12i02.16750

Balla, J., & Hagger, M. S. (2025). Protection motivation theory and health behaviour: conceptual review, discussion of limitations, and recommendations for best practice and future research. Health Psychology Review, 19(1), 145–171. https://doi.org/10.1080/17437199.2024.2413011

Balundė, A., Perlaviciute, G., & Truskauskaitė-Kunevičienė, I. (2020). Sustainability in Youth: Environmental Considerations in Adolescence and Their Relationship to Pro-environmental Behavior. Frontiers in Psychology, 11(November), 1–13. https://doi.org/10.3389/fpsyg.2020.582920

BRIN. (2023). Sistem Pemantauan Titik Panas (Hotspot Monitoring System). Badan Riset Dan Inovasi Nasional. https://hotspot.brin.go.id/

Cabello, V. M., Véliz, K. D., Moncada-Arce, A. M., García-Huidobro, M. I., & Juillerat, F. (2021). Disaster risk reduction education: Tensions and connections with sustainable development goals. Sustainability (Switzerland), 13(19), 1–18. https://doi.org/10.3390/su131910933

Carrasco, S., & O'Brien, D. (2018). The Role of Humanitarian Agencies in Reconstruction and Development of Disaster Affected Communities in Japan and the Philippines. Procedia Engineering, 212(2017), 606–613. https://doi.org/10.1016/j.proeng.2018.01.078

Creswell, J. W., & Creswell, J. D. (2017). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. SAGE Publications. https://books.google.co.id/books?id=KGNADwAAQBAJ

Cui, Y., & Lv, J. (2024). Curriculum design and teaching method under ecological education concept. Curriculum and Teaching Methodology, 7(2), 167–173. https://doi.org/10.23977/curtm.2024.070225

Dwirahmadi, F., Barnes, P., Wibowo, A., Amri, A., & Chu, C. (2023). Linking Disaster Risk Reduction and Climate Change Adaptation through Collaborative Governance: Experience from Urban Flooding in Jakarta. Geosciences (Switzerland), 13(11). https://doi.org/10.3390/geosciences13110353

Firdausya, I. (2025). Sebagian Besar Satuan Pendidikan Berada di Zona Rawan Bencana. Media Indonesia. https://mediaindonesia.com/humaniora/765036/sebagian-besar-satuan-pendidikan-berada-di-zona-rawan-bencana

Foster, K., Alexander, L., Steele, M., Hale, T., Hutchison, L., Trejo, R., & Boardman, J. (2025). A mixed methods study of wellbeing and resilience of undergraduate nursing students: implications for the post-pandemic era. BMC Nursing, 24(1). https://doi.org/10.1186/s12912-025-03066-0

Gustavo, G. J. P., & Rakuasa, H. (2023). Disaster Education and the Role of Geographers: A Step Toward a Disaster Resilient Ambon City: A Review. Journal of Education Method and Learning Strategy, 1(03), 183–192. https://doi.org/10.59653/jemls.v1i03.238

Haines, S. J., Strolin-Goltzman, J., Ura, S. K., Conforti, A., & Manga, A. (2022). It Flows Both Ways: Relationships between Families and Educators during the COVID-19 Pandemic. Education Sciences, 12(11). https://doi.org/10.3390/educsci12110745

Harrison, M. E., Deere, N. J., Imron, M. A., Nasir, D., Asti, H. A., Aragay Soler, J., Boyd, N. C., Cheyne, S. M., Collins, S.

A., D'Arcy, L. J., Erb, W. M., Green, H., Healy, W., Holly, B., Houlihan, P. R., Husson, S. J., Jeffers, K. A., Kulu, I. P., Kusin, K., … Struebig, M. J. (2024). Impacts of fire and prospects for recovery in a tropical peat forest ecosystem. Proceedings of the National Academy of Sciences, 121(17), e2307216121. https://doi.org/10.1073/pnas.2307216121

Ho, G. W. K., Leung, D. Y. L., Chan, A. C. Y., Bressington, D. T., & Karatzias, T. (2025). How Do You Become Resilient? A Critical Realist Explanation of the Youth Resilience Process. Adversity and Resilience Science, 6(2), 105–121. https://doi.org/10.1007/s42844-024-00154-z

