*sustainability*

MDPI

*Article*

# The Interplay between School Preparedness and Student's Individual Protective Actions: The Mediating Role of Disaster Education

**Ziyi Wang [1], Ziqiang Han [1] and Yuhuan Li [2,*]**

[1] School of Political Science and Public Administration, Shandong University, Qingdao 266237, China; ziyi.wang.em@mail.sdu.edu.cn (Z.W.); ziqiang.han@sdu.edu.cn (Z.H.)
[2] School of Government, Central University of Finance and Economics, Beijing 100081, China
* Correspondence: yuhuan.lee@163.com; Tel.: +86-010-62288387

**Abstract:** Disaster preparedness serves as a pivotal strategy to achieve the 2030 Sustainable Development Goals. Empowering children and youth in disaster risk reduction through the education system not only enhances present resilience, but also augments future sustainability. This study investigates the mediating role of disaster education between school preparedness and student preparedness, using data from a survey conducted in China, encompassing a substantial sample size of 3675. Employing multiple linear regressions and the Sobel–Goodman tests, the study estimates correlations while controlling for essential confounding variables, such as socioeconomic and demographic characteristics. The results reveal that both school preparedness and disaster education are positively correlated with higher levels of student preparedness. Notably, disaster education plays a mediating role between school preparedness and student preparedness. These findings underscore the paramount importance of seamlessly integrating effective school preparedness and disaster education initiatives, equipping students to confidently navigate potential disasters and emergencies.

**Keywords:** school preparedness; disaster education; student preparedness; China



**Citation:** Wang, Z.; Han, Z.; Li, Y. The Interplay between School Preparedness and Student's Individual Protective Actions: The Mediating Role of Disaster Education. *Sustainability* **2023**, *15*, 14888. https://doi.org/10.3390/su152014888

Academic Editor: Grigorios L. Kyriakopoulos

Received: 7 August 2023
Revised: 6 October 2023
Accepted: 13 October 2023
Published: 15 October 2023



## 1. Introduction

Mitigating losses and minimizing the impact on individuals during disasters stand as pivotal benchmarks within the ambit of the 2030 Sustainable Development Goals (SDGs), particularly related to the climate action, sustainable cities, and communities goals [1]. Positioned as one of the four priorities proposed in the Sendai Framework for Disaster Risk Reduction 2015–2030, disaster preparedness emerges as a critical approach to actualize the disaster risk reduction goals advocated in the SDGs [2]. The educational sector asserts that integrating disaster education and preparedness within schools not only enhances the resilience of our society, but also serves to mitigate potential disaster, especially in the face of increasing climate change and the global surge in climate-related disasters [3]. In response, the establishment of a Global Alliance for Disaster Risk Reduction and Resilience in the Education Sector has been orchestrated, dedicated to advancing comprehensive safety theory and practice on a global scale. The Comprehensive School Safety Framework, which includes safer learning facilities, school safety and educational continuity management, and risk reduction and resilience education as three pillars, was advocated in both disaster risk reduction and education sectors globally [4].

School safety needs a more comprehensive perspective [5]. School disaster preparedness, also referred to as emergency preparedness, stands out as the most foremost and fundamental safety measure during non-emergent periods. It encompasses activities such as formulating contingency plans, providing capacity training for school administrators, assembling emergency management teams, bolstering school infrastructure and safety protocols, and establishing connections with community members, etc. [4,6–9]. The essence

of disaster preparedness in school lies in the capacity to diminish risks, reduce potential losses, and ensure the uninterrupted functioning of schools during crises and, ultimately, to uphold the safety, health, and wellbeing of students, teachers, and communities.

Disaster education [10–12], also referred to as hazards education [13], or termed as risk and resilience education in the new Comprehensive School Safety Framework (CSSF), is another pillar of school safety and is one of the most well-studied components. The essence of disaster education does not lie in instilling fear in children through threats but rather in enhancing their awareness of risks and empowering their capacity and resilience to various disasters, both within and beyond the school environment [14–16]. The resilience nurtured in a child today finds fruition in the resilience of an adult tomorrow, collectively contributing to the establishment of a resilient society—a critical necessity in confronting the escalating challenges posed by mounting disasters in the context of climate change.

A fundamental aim of disaster education is to augment students' consciousness of risk and bolster their resilience against external shocks, with self-protection actions serving as essential individual preparedness measures. Additionally, disaster researchers aspire to see the knowledge and skills imparted through disaster education in schools cascade to families and communities [17,18], as a slogan says: "linking small hands to big hands". Consequently, students' engagement in disaster preparedness activities, otherwise termed as self-protection activities, can emerge as a direct outcome of disaster education. This connection is intricately linked to school preparedness, another integral pillar of school safety management.

However, despite the growing body of literature on disaster education, there remains a dearth of research linking school preparedness and students' individual adoption of protective behaviors. To address this gap, we employ large survey data from seven provinces in China to examine the correlations between school preparedness and the individual adoption of self-protection behaviors. In contrast to most studies which focus on limited cases [19], this study represents the first large-scale exploration of disaster education, school preparedness, and student preparedness using data from China. Furthermore, we delve into the connection between school preparedness and students' adoption of protective actions from the students' perspective, including disaster education as a mediating variable and innovative facet of our research.

Therefore, we hypothesize that (1) with a higher degree of implementation of school safety protection/school preparedness measures, the students from that school will have a higher degree of individual preparedness adoptions; (2) if a school has a disaster education program, the students from that school will have a higher degree of individual preparedness adoptions; and (3) disaster education can partially explain correlations between school preparedness and individual preparedness.

## 2. Materials and Methods

### *2.1. Data and Sampling*

A total of 3675 students, spanning primary schools, middle schools, high schools, and vocational schools across seven provinces in China, participated in the study. The data used in this analysis were sourced from the School Safety Research Committee of the China Emergency Management Association's study conducted in 2016 [20]. The survey covered the capital cities of seven provinces, to represent the geographic diversity in China, including Liaoning (northeast), Beijing (north), Jiangsu (east), Hunan (central), Guangdong (south), Guizhou (southwest), and Gansu (northwest). One primary school, one middle school, one high school, and one vocational school from each city was conveniently selected. Then, one class from each grade of the middle school, high school, and vocational school, except for grades one to three in primary school, was randomly chosen to participate in the survey. All students in the randomly selected classes took part in the survey. The final model included 3505 students, with no missing values for the variables included. The sampling strategy is illustrated in Figure 1.

