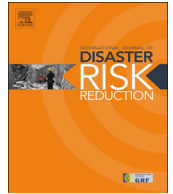




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## Review Article

# Evaluations of disaster education programs for children: A methodological review



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### ABSTRACT

The purpose of this methodological literature review was to investigate how scholars and practitioners currently measure and judge the effectiveness of disaster education programs for children through evaluation. From a systematic search of the published and gray literature, 35 studies were identified and analyzed to develop a categorization of the operational components of the existing body of research, including the types and sources of evaluations, research methods and designs, research participants, outcome indicators, approaches to analysis, and research limitations. A significant finding is that most of what is known about the effectiveness of disaster education programs for children is based on the results of quantitative studies with children that generally focused on measuring children's knowledge of disaster risks and protective actions and child reports of preparedness actions. The majority of descriptive and quasi-experimental studies concluded that programs were effective based on the portion or positive change in children's correct answers on surveys, and most correlational studies concluded positive outcomes such as household preparedness were associated with children's participation in disaster education programs. However, many of the studies had significant methodological limitations. While there is evidence of valuable knowledge change, there is still very limited empirical evidence of how disaster education programs facilitate children's roles in household preparedness, their self-protective capacities, or their likelihood of preparing for disasters as adults. In addition to the need to identify and refine program theory and meaningful outcome indicators, the authors suggest several other opportunities for future research.

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## 1. Introduction

Research has found that advanced preparations for disasters can save lives, reduce injuries and prevent damage to property and critical infrastructure, enabling communities to recover more quickly [60,50,73]. Disaster education, which includes education on disaster risks, mitigation and preparedness strategies, is one approach to reducing the negative consequences of disasters [42,70]. According to the 2005–2015 *Hyogo Framework for Action* [75], the objective of disaster education is 'to build a culture of safety and resilience at all levels,' in order to reduce the adverse social and economic impacts of hazards. Disaster education programs and media have historically targeted adults with information on disaster risks and ways to prepare their families, such as creating family emergency plans, purchasing home and rental insurance, and stockpiling food, water and supplies [20]. Despite these long-standing education efforts, household preparedness levels have remained low and generally unchanged, even while the costs and dangers of catastrophic disasters have increased [48], indicating public education is failing to motivate adults to take preparedness measures.

Over the last decade, emergency management agencies, schools and non-governmental organizations have increasingly targeted children as an audience for disaster education [79,67,65,43,78,41,37]. According to the United Nations Children's Fund [76,19], disaster education programs for children intend to 'contribute to a drastic shift in mentalities and perceptions as well as behavioral change towards a more proactive preventative approach to disasters.' Recently, the U.S. Federal Emergency Management Agency [23] and UNICEF [64] have documented a wide range of disaster education programs for children globally, including formal and informal community, school-based and extra-curricular programs supported by government or private sector funding. The increasing development and investment in disaster education programs for children reflect an international consensus that these educational initiatives produce some gain in individual and community resilience to disasters [82]. However, several authors conclude there is very little formal evaluation of these programs and their effectiveness achieving desired learning and behavioral outcomes [62,64,22,60].

Although research in this area is growing, there is currently no scholarly consensus on what counts as credible evidence of effectiveness of disaster education programs for children (for a related discussion, see [16]). In a case study of school-based disaster education in 30

countries, Selby and Kagawa [64] concluded, 'assessment of student learning is the least considered and least developed element of disaster risk reduction education.' One area requiring further examination is the development of measurable program outcomes that explicitly link children's learning to improvements in disaster preparedness, and outcomes during and after disasters. Another is the identification of practical and effective evaluation methodologies, particularly age-appropriate data collection methods to assess indicators of children's disaster resilience.