Huyler, D., & McGill, C. M. (2019). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, by John Creswell and J. David Creswell. Thousand Oaks, CA: Sage Publication, Inc. 275 pages, $67.00 (Paperback). New Horizons in Adult Education and Human Resource Development, 31(3), 75–77. https://doi.org/10.1002/nha3.20258

Japalaghi, Z., Bahrami, A., Beiranvand, R., Soltaninejad, H., Varseh, M., & Sharifi, N. (2025). The effect of educational intervention based on protection motivation theory in improving reproductive health protective behaviors: a quasi-experimental study. BMC Women's Health, 25(1). https://doi.org/10.1186/s12905-025-03680-9

Kim, T., & Yi, S. ri. (2024). Accelerated system-reliability-based disaster resilience analysis for structural systems. Structural Safety, 109 (January), 102479. https://doi.org/10.1016/j.strusafe.2024.102479

Maruddani, R. F., Somantri, L., & Panjaitan, F. (2024). Analisis Spasial Perubahan Tutupan Lahan Pasca Kebakaran Hutan Dan Lahan Di Kabupaten Muaro Jambi. Jurnal Tanah Dan Sumberdaya Lahan, 11(2), 443–453. https://doi.org/10.21776/ub.jtsl.2024.011.2.15

Matsukawa, A., Nagamatsu, S., Ohtsuka, R., & Hayashi, H. (2024). Disaster Resilience Scale for individuals: A fundamental requirement for a disaster-resilient society. International Journal of Disaster Risk Reduction, 107(March), 104405. https://doi.org/10.1016/j.ijdrr.2024.104405

Noviana, E., Kurniaman, O., Guslinda, Munjiatun, Zufriady, & Dewi, R. S. (2020). Identification of Knowledge Mitigation of Forest and Land Fire Disasters; A Preliminary Study for Management of Disaster Learning in Elementary School. Journal of Physics: Conference Series, 1655(1), 0–5. https://doi.org/10.1088/1742-6596/1655/1/012097

Pangestu, S. D., & Fedryansyah, M. (2023). Implementasi Mitigasi Bencana Alam Berbasis Masyarakat Melalui Kampung Siaga Bencana Di Desa Cihanjuang Kecamatan Cimanggung Kabupaten Sumedang. Focus : Jurnal Pekerjaan Sosial, 6(1), 192. https://doi.org/10.24198/focus.v6i1.47267

Parrott, E., Lomeli-Rodriguez, M., Burgess, R., Rahman, A., Direzkia, Y., & Joffe, H. (2025). The Role of Teachers in Fostering Resilience After a Disaster in Indonesia. School Mental Health, 17(1), 118–136. https://doi.org/10.1007/s12310-024-09709-y

Pratama, H., & Putranto, A. (2022). Pembelajaran Berbasis Lingkungan Sebagai Upaya Resiliensi Sosial dan Mitigasi Bencana. Jess: Jurnal Education Social Science, 1(1), 19–34. https://doi.org/10.21274/jess.v1i1.5354

Reimers, F. M., & Schleicher, A. (2020). Schooling disrupted, schooling rethought: How the COVID-19 pandemic is changing education. https://globaled.gse.harvard.edu/files/geii/files/education_continuity_v3.pdf%0A

Saharjo, B. H., & Hasanah, U. (2023). Analisis Faktor Penyebab Terjadinya Kebakaran Hutan dan Lahan di Kabupaten Pulang Pisau, Kalimantan Tengan. Journal of Tropical Silviculture, 14(01), 25–29. https://doi.org/10.29244/j-siltrop.14.01.25-29

Sakti, A. D., Rahadianto, M. A. E., Pradhan, B., Muhammad, H. N., Andani, I. G. A., Sarli, P. W., Abdillah, M. R., Anggraini, T. S., Purnomo, A. D., Ridwana, R., Yulianto, F., Manessa, M. D. M., Fauziyyah, A. N., Yayusman, L. F., & Wikantika, K. (2022). School location analysis by integrating the accessibility, natural and biological hazards to support equal access to education. ISPRS International Journal of Geo-Information, 11(1). https://doi.org/10.3390/ijgi11010012