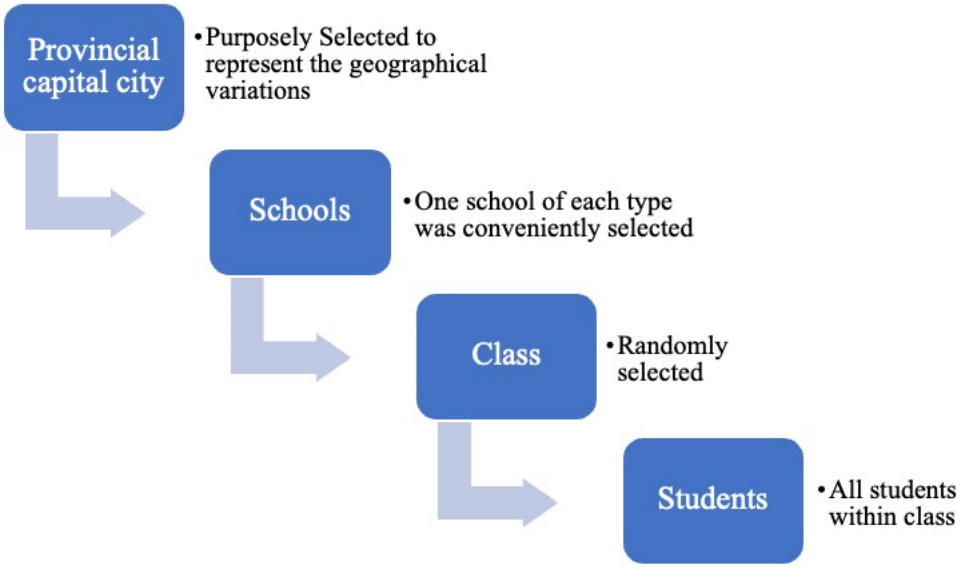



**Figure 1.** Sampling and data collection strategy.

As reported in a previous study using the same dataset [20], an online platform was used to facilitate the data collection process. Students completed the surveys using computers or tablets, depending on the availability of IT equipment in each school, with the assistance of a research assistant. That confirms that the data collection was conducted in person, but with the support of IT equipment.

### *2.2. Measurements*

The dependent variable is a student's awareness and protective actions they have taken, which is measured by the total number of protective activities they have undertaken from a predefined list. Based on previous studies [21,22], we proposed eight potential actions that a student may take in emergency situations and inquired whether they had performed these activities individually. Each action adopted was assigned a score of one, while those not adopted were scored as zero. The sum of the scores from the eight actions constituted a student's preparedness score. As shown in Table 1, the eight protective actions were as follows: "Pay attention to disaster or emergency news", "Pay attention to risk factors around home and schools", "Alert my friends not to go to dangerous places during daily time", "Discuss how to keep safe or what to do during emergencies with my classmates", "Tell my parents or other guardians about the disaster or safety knowledge learned at school", "Participate in emergency exercises in school", "Remember my parents' phone number or other emergency contact number", and "If I find some unsafe place in school, I will tell teachers".

The school preparedness also included eight items, according to previous studies [23–25]. Similarly, we asked students, "Has your school taken the following actions according to your knowledge and awareness?" The answers to each question were "Yes (1)" or "No (0)". The sum of the positive answers to the eight statements was used as the school preparedness degree. The eight actions were as follows: "Do not let students go out of the campus from Monday to Friday", "Has school police or security personnel on campus", "Non-school visitors should register at the front door", "School students are required to wear school suits or school badges as identity", "School has a student behavior code and is routinely inspected", "School has security cameras", "School has emergency/safety response teams", and "School has emergency evacuation signs".

**Table 1.** Descriptive analysis of student preparedness, school preparedness, and disaster education.

| | | Freq | Percent |
|---|---|---|---|
| Student preparedness | Pay attention to disaster or emergency news | 2919 | 83.23 |
| | Pay attention to risk factors around home and schools | 2675 | 76.30 |
| | Alert my friends do not go to dangerous places during daily time | 3037 | 86.62 |
| | Discussed how to keep safe or what to do during emergencies with my classmates | 1777 | 50.68 |
| | Tell my parents or other guardians about the disaster or safety knowledge learned at school | 2747 | 78.35 |
| | Participated in emergency exercises in school | 3301 | 94.13 |
| | Remembered my parents' phone number or other emergency contact number | 3379 | 96.35 |
| | If I found some unsafe place in school, I will tell teachers | 2183 | 62.26 |
| School preparedness | Do not let students go out of campus from Monday to Friday | 1886 | 55.47 |
| | Have school police or security personnel on campus | 3383 | 95.59 |
| | Non-school visitors should register at the front door | 2670 | 89.54 |
| | School students are required to wear school suits or school badges as identity | 2830 | 80.15 |
| | School has a student behavior code, and is routinely inspected | 3148 | 93.05 |
| | School has security cameras | 3522 | 97.94 |
| | School has emergency/safety response teams | 2610 | 82.94 |
| | School has emergency evacuation signs | 3049 | 91.18 |
| Disaster education course in school | Yes | 2801 | 76.22 |
| | No | 874 | 23.78 |
| Perceived importance of disaster education | Very important | 3293 | 89.61 |
| | Important | 309 | 8.41 |
| | Not important | 44 | 1.20 |
| | Not important at all | 29 | 0.79 |

The disaster education had five measures. Firstly, the respondent was asked, "Does your school have a specific safety education course?" and the answers were "Yes (1)" or "No (0)". Another question inquired about the perceived importance of safety education at school, and the respondent was asked, "Do you think safety education at school is important?" The answers ranged from one to four, representing the meaning from "Not important at all" to "Very important". We asked three other questions with multiple choices of answers. The first one asked about the contents of safety education, and we listed 26 types of hazards, from natural hazards like earthquakes, to food safety, violence, terrorism attack, etc. The second one asked about the methods of safety education received, and we proposed 12 methods, from lectures to visiting, games, etc. The last one was about who gave the safety education, and there were five potential actors, including the head teacher, a specific safety instructor, school leaders, a police officer/firefighter/nurse/doctor, other teachers in school, volunteers from NGOs, and parents. The disaster education contents, methods, providers, and times of delivery were only reported in descriptive analysis and were not used for modeling.

We controlled for several variables in the analysis, including grade (1 = primary, 2 = middle, 3 = high, 4 = professional), gender (1 = male, 0 = female), whether the school was a local key school (1 = yes, 0 = no), whether the respondent was a minority (1 = yes, 0 = no), whether the respondent was boarding during weekdays (1 = yes, 0 = no), the main guardians (1 = both parents, 2 = a single parent, 3 = grandparents), the father and mother's education attainment level (1 = primary school, 2 = middle school, 3 = high school, 4= junior college, 5 = undergraduate, 6 = postgraduate), perceived family socioeconomic status (1 = very low, 2 = below the average, 3 = middle, 4 = above average, 5 = very

high), and the provincial difference (1 = Beijing, 2 = Gansu, 3 = Guangdong, 4 = Guizhou, 5 = Hunan, 6 = Jiangsu, 7 = Liaoning).

Neither the school preparedness nor the individual preparedness or the disaster education measures are psychometric scales. The school preparedness module was initially used in the National Crime Victimization Survey's School Crime Supplement [26], and the research team modified it to align with the situation of school safety management in China. The individual preparedness and disaster education modules, along with the control variables, were designed by the research team based on their previous studies [27–29].