The purpose of this methodological literature review was to investigate how scholars and practitioners currently measure and judge the effectiveness of disaster education programs for children through evaluation. The extent of the existing body of research on disaster education for children is not well defined. The few commonly cited studies of disaster education for children, particularly those by Ronan et al., have reported preliminary findings based on both correlational [56,58,61] and quasi-experimental studies [57,59]. However, as these authors themselves conclude, more research is necessary to identify causal relationships between children's education and improvements in individual and community disaster resilience. Since many disaster education programs have been developed by non-formal educators, such as emergency management agencies and child protection organizations, program evaluations may exist in the gray literature in the form of government reports, internal studies and white papers [55,10]. Therefore, the review presented here results from a broad and systematic search for both published and unpublished studies that evaluate the impacts and implementation of disaster education programs for children.

To characterize the current state of evaluation of disaster education programs for children, the studies were analyzed to develop a categorization of the operational components of the existing body of research, including the types and sources of evaluations, research methods and designs, research participants, outcome indicators, approaches to analysis, and research limitations. In particular, this study examines the types of outcome indicators used to measure program impacts. It also examines the data collection methods used in studies involving children to identify promising practices. In addition, the categorization of research limitations reported in the studies is used to identify common research constraints and possible solutions. On the basis of these findings, the authors suggest ways to improve the quality and breadth of

evaluation of disaster education programs for children and opportunities for further research.

## 2. Method

For the purpose of this review, *disaster* is defined as a natural or human-caused hazard that causes ‘a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources’ [77]. By this definition, disasters include destructive events such as earthquakes, tsunamis, storms, hurricanes, tornados, wildfires, floods, pandemics, nuclear emergencies, chemical spills and terrorism, among others. *Disaster risk* is defined as the potential for negative impacts from disasters including loss of life, injuries and damage to assets, functions and services.

This review includes evaluations of the impacts and implementation of disaster education programs for children age 18 and younger. *Evaluation* is liberally defined as ‘an implied inquiry process for collecting and synthesizing evidence that culminates in conclusions about the state of affairs, value, merit, worth, significance, or quality of a program’ [25, p. 139–40]. Studies were included in the review if they described a research design using surveys, questionnaires, interviews, focus groups, observations or content analysis, and research participants including children, or the teachers or parents of children, who participated in a disaster education program. *Disaster education program* is shorthand for an educational initiative that includes the practice of teaching two incorporated subjects: (1) disaster risks and (2) actions to mitigate or reduce injuries and damage from disasters. Education programs that teach only the science of natural hazards did not meet the definition of disaster education for the purpose of this review.

Articles and reports were identified through a broad, multi-faceted search strategy. First, academic databases were searched including Scopus, Web of Knowledge and Academic Search Premier. Each search was refined to articles written in English using a combination of the words *evaluat* or *assess\**; *child\**, *youth* or *teen\**; *interview\**, *focus groups*, *survey\**, *observation\**, or *questionn\**; *curricul\**, *educat\** or *teach\**; and *hazard\**, *safety* or *disaster\**. These searches yielded more than 40,000 results, and the results were further refined using the individual search terms *earthquake\**, *volcan\**, *fire\**, *tsunami\**, *hurricane\**, *storm\**, *flood\** and *tornado\**. The U.S. Department of Education's Educational Resources Information Center (ERIC) was also searched using the terms *children*, *disaster*, *hazard* and *evaluation*.

Once duplicates were removed, the titles of 2838 articles were reviewed (see Table 1). Originally it was expected that the review would include studies evaluating a wide range of hazards and safety-oriented educational programs for children. However, the search generated more articles about disaster education programs than expected. Therefore, studies of educational programs on other safety and hazards-related topics, such as household fire safety, gun safety and prevention of unintentional injuries, were excluded. Consequently, the titles were refined to 354 abstracts for potential inclusion. Studies were then excluded if they did not assess the effectiveness or implementation of an education intervention. Also, the reference lists of other literature reviews and case study reports were reviewed which yielded two additional evaluations. During this process, 33 papers met the inclusion criteria.

