

# Strategy for Disaster Adaptation to Improve Student Resilience in Schools: A Systematic Review

*Strategi Adaptasi Bencana bagi Meningkatkan Daya Tahan Pelajar di Sekolah: Tinjauan Sistematis*

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**ABSTRACT** *For several years, disaster-related studies have always focused on disaster preparedness and risk reduction efforts. Researchers also attribute disasters more to the context of society, even though schools are one of the most vulnerable places to catastrophe. Many schools are located in disaster-prone areas, and children spend most of their time in school. This study aims to identify strategies to improve disaster adaptation capacity in schools. This study used a database from Sciencedirect, Springerlink, Taylor & Francis, and Emerald with the keywords "adaptation", "disaster", "children", "strategy", and "school". There were 7,230 articles in total related to these keywords, and only 21 articles were selected. The remaining articles were unselected due to a less relevant stance to the topic of this study. Thematic analysis techniques were used in the process of analysing reports. The thematic analysis results show that there are five main strategies in improving disaster capacity in schools, that is increasing access to assets, flexibility and diversity, social ability, learning integration, and organizational development. From these five strategies, 25 sub-strategies were obtained to support the achievement of disaster adaptation. The government needs to pay more attention to the schools' condition in disaster-prone areas and implement disaster adaptation strategies in schools. The ability of disaster adaptation can encourage the school community to be well-prepared in overcoming disasters.*

**Key Words:** disaster adaptation, resilience, school, strategy, student

## 1. Introduction

In recent years, the frequency of disasters throughout the world has shown a magnificent increase. Achora and Kamanyire (2016) states a steady increase in the number of disasters

occurrences worldwide. 2018 is even entitled to the year with the most impressive number of disasters; there were 39 drought and extreme temperature episodes, 20 earthquake and tsunami disasters, 108 floods, 84 hurricanes, ten forest fire accidents, and seven volcanic activities (Centre for Research on the Epidemiology of Disaster, 2019). The event of disasters is often associated with destiny. A human cannot avoid any form of catastrophic events and the time it happens. The government has prepared many policies to reduce disaster risks; however, there are significant problems in efforts to reduce disaster risk, such as the lack of responsible organizations in disaster areas (Pourhosseini et al., 2015).

As a matter of fact, this problem is influenced by organization members' insufficient expertise and ability during a disaster emergency (Pourhosseini et al., 2015). This poor capacity shows that many individuals are incapable of disaster adaptation in their surroundings. This issue also occurs in schools. School is a second-place after home for children to spend time, so it is essential to create a safe and comfortable atmosphere (Bhebhe et al., 2019). Most children spend six hours each day at school (Wherry, 2004) for 208 days (Parinduri, 2014). This is affirmed by the Organization for Economic Cooperation and Development (OECD) (2014), stating that primary school students spend 802 hours in school for one full year and 924 hours for high school students for one year.

Children are one of the vulnerable groups in disasters (Amri et al., 2017). Children's limitations influence this vulnerability in understanding the disaster risk conditions around them (Hermon et al., 2019). Children will respond to the effects of disasters longer than others. Frequently, these impacts will be unveiled a few months after the tragedy (Myers-walls, n.d.); therefore, some efforts are required to improve children's preparedness to deal with the disaster risks. Schools must contribute to efforts to increase children's preparedness for disasters, given that students spend most of their time in school (Achora & Kamanyire, 2016).

Schools must develop disaster adaptation strategies, so children feel secure while in school. Disasters happen anytime and anywhere, bringing damage to infrastructure and trauma to children (Bhebhe et al., 2019). Catani et al. (2008) state that children will experience Posttraumatic-Stress Disorder (PTSD) of 14-95% after experiencing a direct catastrophic event. Children are very vulnerable to experience psychological and emotional problems due to disasters; however, these consequences are still disregarded by the public (Catani et al., 2008). The community still focuses on the physical impacts caused by disasters, such as death, facilities and infrastructure damage, and community economic slowdown. Another perception from the community in light of disaster conditions is the assumption that schools are not safe during disaster emergencies (Ssekamanya et al., 2016). Schools must create a positive atmosphere for children's development, involvement, and adaptation (Varela et al., 2018). If children fully trust schools, they will find it easier to develop themselves.