### *2.3. Data Analysis Strategy*

In the first step, we provided a detailed descriptive analysis of student preparedness, school preparedness, and safety education. The distribution of the socioeconomic and demographic variables was reported in an appendix. Next, we conducted ordinal linear regression (OLS) models, using student preparedness as the dependent variable, school preparedness as the independent variable, and safety education as the mediating variable. Meanwhile, Sobel–Goodman tests were employed to estimate the correlations, while controlling necessary confounding variables. All analyses were conducted using the statistical software Stata/SE 16.1.

## 3. Results

### *3.1. The Participants*

According to the students' report, 3675 students were included in this analysis. As shown in Table S1, primary school students made up 37.77%, 27.76% were middle school students, 26.91% were high school students, and 7.56% were from vocational schools. Boys made up 48.22%, 34.45% were from local key schools, only 8.24% were minorities, and 18.18% of them were in boarding school. Those living with both parents made up 73.28%, 9.90% were from a single parent family, and 16.82% were living with their grandparents. Of their parents, 34.34% of their fathers and 33.36% of their mothers had college-level and above education. The perceived socioeconomic status of the family, ranked from high to low, was 4.57%, 26.39%, 54.20%, 10.99%, and 3.84%, respectively. Those from Beijing made up 16.08%, 12.46% were from Gansu, 12.82% were from Guangdong, 13.66% were from Guizhou, 21.44% were from Hunan, 10.56% were from Jiangsu, and 12.98% were from Liaoning.

### *3.2. School Preparedness and Student Proactive Actions*

We inquired about the students' awareness of eight school preparedness activities (Table 1). According to the students' report, the ranking of school preparedness activities from high to low were: had security cameras (97.94%), had school security personnel (95.59%), had a code of conduct (93.05%), had clear evacuation signs (91.18%), required registration for non-school visitors (89.54%), had an emergency response team (82.94%), required to wear uniforms or badges (80.15%), and not allowed outside during lunchtime (55.47%).

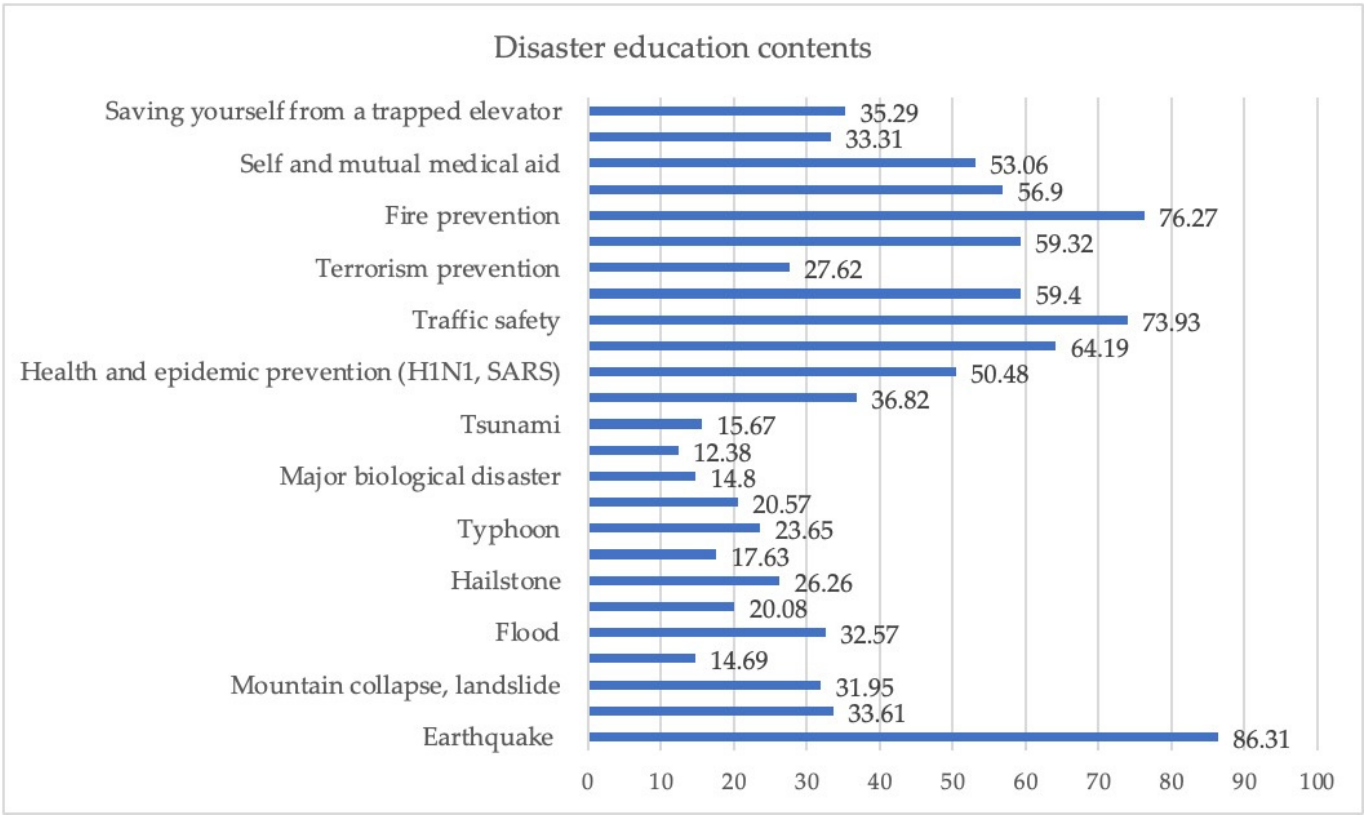
The students' adoption of self-protection behaviors, ranked from high to low, were: remembered parents' phone number (96.35%), participated in emergency drills (94.13%), reminded friends not to go to dangerous places (86.62%), paid attention to disaster news (83.23%), took disaster knowledge learned at school to home (78.35%), paid attention to risks around school and their home (76.30%), reported unsafe places to teachers (62.26%) and discussed disasters and coping strategies with their peers (50.68%).

### *3.3. Disaster Education*

We inquired about the students' safety education course and the perceived importance of disaster education (Table 1). According to the students' report, 76.22% of the students indicated that they had received a specific safety education course at school. Out of these,