In addition, a Google search was performed using the titles of 50 disaster education programs for children listed in the 2011 version of FEMA's *Catalogue of Youth Disaster Preparedness Education Resources* [23], which yielded four additional reports for potential inclusion. Also, 42 program

**Table 1**  
Literature search results.

Source	Search criteria	Results	Refined by	Results	Titles	Absts.	Incl.
Scopus, Web of Knowledge, Academic Search Premier – Education Research, Educational Resources Information Center (May 2012)	<i>evaluat*</i> or <i>assess*</i> ; AND <i>child*</i> , <i>youth</i> or <i>teen*</i> ; AND <i>interview*</i> , <i>focus groups</i> , <i>survey*</i> , <i>observation*</i> , or <i>questionn*</i> ; AND <i>curricul*</i> , <i>educat*</i> or <i>teach*</i> ; AND <i>hazard*</i> , <i>safety</i> or <i>disaster*</i>	45,543	<i>fire*</i> <i>earthquake*</i> <i>hurricane*</i> <i>volcan*</i> <i>tsunami*</i> <i>storm*</i> <i>flood*</i> <i>tornado*</i>	2412	2838 After dups. removed	354	33
<i>Catalogue of Youth Disaster Preparedness Education Resources</i> (2011 version)	Google search of 50 titles of disaster education programs	4			4	4	2
<i>Catalogue of Youth Disaster Preparedness Education Resources</i>	42 program coordinators identified and emailed (23 responded)	7			7	1	1
University of Delaware's Disaster Research Center library (Oct. 2012)	Catalog search of 'disasters and children'; 'disaster education and children'; 'disaster and education and children'	411			33 after dups removed	8	2
<b>Total papers included</b>						<b>38</b>	

coordinators were emailed in May 2012 and invited to provide program evaluations, including informal studies and unpublished reports. Twenty-three program coordinators responded, including 12 who reported an evaluation had been done, although five could not share the results because the data was for internal use only or a report was not prepared. The other 11 coordinators indicated that an evaluation had not been done due to time, staff and funding constraints. In total, seven papers were provided by email, including six duplicates and one additional report. Lastly, the catalog of the University of Delaware's Disaster Research Center library was searched, which yielded two additional studies from book chapters.

In total, 38 papers met the inclusion criteria. Using a grounded theory approach [72], each paper was coded by two raters using more than 100 codes under variables comprising four main concepts of interest: (1) *program description*: developer type, content type, format, geographic location, duration; (2) *evaluation context*: object, evaluator type, publisher type, evaluation type and location; (3) *research design*: design type, data collection tools, research participants (including type, number and demographics), sample response rate, outcome indicators and analysis methods; and (4) *research outcomes*: study limitations and research conclusions. Two raters coded the articles independently and compared results to resolve inconsistencies. Several of the articles had vague or missing information for a number of variables and where this occurred is noted in the results.

### 3. Results

The review identified 38 papers that describe evaluations of 40 disaster education programs for children, including 30 specific education programs and 10 cases of non-specific disaster education delivered in schools and communities. The 38 papers were categorized as 35 studies for the review as some studies were discussed in more than one paper. Table 2 provides a summary of the 35 studies.

The following results present themes identified from the coding process under the categories: disaster education program descriptions, evaluation contexts, research locations and participants, research designs, outcome indicators, study conclusions and research limitations.

#### 3.1. Disaster education program descriptions

Evaluation of the impact and implementation of disaster education programs for children is occurring internationally, and the studies included in this review illustrate the varying types and geographic spread of these programs (Table 2). Eighteen of the 40 education programs evaluated were delivered in the United States and 22 programs were delivered in other countries. Seven of the programs were nationally implemented, including school-based programs in Turkey [74], Nepal [69], Israel [71], New Zealand [33] and three public, self-study websites for children developed by the United States Federal Emergency Management Agency [63].

The studies include evaluations of 30 specific disaster education programs and 10 cases of non-specific disaster education delivered in schools and communities. Of the 30 specific educational interventions evaluated, most were reported as being developed by people or organizations from an academic or emergency management discipline; specifically, nine programs (30%) were developed by academic researchers, most of whom worked at universities or research organizations; six (20%) were developed by national level government agencies; five (17%) by non-governmental organizations (NGOs); three (10%) by local or state emergency management agencies; and three (10%) by schools. One program was developed by a collaboration of a national agency, NGO and academic researchers. For 13 programs, including the 10 non-specific cases, the developer was not specified.