Schools must encourage the realization of disaster adaptation capacity improvement to their students. Adaptability cannot be accomplished instantly because it requires a long process (Sridarran et al., 2018). Adaptation and disaster risk reduction are strategies to reduce natural disaster risks; nevertheless, the reduction only focuses on short-term

conditions while adaptation focuses on long-term needs (Davis & Vulturius, 2014). The long-term focus ultimately encourages adaptation to be an aspect that all levels must consider minimizing the number of disaster victims. To reduce the number of victims, the individual capacity becomes an important thing that should be looked after. Disaster adaptation is a strategy often applied to change personal behaviour in dealing with disasters (Deng et al., 2017; Aristianti & Christiawan, 2019). Therefore, children's adaptability will affect the efforts to minimize disaster victims.

Adaptation is often associated with mitigation efforts, spatial management, and technological innovation (Renald et al., 2016). Schools need to formulate disaster adaptation strategies that cover all of these efforts; nonetheless, the research on adaptation is still minimal. Most disaster research focuses on preparedness, early warning, mobilization, disaster risk reduction, disaster mitigation, and disaster knowledge (Lwasa et al., 2017). Specific strategy to improve disaster adaptability in schools is in demand as one of the focuses of future disaster research since adaptation is a long-term concept. Therefore, this study aims to determine the appropriate disaster adaptation strategy in schools based on previous studies that have been carried out.

## **2. Research Method**

### **2.1 Data Collection and Multi-stage Processes**

A systematic review is a reviews information that is continually updated (Elliott et al., 2017). A systematic method of review is not only conducted in the science of disaster but also in many other sciences, such as health, environment, social economy, education, and security. In disaster milieu, systematic review used also focuses on other studies, such as disaster risk reduction (Djalante, 2018; Kankanamge et al., 2019), community perceptions and behaviour towards disaster risks (AlQahtany & Abubakar, 2020), disaster management (Ritchie & Jiang, 2019), risk reduction strategies (Aghaei et al., 2019; Wamsler & Johannessen, 2020), disaster planning and preparedness (Raikes et al., 2019), disaster risk financing (Katongole, 2020), disaster mitigation (Shreve & Kelman, 2014), disaster risk education (Proulx & Aboud, 2019), disaster risk policy (Mashi et al., 2019; Pertiwi et al., 2020), and school resilience (Mirzaei et al., 2019).

The researchers adopted data collection, document selection, analysis, and results from the presentation of each systematic review study conducted previously. The researchers also used a multi-layer systematic review to distinguish the inclusion and exclusion documents related to the topic of study (Djalante, 2018). This study used a publication database from Scencedirect, Springerlink, Taylor & Francis, and Emerald, with a publication period from 2009 to 2019 (10 years). The use of the database is because article readers often use databases. In the initial stage, the researchers used keywords to search in these five databases. The main keywords used are "adaptation", "disaster", "children" and "strategy". In addition, the researchers also included the keyword "school" in determining patterns of disaster adaptation in schools. In total, there were 7,230 articles related to these keywords (Table 1).

**Table 1: Multi-stage Process in Systematic Review**

Stage	Inclusion/ Exclusion	Description	Search topics	Results
First	Inclusion based on search topics	Using keywords	("adaptation") and ("disaster") and ("school") and ("strategy") and ("children")	7230
Second	Exclusion on keyword Exclusion on subject area Exclusion on title Exclusion on language Exclusion on subject area Exclusion on content type	Relate to medicine and public health Only in natural disaster in general Those that are relate on title Only article that are written in English Subject areas that are too broad are excluded Only research article, review and conference paper	and (EXCLUDE (LANGUAGE, "Germany") or (EXCLUDE (LANGUAGE, "Dutch") or (EXCLUDE (LANGUAGE, "France") or (EXCLUDE (LANGUAGE, "Italian") and (EXCLUDE (SUBJAREA, "MEDICINE") or EXCLUDE (SUBJAREA, "NUTRITION") or EXCLUDE (SUBJAREA, "STATISTICS") or EXCLUDE (SUBJAREA, "COMPUTER SCIENCE") or EXCLUDE (SUBJAREA, "CHEMISTRY") and (EXCLUDE (CONTYPE, "Chapter") or (EXCLUDE (CONTYPE, "Book") or (EXCLUDE (LANGUAGE, "Protocol") or (EXCLUDE (LANGUAGE, "Conference work entry")	1257
Final	Final exclusion	Subject areas that are too broad are excluded		21

The second phase includes exclusion documents to strengthen the results of the study. This exclusion relates to subject areas and titles with no direct connection to the topic of this study. There were approximately 1,257 exclusion articles. The exclusion phase was performed because disaster adaptation in schools is still minimal. Most of the publications regarding adaptation are majorly related to society, disaster challenges, and climate change. The data exclusion will further strengthen the review of disaster adaptation strategies in schools. The exclusion was also carried out on language; researchers only used English articles, so articles in German, Dutch, French and Italian were eliminated. Also, the exclusion was conducted on the subject areas of medicine, nutrition, statistics, computer science, and chemistry. The last stage is the researchers determined related research to disaster adaptation capacity in schools. However, given the limited research related to disaster adaptation in schools, the researchers also used the community and individual disaster adaptation capacity to support this topic.