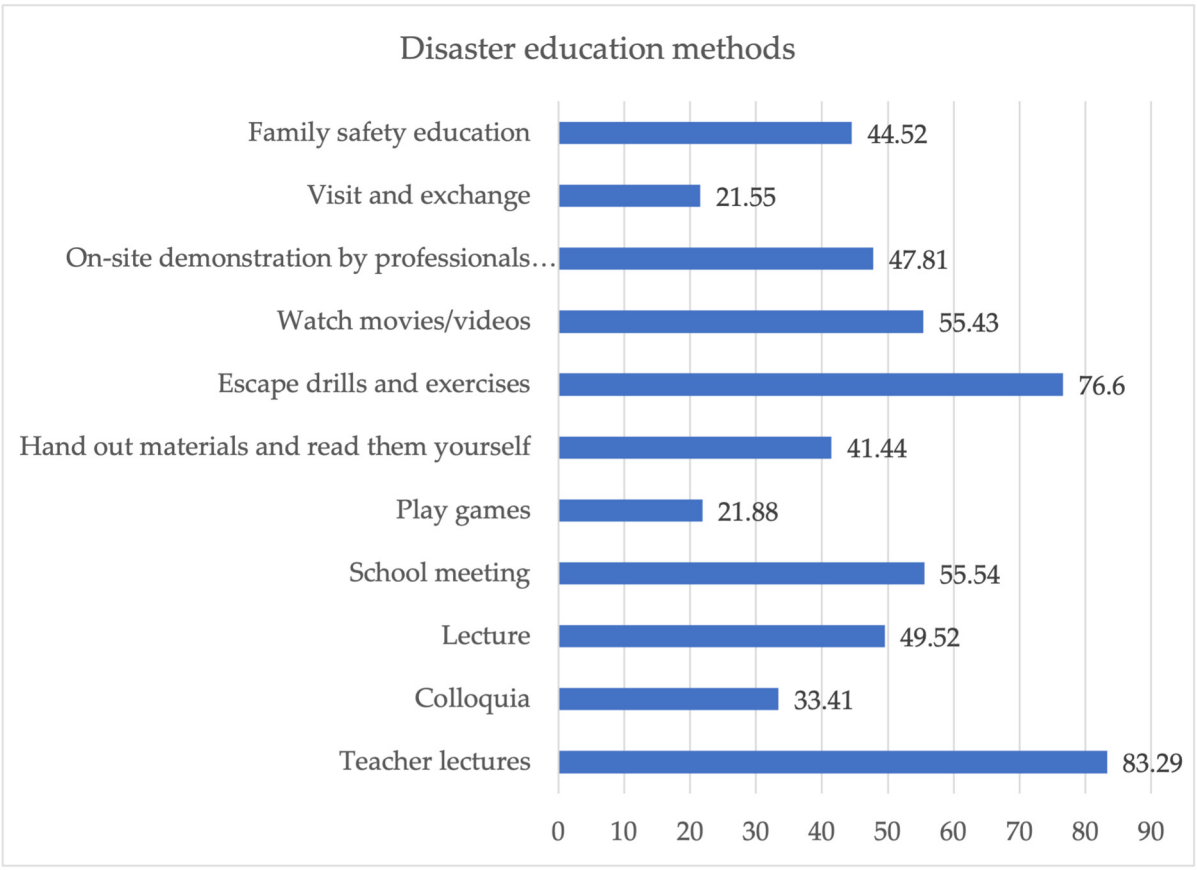
89.61% believed that safety education is very important, 8.41% considered it important, while only 1.99% said that it is not important.

Regarding the content of disaster education, education methods, education providers and the times of delivery of the education (Figure 2a–d), the disaster education contents, ranked from high to low, were: earthquake (86.31%), fire prevention (76.27%), traffic safety (73.93%), food safety (64.19%), theft and fraud prevention (59.4%), drowning prevention (59.32%), occupants evacuation (56.9%), self and mutual medical aid (53.06%), health and epidemic prevention (50.48%), wildfire (36.82%), saving yourself from a trapped elevator (35.29%), debris flow (33.61%), psychological adaptation training (33.31%), flood (32.57%), mountain collapse and landslide (31.95%), terrorism prevention (27.62%), hailstones (26.26%), typhoon (23.65%), sand storm (20.57%), winter storm (17.63%), tsunami (15.67%), major biological disaster (14.8%), volcano (14.69%), and storm tide (12.38%).

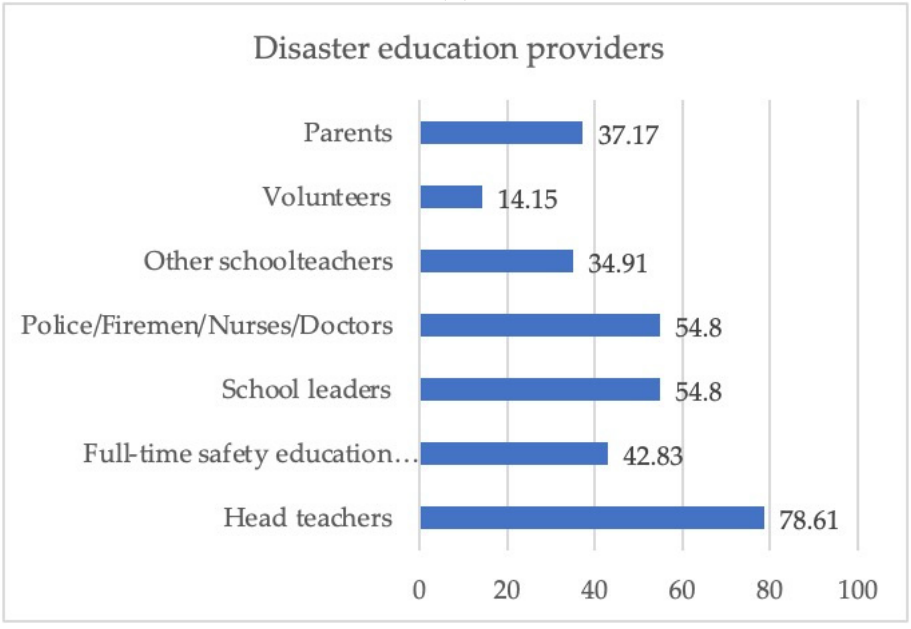



(**a**)

**Figure 2.** *Cont.*

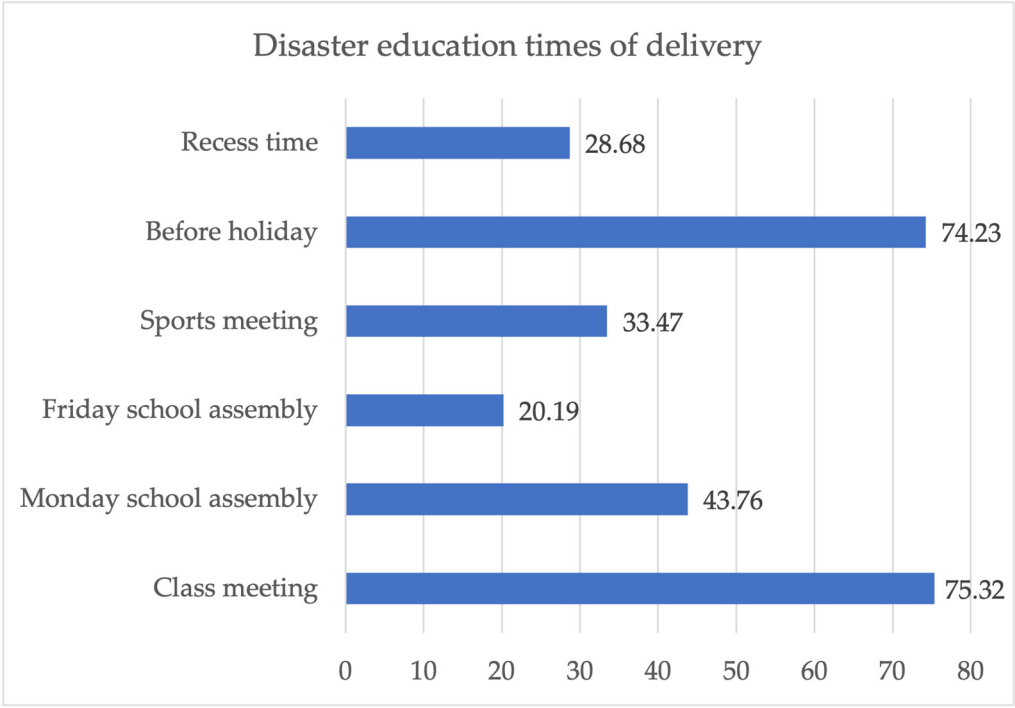



(**b**)




(**c**)

**Figure 2.** *Cont*.




(**d**)

**Figure 2.** (**a**) Description of disaster education contents; (**b**) description of disaster education methods; (**c**) description of disaster education providers; (**d**) description of disaster education times of delivery.