#### 3.2. Evaluation contexts

The earliest evaluation identified in the search was published in 1992, and the remaining evaluations were prepared between 2001 and 2012. While older papers and reports are more difficult to find, the increasing number of evaluations, particularly from 2008 onwards, mirrors the increasing international policy interest in disaster education programs for children (Table 2).

Although the majority of the 38 papers were published in journals or books, 40% are unpublished or un-cataloged reports, confirming that a significant portion of program evaluations exists in the gray literature. Specifically, of the 38 papers, 22 (58%) were published in peer-reviewed academic journals and two (5%) were published in books. Among the articles that were not cataloged in scholarly databases, eleven (29%) were prepared by an academic research organization, meaning these studies were prepared by Ph.D.-level researchers but were not necessarily subject to external peer review. The three remaining studies (8%) constitute internal reports, one distributed by a government agency, one by a NGO and one by a regional emergency management organization. The studies identified were designed exclusively by academic researchers (91%) or professional evaluators (9%).

#### 3.3. Research locations and participants

Most evaluations took place where children and other study participants could be feasibly accessed by researchers. Twenty-five studies (71%), took place in a school setting, seven (20%) took place in an extracurricular or summer camp setting and one study (3%) was conducted online. Two evaluations (6%) were content analyses of websites.

There was a wide range of numbers of research participants but a skew toward small sample sizes (Table 3). Eleven studies (31%) had 17–93 participants, seven (20%) had 101–282 participants, six (17%) had 356–452 participants, three (9%) had 560–767 participants, five (14%) had 1065–2648 participants, and one (3%), a national evaluation in Turkey, included more than 9000 participants, primarily adults training for positions as school-based program instructors.

**Table 2**

Summary of evaluations of disaster education programs for children.

Study	Object	Type	Participants	Design	Data tools	Analysis	Findings (includes statistical significance)
(1) Do hypermedia systems really enhance learning? A case study on earthquake education [26]	Effectiveness of a hypermedia system, <i>Terremoti</i> (Earthquakes) in producing meaningful learning	Impact and process	Teens, age 14-19 (36)	Mixed methods: • Quasi-experimental one group pretest-posttest • Descriptive interviews Descriptive naturalistic observations	Mixed methods questionnaire Individual interviews Observations	Quantitative analysis basic** Qualitative analysis	<b>No effect:</b> Some students clearly appeared to have acquired new knowledge, however, the most evident variations appear in the form of a marginal and episodic restructuring of the existing knowledge rather than an understanding of the models behind the facts.
(2) Correlates of hazard education programs for youth [58]	Effectiveness of non-specific school-based hazard education programs for youth in increasing community resilience	Impact	Children, age 7–13 (56) Parents	Correlational – observational study	Quantitative questionnaire	Quantitative analysis advanced*** – multiple regression analyses	<b>Mostly positive:</b> Youth involved in hazards education programs reported a greater number of home hazards adjustments and had more correct knowledge.
(3) School children's risk perceptions and preparedness: A hazards education survey [61]	Effectiveness of non-specific hazard education programs	Impact	Children, age 5–13 (409)	Correlational – observational study	Quantitative questionnaire	Quantitative analysis advanced – correlation analysis	<b>Mixed:</b> children involved in hazards education programs demonstrated more stable risk perceptions, reduced hazard-related fears, and greater awareness of hazard-related protective behaviors compared to non-educated children. However, no differences were noted in home-based preparedness as a function of education.
(4) Hazards education for youth: A quasi-experimental investigation [59]	Comparing the effectiveness of readings and classroom discussions on disasters vs. program supplemented with an explicit emergency management focus	Impact	Children, age 11–13 (219) Parents	Quasi-experimental – Treatment and control (intact groups) pretest/posttest design	Quantitative questionnaire	Quantitative analysis advanced – ANOVA frequency, t-tests	<b>Mostly positive:</b> taken together, based on significant trials effects for five of the six factors under study, the findings here support the role of hazards education programs in both problem- and emotion-focused domains.
(5) Impact analysis of the Canadian Red Cross Expect the Unexpected program [19]	Effectiveness and implementation of the of the <i>Expect the Unexpected</i> program in Canada	Impact and process	Children, age 7–13 and parents (429 pairs) School teachers (14)	Correlational – observational study	Quantitative questionnaire	Quantitative analysis basic	<b>Not conclusive:</b> a conclusive relationship between student participation in <i>Expect the Unexpected</i> and changes in household emergency preparedness cannot be confirmed from the data collected.
(6) Linking experience, education, perception and earthquake preparedness [66]	Effectiveness of non-specific school-based disaster education in Japan	Impact	Teens, age 15–16 (1065)	Correlational – observational study	Quantitative questionnaire	Quantitative analysis advanced – cross tabulation	<b>Mixed:</b> school education alone cannot motivate behavioral change, however it can provide knowledge and activate student interest.
(7) Basic Disaster Awareness In Turkish Schools Program 2003 – 2005 [74]	Effectiveness of the <i>Basic Disaster Awareness Curriculum</i> (Instructor's Handbook and CD) and implementation of cascading	Impact and process	Instructor trainees (9000+) Instructors (114)	Mixed methods: • Quasi-experimental – One group pretest/posttest	Quantitative questionnaire Questionnaire – not specified	Quantitative analysis basic	<b>Mostly positive:</b> significant impacts in both student and teacher knowledge gains, as well as dramatic increases in family household hazard adjustments,