### **3. Data Analysis**

The data analysis performed in this study is thematic analysis. The thematic analysis allows researchers to analyse the component classification (Aghaei et al., 2019) related to disaster adaptation capacity. Before classifying disaster adaptation strategies, the researchers analysed the authors, the focus of the research fields, and the publication period of the selected articles. This was conducted to compare practical developments related to disaster adaptation.

### **4. Finding and Discussion**

This section discusses the descriptive analysis of articles of a systematic review and group strategies in improving disaster adaptation capacity dividing into five strategies, namely: increasing access to assets, flexibility and diversity, social capacity, learning integration, and organizational development.

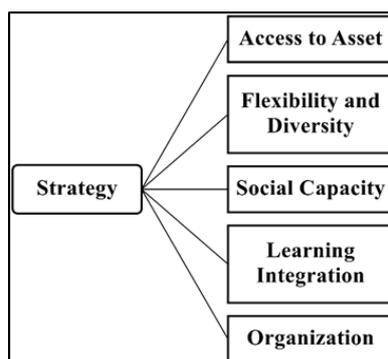
#### **4.1 Descriptive Analysis of the Articles**

Descriptive analysis of the articles was administered by observing the study characteristics of the selected articles. Based on 21 selected articles, research related to disaster adaptation had been conducted in various countries with a different focus of study. Some articles discuss the disaster adaptation capacity in schools, individuals, communities, and even government. Each study proposes a different strategy. Considering that disaster adaptation conditions in schools are related to students and teachers, the following 21 articles were used to formulate strategies for improving the disaster adaptation capacity in schools. Based on Table 2, nine articles (42.9%) used the literature review as the methodology, and three (14.3%) used mixed studies. Many articles employing literature

review show that disaster studies had been carried out for a long time so that the data on disasters could be obtained through documentation studies. The publications regarding disasters conducted in 2019 mostly came from Nepal, Zimbabwe, and South Africa, the countries with a high level of disaster vulnerability (International Federation of Red Cross and Red Crescent Societies, 2017). Most articles (12 articles/57.1%) used content analysis as their analysis technique. Content analysis is often used in research because researchers can determine credibility as in quantitative studies (Bengtsson, 2016).

#### 4.2 Strategies to Increase Disaster Capability

Disaster adaptation strategies that can be carried out in schools are related to the learning process and other aspects that need to be considered, such as infrastructure, policies, and school management. This is following the development of disaster-safe schools that have been carried out so far. Disaster-safe schools will pay attention to three aspects: safe school facilities, school disaster management, and disaster risk reduction education (Amri, 2017; UNISDR & GADRRRES, 2017). These three aspects become the basis for researchers to classify disaster adaptation strategies that can be implemented in a school. Based on the aspect of disaster-safe schools, the researchers grouped the search results. They then found several strategies that schools could adopt to adapt to disasters. Efforts to improve disaster adaptation capability can be administered by looking after five strategies: increasing access to assets, flexibility and diversity, increasing social capacity, learning integration, and organizational development. Each of these strategies is described in more detail through a sub-strategy. Table 3 explains the sub-strategy that can be carried out to improve disaster adaptation capacity in schools.