The disaster education methods, ranked from high to low, were: teacher lectures (83.29%), escape drills and exercises (76.6%), school meeting (55.54%), watching movies (55.43%), lectures (49.52%), family safety education (44.52), handout materials and self-reading (41.44%), colloquia (33.41%), playing games (21.88%), and visits and exchanges (21.55%). The disaster education providers, ranked from high to low, were: head teachers (78.61%), school leaders (54.8%), police officers/firefighters/nurses/doctors (54.8%), parents (37.17%), other schoolteachers (34.91%), and volunteers (14.15%). The disaster education times of delivery, ranked from high to low, were: class meeting (75.32%), before holidays (74.23%), Monday school assemblies (43.76%), sports meeting (33.47%), and Friday school assemblies (20.19%).

### *3.4. The Correlations between School Preparedness, Student Proactive Actions, and Disaster Education*

We used the three-step method to estimate the correlations between school preparedness, disaster education, and individual preparedness. As shown in Table 2, school preparedness is positively associated with students' self-protective behaviors and their disaster education course in school, as well as the perceived importance of disaster education. At the same time, their disaster education course in school and the perceived importance of disaster education were also significantly associated with disaster preparedness, which means the mediating effect of a disaster education course in school and the perceived importance of disaster education on school preparedness and student preparedness was confirmed.

**Table 2.** Test of mediating role of disaster education on school preparedness and student preparedness.

| | Student Preparedness | Student Preparedness | Student Preparedness | Disaster Education Course in School | Perceived Importance of Disaster Education |
|---|---|---|---|---|---|
| School preparedness | 0.549 *** | 0.512 *** | 0.505 *** | 0.0561 *** | 0.0742 *** |
| | (0.0162) | (0.0163) | (0.0167) | (0.00395) | (0.00416) |
| Disaster education | | 0.673 *** | | | |
| | | (0.0654) | | | |
| Perceived importance of disaster education | | | 0.580 *** | | |
| | | | (0.0626) | | |
| Compared with primary school<br>Middle school | −0.304 *** | −0.217 *** | −0.247 *** | −0.121 *** | −0.0923 *** |
| | (0.0735) | (0.0729) | (0.0729) | (0.0179) | (0.0189) |
| High school | 0.0517 | 0.183 ** | 0.108 | −0.184 *** | −0.0908 *** |
| | (0.0767) | (0.0767) | (0.0761) | (0.0181) | (0.0191) |
| Professional | −0.0167 | −0.0114 | 0.0352 | 0.00329 | −0.0843** |
| | (0.127) | (0.125) | (0.125) | (0.0317) | (0.0333) |
| Key school | 0.0238 | 0.0394 | 0.0249 | −0.0166 | 0.00104 |
| | (0.0693) | (0.0683) | (0.0685) | (0.0170) | (0.0179) |
| Boy | 0.00593 | −0.00176 | 0.0395 | 0.00924 | −0.0560 *** |
| | (0.0517) | (0.0510) | (0.0512) | (0.0128) | (0.0135) |
| Board | −0.201 *** | −0.228 *** | −0.185 ** | 0.0388 ** | −0.0275 |
| | (0.0750) | (0.0739) | (0.0741) | (0.0190) | (0.0200) |
| Minority | −0.00155 | −0.0198 | 0.0216 | 0.0234 | −0.0366 |
| | (0.102) | (0.101) | (0.101) | (0.0246) | (0.0259) |
| Compared with parents<br>Single-parent family | −0.252 *** | −0.234 *** | −0.223 ** | −0.0273 | −0.0537 ** |
| | (0.0912) | (0.0899) | (0.0902) | (0.0220) | (0.0232) |
| Grandparents | −0.146 ** | −0.146 ** | −0.122 * | 0.00679 | −0.0367 * |
| | (0.0741) | (0.0730) | (0.0733) | (0.0183) | (0.0193) |
| Father's education | 0.000627 | 0.0136 | 0.00358 | −0.0191*** | −0.00421 |
| | (0.0287) | (0.0283) | (0.0283) | (0.00715) | (0.00753) |
| Mother's education | −0.0312 | −0.0334 | −0.0207 | 0.00419 | −0.0187 ** |
| | (0.0284) | (0.0280) | (0.0281) | (0.00708) | (0.00745) |
| Socioeconomic status | 0.0712 ** | 0.0639 * | 0.0662 * | 0.0134 | 0.00799 |
| | (0.0350) | (0.0345) | (0.0346) | (0.00867) | (0.00912) |
| Compared with Beijing<br>Gansu | −0.281 ** | −0.119 | −0.327 *** | −0.244 *** | 0.0730 ** |
| | (0.112) | (0.112) | (0.111) | (0.0282) | (0.0297) |
| Guangdong | −0.350 *** | −0.316 *** | −0.355 *** | −0.0488 * | 0.00650 |
| | (0.100) | (0.0990) | (0.0992) | (0.0254) | (0.0268) |
| Guizhou | −0.204 * | −0.199 * | −0.277 ** | −0.0247 | 0.105 *** |
| | (0.122) | (0.120) | (0.120) | (0.0273) | (0.0287) |
| Hunan | −0.181 * | −0.165 * | −0.229 ** | −0.0188 | 0.0818 *** |
| | (0.0929) | (0.0915) | (0.0919) | (0.0235) | (0.0247) |
| Jiangsu | −0.737 *** | −0.547 *** | −0.731 *** | −0.282 *** | −0.0122 |
| | (0.104) | (0.104) | (0.102) | (0.0263) | (0.0277) |
| Liaoning | 0.0758 | 0.145 | 0.0811 | −0.103 *** | −0.0125 |
| | (0.105) | (0.104) | (0.104) | (0.0267) | (0.0281) |
| Constant | 3.465 *** | 3.017 *** | 1.405 *** | 0.659 *** | 3.559 *** |
| | (0.199) | (0.201) | (0.297) | (0.0492) | (0.0518) |
| Observations | 3505 | 3505 | 3505 | 3675 | 3675 |
| R-squared | 0.317 | 0.337 | 0.333 | 0.179 | 0.112 |