Sakurai, A. (2025). Disaster Education BT - Encyclopedia of Disaster Risk Reduction (R. Shaw (ed.); pp. 1–5). Springer Nature Singapore. https://doi.org/10.1007/978-981-97-4547-0_15-1

Schmidt, A., Ellsworth, L. M., Boisen, G. A., Novita, N., Malik, A., Gangga, A., Albar, I., Dwi Nurhayati, A., Putra Ritonga, R., Asyhari, A., & Kauffman, J. B. (2024). Fire frequency, intensity, and burn severity in Kalimantan's threatened Peatland areas over two Decades. Frontiers in Forests and Global Change, 7(February), 1–16. https://doi.org/10.3389/ffgc.2024.1221797

Septikasari, Z., Retnowati, H., & Wilujeng, I. (2022). Pendidikan Pencegahan Dan Pengurangan Risiko Bencana (PRB) Sebagai Strategi Ketahanan Sekolah Dasar Dalam Penanggulangan Bencana. Jurnal Ketahanan Nasional, 28(1), 120. https://doi.org/10.22146/jkn.74412

Shaw, R., Sakurai, A., & Oikawa, Y. (2021). New Realization of Disaster Risk Reduction Education in the Context of a Global Pandemic: Lessons from Japan. International Journal of Disaster Risk Science, 12(4), 568–580. https://doi.org/10.1007/s13753-021-00337-7

Strunk, K. K., & Mwavita, M. (2020). Design and Analysis in Educational Research: ANOVA Designs in SPSS® (1st ed.). Routledge. https://doi.org/10.4324/9780429432798

Syugiarto, S., Khaldun, R. I., Tawil, Y. P., & Kusnadi, H. W. (2022). Pemulihan Pasca-Bencana di Indonesia: Perlukah Dilakukan Perubahan Kebijakan? Jurnal Ilmiah Ilmu Sosial, 8(2), 152–161. https://doi.org/10.23887/jiis.v8i2.47443

Tripathi, R. L. (2025). A Multidisciplinary Approach to Psychosocial Rehabilitation in Low- and Middle-Income Countries: Encouraging Mental Health Recovery. Journal of Psychosocial Rehabilitation and Mental Health, 12(1), 93–101. https://doi.org/10.1007/s40737-024-00444-w

Tultrairatana, S., & Phansuea, P. (2022). Symptoms related to air pollution, mask-wearing and associated factors: a cross-sectional study among OPD pollution clinic patients in Bangkok, Thailand. Journal of Health Research, 36(6), 1058–1067. https://doi.org/10.1108/JHR-11-2020-0548

UNDRR. (2017). Terminology: Resilience. Reduction, United Nations Office for Disaster Risk. https://www.undrr.org/terminology/resilience

UNESCO. (2024). Greening curriculum guidance: Teaching and learning for climate action. https://unesdoc.unesco.org/ark:/48223/pf0000390022

Wang, F., Huang, P., Xi, Y., & King, R. B. (2025). Fostering resilience among university students : the role of teaching and learning environments. Higher Education, 0123456789. https://doi.org/10.1007/s10734-025-01484-2

Wiguna, F. A., Wijaya, A. N., Nabila, N. A.,

& Sawitri, D. R. (2024). Factors Influencing Academic Resilience Among University Student : A Systematic Literature Review. 1–9. https://doi.org/10.4108/eai.24-7-2024.2354394

Windiani, W. (2021). Pentahelix Collaboration Approach in Disaster Management: Case Study on Disaster Risk Reduction Forum-East Java. IPTEK Journal of Proceedings Series, 0(7), 71. https://doi.org/10.12962/j23546026.y2020i7.9540

Zahl-thanem, A., & Rye, J. F. (2024). Spatial inequality in higher education : a growing urban – rural educational gap ? European Sociological Review, 40(March), 1067–1081. https://doi.org/10.1093/esr/jcae015