**Figure 1:** Strategy of Disaster Adaptation Capacity Improvement

**Table 2:** Descriptive Analysis for Systematic Review

Author	Country	Method	Data Collection	Data Analysis
Bennet et al. (2014)	Thailand	Mixed method study	Indepth-interviews and surveys	Content analysis
Nyahunda & Tirivangasi (2019)	Zimbabwe	Mixed method study (exploratory design)	Unstructured interview and Discussion (FGD)	Thematic analysis
Cinner et al. (2018)	Australia	Literature review	Data extraction	Content analysis
Bhebhe et al. (2019)	South Africa	Literature review	Data extraction	Content analysis
Armijos et al. (2017)	Ecuador	Literature review	Data extraction	Content analysis
Deng et al. (2017)	China	Quantitative	Questionnaire	Structural Equation Model (SEM)
Fischer & Jasny (2017)	England	Quantitative	Semi-structured interview	Social Network Analysis (SNA)
Daramola et al. (2016)	Nigeria	Quantitative	Survey	Cross tabulation and SPSS
Adger (2016)	United Kingdom	Literature review	Data extraction	Content analysis
Eriksen & Brown (2011)	Norway	Literature review	Data extraction	Content analysis
Renald et al. (2016)	Indonesia	Quantitative	Questionnaire and Interview	Structural Equation Model (SEM)
Oakes et al. (2016)	Alaska	Qualitative	Interview	Content analysis
Brink (2015)	Sweden	Qualitative	Interview and FGD	Content analysis
Adger et al. (2017)	United Kingdom	Qualitative	FGD	Thematic analysis
Adhikari et al. (2018)	Nepal	Qualitative	Interview, FGD, and observation	Content analysis
Sujakhu et al. (2019)	Nepal	Quantitative	Questionnaire and interview	Livelihood Vulnerability Index (LVI)
Waters & Adger	United Kingdom	Literature review	Data extraction	Thematic analysis
Yamashita <i>et al.</i>	Japan	Literature review	Data extraction	Content analysis
Torrence	Australia	Literature review	Data extraction	Thematic analysis

**Table 3:** Findings and Thematic Analysis for Systematic Review

<b>Variable</b>	<b>Author</b>
<i>Access to Assets</i>	
Financial management	(Adhikari et al., 2018; Bennett et al., 2014; Cinner et al., 2018; Daramola et al., 2016; Ensor et al., 2019; Mortreux & Barnett, 2017; Oakes et al., 2016; Sujakhu et al., 2019)
Technology optimization	(Cinner et al., 2018; Daramola et al., 2016; Ensor et al., 2019; Mortreux & Barnett, 2017; Nyahunda & Tirivangasi, 2019; Torrence, 2014)
Increased infrastructure support	(Armijos et al., 2017; Bennett et al., 2014; Bhebhe et al., 2019; Cinner et al., 2018; Daramola et al., 2016; Mortreux & Barnett, 2017; Oakes et al., 2016)
Equal access to information	(Adhikari et al., 2018; Bhebhe et al., 2019; Brink, 2015; Ensor et al., 2019; Nyahunda & Tirivangasi, 2019; Sujakhu et al., 2019)
<i>Flexibility and Diversity</i>	
Development of flexible adaptation strategies	(Cinner et al., 2018; Fischer & Jasny, 2017; Nyahunda & Tirivangasi, 2019)
Changes in pattern of resources use	(Adhikari et al., 2018)
Conditions and geographical location	(Bennett et al., 2014; Bhebhe et al., 2019; Mortreux & Barnett, 2017; Oakes et al., 2016; Sujakhu et al., 2019; Yamashita et al., 2016)
Increased mobilization capabilities	(Bennett et al., 2014; Cinner et al., 2018; Eriksen & Brown, 2011)
<i>Social Capacity</i>	
Sharing knowledge	(Daramola et al., 2016; Oakes et al., 2016; Yamashita et al., 2016)
Trust integration	(Adger, 2016; Deng et al., 2017; Mortreux & Barnett, 2017; Waters & Adger, 2017)
Moral involvement	(Adger et al., 2017; Deng et al., 2017)
Feeling control	(Armijos et al., 2017; Bennett et al., 2014)
Increased social capital	(Daramola et al., 2016; Mortreux & Barnett, 2017)
Ethnic and gender management	(Bennett et al., 2014; Mortreux & Barnett, 2017; Sujakhu et al., 2019)
Increased public participation	(Adger, 2016; Adger et al., 2017; Bennett et al., 2014; Brink, 2015; Cinner et al., 2018; Yamashita et al., 2016)
<i>Learning Integration</i>	
Changing understanding	(Bennett et al., 2014; Bhebhe et al., 2019; Cinner et al., 2018; Deng et al., 2017)
Change response and anticipation	(Bennett et al., 2014; Cinner et al., 2018; Torrence, 2014)