Note: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

We employed the Sobel–Goodman test to test the mediating effects of disaster education on school preparedness and student preparedness. We estimated 2000 bootstrap

samples in which the independent variable was school preparedness, the mediator was a disaster education course in school, and the dependent variable was student preparedness. We also included control variables as covariates in the model. The results indicated that a disaster education course in school partially mediated the relationship between school preparedness and student preparedness (indirect effect = 0.05; 95% CI: [0.03, 0.06]; direct effect = 0.50, 95% CI: [0.47, 0.54]). Specifically, as shown in Table 2, (1) in the regression of the student preparedness (dependent variable) and school preparedness (independent variable), the coefficient of school preparedness was significant ($\beta = 0.55$, $p < 0.01$). (2) In the regression of a disaster education course in school (mediator) and the school preparedness (independent variable), the coefficient of school preparedness was significant ($\beta = 0.06$, $p < 0.01$). (3) In the regression of student preparedness (dependent variable) and a disaster education course in school (mediator), the coefficient of the mediator was significant ($\beta = 0.67$, $p < 0.01$). The effect for path was illustrated in Figure 3.

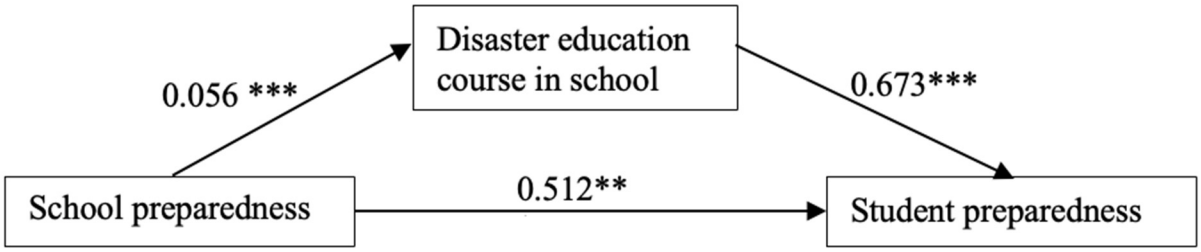



**Figure 3.** The mediating effect of a disaster education course in school on school preparedness and student preparedness. Note: *** $p < 0.01$, ** $p < 0.05$.

Similarly, we tested the mediating roles of the perceived importance of disaster education on school preparedness and student preparedness. The results demonstrated that the perceived importance of disaster education partially mediated the relationship between school preparedness and student preparedness (indirect effect = 0.04; 95% CI: [0.03, 0.05]; direct effect = 0.51, 95% CI: [0.47, 0.54]). The three-step test results of the mediating effects of the perceived importance of disaster education were shown in Table 2. The effect for path was illustrated in Figure 4.

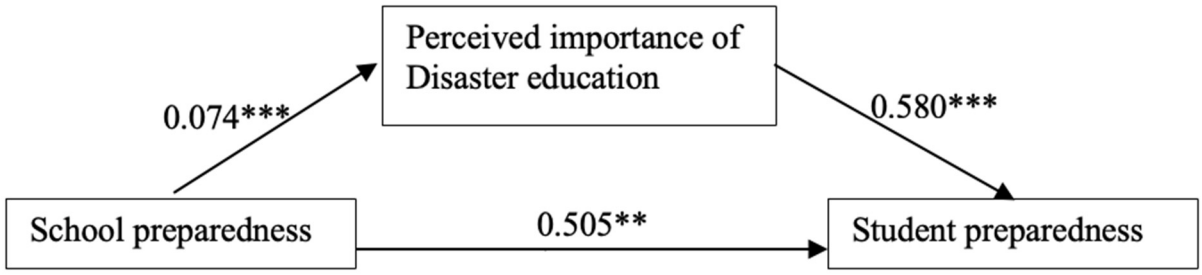



**Figure 4.** The mediating effect of the perceived importance of disaster education on school preparedness and student preparedness. Note: *** $p < 0.01$, ** $p < 0.05$.

## 4. Discussion

This study analyzed the correlations between school preparedness, disaster education, and students' self-protective actions using a survey from children and adolescents from seven provinces in China. Our study has the following two notable contributions to the current literature on school preparedness and disaster education.

Firstly, this is the first study that comprehensively surveyed school preparedness, students' self-reported actions, and disaster education from a large area in China. Particularly, the contents, education methods, education providers, and education time of delivery are reported. Although China has become the first prolific country in disaster science topics [30], in-depth and comprehensive analysis of disaster education is still limited. Unlike

the disaster education programs, such as the "Shakeout" programs, started in California and then expanded to other places in the United States and other countries [31–33], or the disaster education programs from New Zealand or Japan [34–36], or those from other low–middle-income countries like Nepal [37], the Chinese disaster education program is a mix of bottom-up and top-down methods, which rapidly emerged after the 2008 Wenchuan earthquake. In the southwest area with a high earthquake risk, disaster education at school has been very well adopted and supported by local schools, government agencies, NGOs, and community members [19]. As found in this study, most of the disaster education methods are still teacher lectures, and they are delivered by schoolteachers. The engagement of professionals, such as firefighters, nurses, medical professionals, or emergency management professionals, is still very limited. Therefore, considering the increasing trends and occurrences of various disasters in and out of China, the effects of different disaster education methods [38,39], and the collaboration mechanisms between schools, families, and professionals [40,41] should be particularly investigated in the future. Particularly, ways to engage children and adolescents and ways to empower them should be considered as the center for disaster education [42].

Secondly, this study establishes a connection between school preparedness activities and students' reported self-protection behaviors, a relationship that has been rarely investigated before. As shown from the data, school preparedness is positively associated with a higher degree of self-protection behaviors. This association is both direct and indirect, through disaster education. This finding partially supports the effectiveness of school preparedness and disaster education in enhancing students' awareness and behaviors, as measured by protective actions in this study. School preparedness can serve as an indicator of school climate's focus on safety. Consequently, this school climate can significantly influence students' awareness and behaviors. Therefore, disaster education should extend beyond knowledge sharing, to foster a school climate and culture that promotes safety. However, due to the design limitations of this study, we did not extend this linkage to family disaster preparedness behaviors or to community disaster risk reduction activities. Consequently, we were unable to examine the assumption of disaster education transitioning from a "small hand" to a "big hand". As specific cases have shown, the effects of disaster education on enhancing family preparedness and community engagement still lack concrete evidence, and these effective pathways need further exploration.

Disaster preparedness serves as a life-saving measure, safeguarding against both loss of life and loss of economic stability [43]. These endeavors assume a pivotal role in shaping a sustainable future, intimately intertwined with several United Nations Sustainable Development Goals, including climate action, sustainable cities and communities, and quality education. Our study partially furnishes empirical validation to the assertion that school preparedness and disaster education contribute to bolstering society's resilience and capacity for disaster risk reduction, as in the belief that knowledge passes "from small hand to big hand". However, this study only provides evidence in the first half of this pathway, and studies investigating the link from school preparedness and disaster education to household preparedness and community resilience should be undertaken in the future. The analysis underscores an escalating pattern of natural disasters, with a pronounced prevalence of climate-related calamities. Instances of extreme weather events, such as flash floods and wildfires, spanning continents from Asia to Europe, the Americas, and Oceania, resolutely establish that no nation can be immune to their impact. Considering these circumstances, it is incumbent upon us to cultivate preparedness and adaptability, thereby upholding the continuity and sustainability of humankind.

There are at least two major limitations of this study. First, the cross-sectional nature of this study design cannot generate a causal relationship between school preparedness, disaster education, and students' self-protection activities. Longitudinal studies are needed, especially in the case of disaster education, because human beings are prone to forgetting a disaster and find it difficult to truly learn from past disasters. Second, we did not investigate the detailed effects of different education methods, education providers and education

times of delivery [39,42,44,45]. In practice, schoolteachers are the most common instructors for disaster education; however, many of them lack expertise in this area. In some places, school nurses, school psychological consultants, or school resource officers can serve as additional experts. In other cases, schools may contract disaster education out or collaborate with external professionals, like firefighters or emergency management professionals. Regarding disaster education methods, traditional knowledge sharing may be the most widely available but is not necessarily the most effective. Utilizing more engaging methods like Photovoice or incorporating recent technologies like virtual reality (VR) or artificial intelligence (AI) may have better effects, but affordability could be a concern. Therefore, exploring the effects of disaster education methods and educational service providers should be investigated using sound and rigorous methods in the future. Furthermore, it is essential to acknowledge that this analysis reflects the state of school safety and disaster education measures before the COVID-19 pandemic. Given the extensive and far-reaching impact of COVID-19, there have likely been changes in school safety management in China. However, these changes are beyond the scope of this analysis. A systematic examination on the changes in school safety management before and after the COVID-19 pandemic would be an intriguing and valuable area for future research.

## 5. Conclusions

Using a survey of 3675 students from seven provinces in China, this paper investigated the associations between school preparedness and students' adoption of self-protection behaviors, with a focus on disaster education. School preparedness is associated with higher self-protection levels in students, and these associations are both direct and indirect mediated through the disaster education program.

**Supplementary Materials:** The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su152014888/s1; Table S1: descriptive analysis of control variables shown.

**Author Contributions:** Conceptualization, Y.L.; methodology, Z.W.; validation, Z.W. and Y.L.; formal analysis, Z.W.; writing—original draft preparation, Z.W.; writing—review and editing, Y.L. and Z.H.; visualization, Y.L.; data source, Z.H.; funding acquisition, Y.L. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research was funded by the National Natural Science Foundation of China, grant number 72274232 and National Natural Science Foundation of China, grant number 71804207.

**Institutional Review Board Statement:** According to the statement of the survey.

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The data presented in this study are available on request from the corresponding author.

**Acknowledgments:** The authors would like to thank all the participants of the survey.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. United Nations. *Transforming Our World: The 2030 Agenda for Sustainable Development*; United Nations: New York, NY, USA, 2015.
2. United Nations Office for Disaster Risk Reduction. *Sendai Framework for Disaster Risk Reduction 2015–2030*; United Nations Office for Disaster Risk Reduction: New York, NY, USA, 2015.
3. World Meteorological Organization. *WMO Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970–2019)*; World Meteorological Organization: Geneva, Switzerland, 2021.
4. Global Alliance for Disaster Risk Reduction & Resilience in the Education Sector. *Comprehensive School Safety Framework 2022–2030*; Global Alliance for Disaster Risk Reduction & Resilience in the Education Sector: Geneva, Switzerland, 2022.
5. Han, Z.; Petal, M.; Zhang, Q. Children and School Safety Studies Need More Comprehensive and Systematic Views. *Disaster Prev. Manag.* **2021**, *30*, 261–263. [CrossRef]
6. FEMA. *Safer, Stronger, Smarter: A Guide to Improving School Natural Hazard Safety*; FEMA: Washington, DC, USA, 2017.