Share disaster experience from other locations	(Cinner et al., 2018; Yamashita et al., 2016)
Local knowledge	(Cinner et al., 2018; Eriksen & Brown, 2011; Nyahunda & Tirivangasi, 2019)
Discovery and innovation	(Bhebhe et al., 2019; Ensor et al., 2019; Renald et al., 2016; Torrence, 2014; Waters & Adger, 2017)
Increase individual capacity	(Bhebhe et al., 2019; Brink, 2015; Mortreux & Barnett, 2017)
Integration of knowledge, skills and management	(Cinner et al., 2018; Yamashita et al., 2016)
<i>Organizational Development</i>	
Development of policy based on local conditions	(Adger, 2016; Brink, 2015)
Support from government and other organizations	(Adhikari et al., 2018; Ensor et al., 2019; Nyahunda & Tirivangasi, 2019)
Development of network and collaboration	(Adhikari et al., 2018; Armijos et al., 2017; Bennett et al., 2014; Cinner et al., 2018; Fischer & Jasny, 2017; Oakes et al., 2016; Torrence, 2014; Waters & Adger, 2017)

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### 4.3 Increase Access to Assets

Disaster adaptation efforts will come to light if it is fair and balance access to assets. These assets are divided into financial management, technology optimization, increased infrastructure support, and equal distribution of disaster information. The strategy is following one proposed by Mortreux & Barnett (2017), stating that the essential factors required to improve the disaster adaptation capacity are natural (resources), physical (infrastructure and technology), finance, social (collaboration network), and humans. Individuals will be easier to adapt if they have advantages to access everything during a period of change (Cinner et al., 2018); however, individuals have different levels of access.

Each individual often encounters differences in accessing resources regarding financial management, infrastructure, information, and technology (Cinner et al., 2018; Ensor et al., 2019). Lack of individual access to financial, information and knowledge aspects of disasters drives the adaptation practices of each individual differently (Adhikari et al., 2018). Individuals who have access to these four factors will find it easier to adapt to disasters than individuals with no access. Access to finance and infrastructure widely influences adaptive capacity (Daramola et al., 2016). Often, individuals are constrained by financial problems during adaptation (Bennett et al., 2014; Sujakhu et al., 2019). They must seek loans in other forms of support to further introduce the importance of adaptation to disaster.

In disaster preparations, every individual must have equal access to infrastructure (Bennett et al., 2014; Bhebhe et al., 2019). Infrastructure in every place has a different level and quality; thus, individual access to infrastructure is also different. For instance, the available infrastructures in schools often do not own disaster prevention mechanisms, and

it indicates the inadequateness of the disaster preparedness planning process in schools (Bhebhe et al., 2019). The existence of good infrastructure planning in schools will ease the school community to adapt to all types of disasters around them (Bennett et al., 2014). It is because the infrastructures and services can encourage change responses in each individual (Armijos et al., 2017). Therefore, to have equal access to infrastructure, it must possess good quality, encouraging the realization of safety management in schools.

The development of adaptation is also hampered due to the lack of technology and information accessed by each individual (Nyahunda & Tirivangasi, 2019). Individuals must acknowledge how to obtain information during an emergency and access official information concerning disaster risks in the vicinity and the best way to protect their properties from such disasters (Brink, 2015). The lack of disaster information accessed by every individual will increase the disaster vulnerability chances of victims. Increasing access to disaster information can enhance proactive planning in disaster adaptation (Sujakhu et al., 2019). Every individual must be aware of the surrounding disaster risks and appropriate behaviours that should be shown to minimize the risks, so each individual knows the importance of disaster adaptation (Nyahunda & Tirivangasi, 2019). Disaster information is from the government and other disaster-prone locations with the same disaster vulnerability. Information regarding adaptation practices and behaviour from other locations will strengthen the adaptation capability of the individual in disaster-prone locations (Brink, 2015). Individual who has obtained disaster information can adopt new technology to reinforce the disaster adaptation capability (Torrence, 2014).

#### **4.4 Flexibility and Diversity**

Flexibility and diversity are a strategy carried out by considering the development of disaster patterns from one region to another, so every activity or policy issued should be based on existing flexibility and diversity aspects. The flexibility and diversity strategy can be classified into four sub-strategies: the development of flexible adaptation strategies, changes in resource use patterns, geographical conditions and locations, and increased mobility capabilities. The government has prepared strategies related to disaster risk reduction or preparedness; however, these strategies have not significantly reduced disaster victims' reduction. Nyahunda & Tirivangasi (2019) state that the lack of an effective disaster strategy to reduce the number of victims of disasters encourages the need for a more flexible strategy formulation. The existence of flexible strategy changes can be used to manage disturbances that might occur in the future (Cinner et al., 2018); they can also be used to adapt to changes in the environment (Eriksen & Brown, 2011). Developing more flexible management strategies and policies is part of adaptive capacity (Fischer & Jasny, 2017). Adaptive capacity encourages an individual's ability to respond to external barriers by modifying existing behaviour actively.