7. Tipler, K.; Tarrant, R.; Tuffin, K.; Johnston, D. Legislative Requirements and Emergency Management Practitioner Expectations of Preparedness in New Zealand Schools. *Aust. J. Emerg. Manag.* **2017**, *32*, 32–39.
8. Kawasaki, H.; Cui, Z.; Kurokawa, M.; Sonai, K. Current Situation of Disaster Preparedness for Effective Response in Japanese Special Needs Schools. *Disaster Med. Public Health Prep.* **2023**, *17*, e435. [CrossRef]
9. Horton, D.; Spigelmyer, P.; Zoucha, R.; Rebmann, T. Disaster Preparedness in K-12 Schools: An Integrative Review. *J. Sch. Health* **2023**, *93*, 726–732. [CrossRef] [PubMed]
10. Peek, L.; Abramson, D.M.; Cox, R.S.; Fothergill, A.; Tobin, J. Children and Disasters. In *Handbook of Disaster Research*; Handbooks of Sociology and Social Research; Springer: Cham, Switzerland, 2018; pp. 243–262. ISBN 978-3-319-63253-7.
11. Bhandari, R.K. Disaster Education: The Silver Bullet. In *Disaster Education and Management*; Springer India: Pune, India, 2014; pp. 1–27. ISBN 978-81-322-1565-3.
12. Petal, M.; Izadkhah, Y.O. Concept Note: Formal and Informal Education for Disaster Risk Reduction. In Proceedings of the Prepared for the International Conference on School Safety, Islamabad, Pakistan, 14–16 May 2008.
13. Ronan, K.R.; Johnston, D.M. Hazards Education for Youth: A Quasi-Experimental Investigation. *Risk Anal.* **2003**, *23*, 1009–1020. [CrossRef] [PubMed]
14. UNDRR. *Engaging Children and Youth in Disaster Risk Reduction and Resilience Building: A Companion for Implementing the Sendai Framework for Disaster Risk Reduction 2015–2030*; UNDRR: Geneva, Switzerland, 2020.
15. Wisner, B.; Paton, D.; Alisic, E.; Eastwood, O.; Shreve, C.; Fordham, M. Communication with Children and Families About Disaster: Reviewing Multi-disciplinary Literature 2015–Curr. *Psychiatry Rep.* **2018**, *20*, 73. [CrossRef]
16. Ronan, K.; Johnston, D. *Promoting Community Resilience in Disasters: The Role for Schools, Youth, and Families*; Springer Science & Business Media: Berlin, Germany, 2005.
17. Kelly, B.; Ronan, K.R. Preparedness for Natural Hazards: Testing an Expanded Education and Engagement-Enhanced Social Cognitive Model. *Nat. Hazards* **2018**, *91*, 19–35. [CrossRef]
18. Ronan, K.R.; Alisic, E.; Towers, B.; Johnson, V.A.; Johnston, D.M. Disaster Preparedness for Children and Families: A Critical Review. *Curr. Psychiatry Rep.* **2015**, *17*, 58. [CrossRef]
19. Lu, Y.; Wei, L.; Cao, B.; Li, J. Participatory Child-Centered Disaster Risk Reduction Education: An Innovative Chinese NGO Program. *Disaster Prev. Manag. Int. J.* **2021**, *30*, 293–307. [CrossRef]
20. Han, Z.; Zhang, G.; Zhang, H. School Bullying in Urban China: Prevalence and Correlation with School Climate. *Int. J. Environ. Res. Public Health* **2017**, *14*, 1116. [CrossRef]
21. Johnson, V.A.; Ronan, K.R.; Johnston, D.M.; Peace, R. Implementing Disaster Preparedness Education in New Zealand Primary Schools. *Disaster Prev. Manag. Int.* **2014**, *23*, 370–380. [CrossRef]
22. Han, S.; Akiba, M. School Safety, Severe Disciplinary Actions, and School Characteristics: A Secondary Analysis of the School Survey on Crime and Safety. *J. Sch. Leadersh.* **2011**, *21*, 262–292. [CrossRef]
23. Amri, A.; Haynes, K.; Bird, D.K.; Ronan, K. Bridging the Divide between Studies on Disaster Risk Reduction Education and Child-Centred Disaster Risk Reduction: A Critical Review. *Child. Geogr.* **2018**, *16*, 239–251. [CrossRef]
24. Johnson, V.A. *Disaster Preparedness Education in Schools: Recommendations for New Zealand and the United States*; Fulbright New Zealand: Wellington, New Zealand, 2011.
25. Wu, G.; Han, Z.; Xu, W.; Gong, Y. Mapping Individuals' Earthquake Preparedness in China. *Nat. Hazards Earth Syst. Sci.* **2018**, *18*, 1315–1325. [CrossRef]
26. School Crime Supplement (SCS). Available online: https://bjs.ojp.gov/data-collection/school-crime-supplement-scs (accessed on 27 September 2023).
27. Wang, Z.; Han, Z.; Liu, L.; Yu, S. Place Attachment and Household Disaster Preparedness: Examining the Mediation Role of Self-Efficacy. *Int. J. Environ. Res. Public Health* **2021**, *18*, 5565. [CrossRef] [PubMed]
28. Chai, L.; Han, Y.; Han, Z.; Wei, J.; Zhao, Y. Differences in Disaster Preparedness between Urban and Rural Communities in China. *Int. J. Disaster Risk Reduct.* **2021**, *53*, 102020. [CrossRef]
29. Han, Z.; Wang, L.; Cui, K. Trust in Stakeholders and Social Support: Risk Perception and Preparedness by the Wenchuan Earthquake Survivors. *Environ. Hazards* **2021**, *20*, 132–145. [CrossRef]
30. Elsevier A Global Outlook on Disaster Science | Research Intelligence | Elsevier. Available online: https://www.elsevier.com/research-intelligence/campaigns/a-global-outlook-on-disaster-science-2017 (accessed on 30 November 2018).
31. Adams, R.M.; Karlin, B.; Eisenman, D.P.; Blakley, J.; Glik, D. Who Participates in the Great ShakeOut? Why Audience Segmentation Is the Future of Disaster Preparedness Campaigns. *Int. J. Environ. Res. Public Health* **2017**, *14*, 1407. [CrossRef]
32. Johnson, V.A.; Johnston, D.M.; Ronan, K.R.; Peace, R. Evaluating Children's Learning of Adaptive Response Capacities from ShakeOut, an Earthquake and Tsunami Drill in Two Washington State School Districts. *J. Homel. Secur. Emerg. Manag.* **2014**, *11*, 347–373. [CrossRef]
33. Tipler, K.S.; Tarrant, R.A.; Johnston, D.M.; Tuffin, K.F. New Zealand ShakeOut Exercise: Lessons Learned by Schools. *Disaster Prev. Manag. Int.* **2016**, *25*, 550–563. [CrossRef]
34. Johnston, D.; Tarrant, R.; Tipler, K.; Lambie, E.; Crawford, M.; Johnson, V.; Becker, J.; Ronan, K.R. Towards Tsunami-Safer Schools in the Wellington Region of New Zealand: Evaluating Drills and Awareness Programs. *Aust. J. Emerg. Manag.* **2016**, *31*, 59–66.
35. Shiwaku, K. Comparative Study on Teacher Training for School Disaster Management in Armenia and Japan. *Disaster Prev. Manag. Int.* **2014**, *23*, 197–211. [CrossRef]

36. Shiwaku, K.; Ueda, Y.; Oikawa, Y.; Shaw, R. School Disaster Resilience Assessment in the Affected Areas of 2011 East Japan Earthquake and Tsunami. *Nat. Hazards* **2016**, *82*, 333–365. [CrossRef]
37. Shiwaku, K.; Shaw, R.; Kandel, R.C.; Shrestha, S.N.; Dixit, A.M. Future Perspective of School Disaster Education in Nepal. *Disaster Prev. Manag. Int.* **2007**, *16*, 576–587. [CrossRef]
38. Adiyoso, W.; Kanegae, H. The Effect of Different Disaster Education Programs on Tsunami Preparedness among Schoolchildren in Aceh, Indonesia. *Disaster Mitig. Cult. Herit. Hist. Cities* **2012**, *6*, 165–172.
39. Amri, A.; Lassa, J.A.; Tebe, Y.; Hanifa, N.R.; Kumar, J.; Sagala, S. Pathways to Disaster Risk Reduction Education Integration in Schools: Insights from SPAB evaluation in Indonesia. *Int. J. Disaster Risk Reduct.* **2022**, *73*, 102860. [CrossRef]
40. Kawasaki, H.; Yamasaki, S.; Rahman, M.; Murata, Y.; Iwasa, M.; Teramoto, C. Teachers-Parents Cooperation in Disaster Preparation When Schools Become as Evacuation Centers. *Int. J. Disaster Risk Reduct.* **2020**, *44*, 101445. [CrossRef]
41. Pooley, K.; Nunez, S.; Whybro, M. Evidence-Based Practices of Effective Fire Safety Education Programming for Children. *AJEM* **2021**, *36*, 34–41. [CrossRef]
42. Petal, M.; Ronan, K.; Ovington, G.; Tofa, M. Child-Centred Risk Reduction and School Safety: An Evidence-Based Practice Framework and Roadmap. *Int. J. Disaster Risk Reduct.* **2020**, *49*, 101633. [CrossRef]
43. United Nations Office for Disaster Risk Reduction. *Global Assessment Report on Disaster Risk Reduction*; United Nations Office for Disaster Risk Reduction: New York, NY, USA, 2022.
44. Sarabia, M.M.; Kägi, A.; Davison, A.C.; Banwell, N.; Montes, C.; Aebischer, C.; Hostettler, S. The Challenges of Impact Evaluation: Attempting to Measure the Effectiveness of Community-Based Disaster Risk Management. *Int. J. Disaster Risk Reduct.* **2020**, *49*, 101732. [CrossRef]
45. Shyr, W.-J.; Chen, I.-M.; Lee, J.-C.; Su, T.-J. Applying Interactive Teaching Experience and Technology Action Puzzles in Disaster Prevention Education. *Sustainability* **2021**, *13*, 4788. [CrossRef]