Activities that need to be considered to improve disaster safety are identifying and analysing situational needs based on geographic location and disaster trends in the disaster area. Location is an essential aspect of disaster adaptation because every area has different conditions (Oakes et al., 2016; Yamashita et al., 2016). Geographic location will

affect victims' emotions towards a particular area (Mortreux & Barnett, 2017), so it will be easier to influence the adaptation of the disaster. This is confirmed by Bennett et al. (2014), stating that the willingness and length of stay of an individual in an area will cause dependency on conditions in that area. Individuals must understand the condition of their territory well to be able to adapt optimally. Infrastructure planners must pay attention to the geographical condition of schools. Schools should not be under challenging locations to access because it will make students the most vulnerable subjects to disasters (Bhebhe et al., 2019). Schools can improve disaster preparedness by identifying risks and suitable evacuation routes (Proulx & Aboud, 2019). The geographical location will also determine the pattern of social group division (Sujakhu et al., 2019). This division will affect individual access to disaster information. Individuals in disaster-prone areas should have better access to disaster information than individuals in non-disaster-prone areas to avoid disparity in disaster information.

Individuals in disaster-prone locations must gradually change the pattern of resource use (Adhikari et al., 2018). It is because the geographical conditions of the area will change along with the development of disaster events. Individuals who can adapt to these changes must mobilize all components of disaster, and they can make effective adaptation capabilities formed within themselves (Cinner et al., 2018). The ability of mobilization possessed by individuals can reduce their vulnerability (Eriksen & Brown, 2011).

#### **4.5 Social Capacity**

Social capacity is a strategy to improve disaster adaptation capability by taking into account the abilities of individuals. Sub-strategies in social capacity include knowledge sharing, trust integration, moral involvement, feeling control, increasing social capital, ethnic and gender management, and increasing public participation. Trust is one aspect that will affect individuals' perceptions of disaster conditions around them (Deng et al., 2017). Perception connected to the powerlessness of individuals in dealing with disasters will affect the action and hamper adaptability realization (Adger, 2016). Integrating an individual's beliefs and experience will affect the adaptation actions undertaken (Mortreux & Barnett, 2017). The individual will always maintain the trust attached to one's mind. To change these beliefs, an individual must adapt to all changes in surroundings (Waters & Adger, 2017). Individual belief will affect the emotions or feelings he or she has. People will feel safer when they can control their feelings (Armijos et al., 2017). Control over feelings can encourage oneself to gain access to all available resources.

The ability to adapt to disasters will be accomplished if individuals are actively involved in disaster management activities in the environment. Those actively involved in the disaster planning process will find it easier to adapt to disasters (Cinner et al., 2018). Those actively involved in problem-solving will find it easier to act, approve, and vote in every decision-making (Adger et al., 2017). Human needs solidarity, ability, burden fairness, and protection from disaster risks; thus, active participation in disaster activities can increase the adaptive capacity of the individual. This individual participation can be conducted at the local, regional and national levels (Bennett et al., 2014). More and more individuals who actively participate will encourage the realization of adaptive abilities.

This is reinforced by Adger (2016), stating that justice is often associated with an adaptation that will directly affect public participation; the more individuals participate, the more sacrifices and burdens can be minimized.

The ineffectiveness of social capacity is encouraged by ethnic and gender issues, which often become obstacles in conducting disaster adaptation (Cinner et al., 2018). In line with Cinner, Sujakhu et al. (2019) state that disaster vulnerability will be aggravated if increasing ethnic and gender issues are not addressed. Gender is a sign to determine an individual's behavior towards disaster (Mortreux & Barnett, 2017). Differences of opinion between genders will influence decisions for evacuation and disaster preparedness planning, women and men have different adaptation patterns, so gender-based adaptation strategy is needed indeed.

Gender problems will be minimized if individuals can build new knowledge by sharing it with others. Knowledge sharing can be performed through a network of collaboration to increase the adaptation capability of each individual (Daramola et al., 2016). Knowledge sharing is not only conducted by the government only but also between the government and individuals. This occurs because the individual will be directly affected by the disaster so that an increase in the individual's ability is required (Brink, 2015). Individuals are often given an understanding of the importance of an early warning system and forms of local knowledge in disaster mitigation (Daramola et al., 2016) so that individuals can behave following their understanding. Knowledge sharing can also be done by giving workshops to children so that adaptive abilities will be formed early on (Yamashita et al., 2016).

#### **4.6 Learning Integration**

Learning integration is used as one of the strategies to improve the ability of disaster adaptation because learning can change the attitudes and behaviour of individuals towards a change that occurs around them. Sub-strategies that can be done related to the integration of learning include the understanding of change, changing response and disasters anticipation, sharing disaster experiences from other areas, local knowledge, discovery or innovation, increasing individual capacity, and knowledge integration skills and management. Adaptation ability refers to proactive and anticipatory planning of individual actions according to knowledge and experience (Bennett et al., 2014). With this adaptive capacity, each individual can anticipate what will happen in the future and achieve sustainability in disaster management. In disaster management practices, there are principles for developing safer school management through the understanding of change (Bhebe et al., 2019). Individuals who understand change will find it easier to develop knowledge and innovations to increase their capacity.

Individuals are aware of any changes around them and respond to these changes appropriately (Bennett et al., 2014). This is in line with the opinion of Torrence (2014), stating that individuals can defend themselves by learning to anticipate and prepare themselves for all forms of threats by making changes in response and anticipation. The response to change must pay attention to the development of knowledge and technology

related to these aspects (Cinner et al., 2018). The response to risk and the level of confidence of an individual will affect the individuals' readiness in disaster adaptation (Mortreux & Barnett, 2017). Individuals with good perception and response will have good adaptation behaviour, and the presence of specific knowledge related to an aspect will encourage more specific adaptive behaviour (Deng et al., 2017).

Individuals who cannot respond to change appropriately will have a perception of powerlessness and low self-confidence, affecting their actions and adaptive capacity (Adger, 2016). Increase confidence in disaster adaptation; this can be accomplished through local knowledge integration in the community. The presence of local knowledge used in adaptation efforts will encourage adaptation conducted by the community to have future sustainability (Eriksen & Brown, 2011). Local knowledge can be used to build disaster history and data baseline so that individuals will find it easier to formulate and build disaster adaptations acceptable to the whole community (Cinner et al., 2018). Local knowledge plays a significant role in disaster adaptation efforts; however, local knowledge also has a relatively high level of uncertainty (Nyahunda & Tirivangasi, 2019). Local knowledge must be integrated with other learning in order to have a higher level of trust.

The integration of local knowledge, individual ability, and management can encourage the formation of the adaptation capability of each individual (Cinner et al., 2018). The integration is carried out to further increase understanding in learning disaster (Bennett et al., 2014). Japan has applied this integration in innovative schools to encourage students to enjoy the study of disaster risk (Yamashita et al., 2016). This integration will be achieved if a network between organizations can facilitate disaster action and learning simultaneously (Fischer & Jasny, 2017). Organizations should cooperate to form a more appropriate disaster learning for specific areas; without the cooperation between organizations, individuals will not be able to access service resources easily in the event of a disaster.

Disaster adaptation ability is not merely related to the integration of local knowledge in learning. An individual must innovate in the presence of integration. Innovation is one of the activities carried out to deal with actual disaster risks beyond human ability by creating a new technology that can be applied to minimize disaster risks (Renald et al., 2016). Innovation shows how individuals begin to adapt to changes (Waters & Adger, 2017), and innovation is often considered as the essential adaptation that must be possessed by every individual (Ensor et al., 2019). Individuals in the disaster-prone area must develop disaster resilience and reduce disaster vulnerability through adaptation to the disaster conditions (Torrence, 2014). This adaptation behaviour will affect the pattern of disaster mitigation carried out by individuals (Deng et al., 2017).

The development of innovation will be achieved if each individual owns good knowledge and experience capacity. Individual capacity is an important aspect that can determine the success of disaster adaptation in a particular area. Individual capacity can be seen through efforts to reduce exposure to hazards, reduce vulnerability, increase disaster response readiness, and disaster recovery readiness (Brink, 2015). Every human has a different capacity according to the knowledge and experience one possesses. Individual capacity will increase if there is the knowledge sharing about the causal

relationship in a disaster and combines the knowledge with direct learning experiences (direct observation) and indirect learning experiences (social media, news, publications, or other individuals) (Oakes et al., 2016) so that each individual will understand disaster around and how to avoid it.

#### **4.7 Organizational Development**

Improving the ability to adapt to disasters in schools is not only related to each student's individual ability in the school. School organizations are also supposed to develop strategies to improve the adaptability of the community in the school. Strategies related to organizational development include making school policies based on local conditions, increasing support from the government and organizations, and developing networks and cooperation. School organizations must arrange policies that consider the disaster conditions at the local level (Bennett et al., 2014). This is important so that the preparation of policy material is more specific and will directly affect each individual in the school. These policies must obtain support from the government; thus, policies, programs, and disaster adaptation plans prepared by a school can be implemented optimally (Bennett et al., 2014; Nyahunda & Tirivangasi, 2019). Support from the government and other external institutions can increase the adaptive capacity of individuals in a school (Adhikari et al., 2018).

The institutional aspect often encounters adaptation obstacles and collaboration between the government and other organizations are needed to create an adaptation that is in accordance with the conditions (Ensor et al., 2019). Networking and cooperation must be carried out by the schools because the lack of cooperation and coordination can increase the risk of disasters in the school (Fischer & Jasny, 2017). Network development and collaboration are carried out by school organizations to encourage individuals to acquire knowledge and skills from other areas with similar conditions (Cinner et al., 2018). The existence of practical knowledge of similar disaster conditions will further strengthen the students' mentality in school. School will easily make policies after finding the direct exposure to disasters followed by the information exchange between organizations (Oakes et al., 2016). Networks can be done broadly or locally, local networks often have stronger relationships, such as with neighbours or close friends (Waters & Adger, 2017). The level and size of the network will affect the adaptability of an individual.

Adaptation efforts undertaken in one school will affect adaptation patterns in other schools; this happens because, in the preparation of disaster adaptation policies and practices, schools will pay attention to the results of collaboration with other schools with similar conditions (Brink, 2015). Schools must build social cooperation with other unaffected communities so that the safety of every school community can be measured (Torrence, 2014). Collaboration can also be carried out with the community-based organization. The community-based organization has a more flexible concept than other organizations, and it will be easier to improve adaptability and generalize alternative solutions related to disaster adaptability (Armijos et al., 2017). The community-based organization will develop specific communication patterns according to conditions in an

area. Communication adaptation has occurred through shared understanding and vocabulary for disaster risks with others (Armijos et al., 2017). Networking and collaboration with various stakeholders will make coordination complicated to improve the adaptation capability to disasters. Therefore, good coordination planning is needed to decentralized the division of roles and responsibilities (Mashi et al., 2019). If there is no coordinated planning, duplication of roles and responsibilities can further form conflicts between these stakeholders.

## 5. Conclusion

Disaster adaptability is the ability to connect hazards and exploit existing opportunities. The adaptive capabilities possessed by each individual can minimize the impact of disasters by maximizing potential opportunities that might occur. The ability of disaster adaptation will not be accomplished in a short period process; adaptation requires a long and sustainable process (Davis & Vulturius, 2014). As one of the disaster-prone areas for children, schools should be able to create a safe and comfortable learning atmosphere for children in disaster-prone areas. To create a safe atmosphere, schools must have good disaster adaptation strategies. Strategies to improve the adaptive capacity of disasters can be conducted through five strategies, such as increasing access to assets, developing flexibility and diversity, increasing the social capacity of each individual, disaster integration in the learning process, and developing the ability of school organizations.

The strategy to increase access to assets focuses on efforts to balance the ability of every individual in school to reach assets or disaster services available in school. Flexibility and diversity are carried out to adjust the development of disasters in school activities every day. Disaster patterns that occur in every area have differences, so it is essential to understand these differences. Individual capacity needs to be improved so that individual perceptions of changes in their environment become better and can influence the adaptive ability within themselves. Learning is one method to change the attitudes and behaviour of individuals towards a matter; therefore, the integration of disasters in the learning process can affect a student's adaptive ability. An individual's adaptive ability will not be achieved if the organization's development does not follow it to support increased adaptive ability. Each strategy has sub-strategies that can be used to strengthen the implementation of disaster adaptation strategies in schools. The sub-strategies are interrelated; thus, to achieve the effectiveness of disaster adaptation, the school should apply all of these strategies in practice.

This research is still limited to school adaptation strategies based on aspects of disaster-safe schools, whereas internal and external capabilities can influence adaptability. Therefore, future research can be more directed at disaster adaptation research that pays attention to each academic community's internal and external capabilities in schools, especially internal abilities. Internal abilities will be beneficial for students in disaster-prone areas to determine their attitude during disaster events.

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