Table 2 (continued)

Study	Object	Type	Participants	Design	Data tools	Analysis	Findings (includes statistical significance)
	train-the-trainer program to train school teachers		School teachers (99) Children, age 10–14 (101) Teens, age 14–19 (400)	● Descriptive – surveys			and school hazard adjustments in the areas of assessment and planning, physical protection and response capacity development.
(8) Children's risk perceptions and preparedness: Mt Rainier 2005 hazard education assessment, tabulated results [35]	Effectiveness of non-specific school-based teaching on the lahar hazard	Impact	Children and Teens, ~age 11–19 (84)	Descriptive – longitudinal time-lag	Quantitative questionnaire	Quantitative analysis basic	<b>Mostly positive:</b> this is a greater level of awareness than found in the 2000 Orting High School survey. Most students report being involved in education programs and there is evidence that they have interacted with their parents on hazard issues.
(9) Children's risk perceptions and preparedness: Mt Rainier 2006 hazard education assessment tabulated result [34]	Effectiveness of non-specific teaching on disasters/hazards by parents and teachers	Impact	Children and Teens, ~age 11–19 (356)	Descriptive – longitudinal time-lag	Quantitative questionnaire	Quantitative analysis basic	<b>Mostly positive:</b> many of the results from 2006 appear to be consistent with the findings of earlier school assessments on lahar risk. However, there has been a significant increase in lahar awareness and home based engagement over the past six years for students from Sumner.
(10) Tsunami public awareness and the disaster management system of Sri Lanka [36]	Effectiveness of school-based disaster education in Sri Lanka (and other public education)	Impact and process	Children, ~age 10 (1112) School teachers (36)	Descriptive – survey	Quantitative questionnaire	Quantitative analysis advanced – chi-square	<b>No effect:</b> 30% of school children do not yet understand what causes a tsunami. The questionnaire survey results show that disaster education is not conducted comprehensively at the school level.
(11) Applicable methods in teaching earthquakes to preschool children [30]	Impact of six different educational methods for teaching preschoolers about earthquakes	Impact and process	Children, age 5–6 (257) Instructors Parents	Mixed methods: ● Descriptive – naturalistic observation ● Descriptive – survey ● Descriptive – interviews	Observations Individual interviews Questionnaire -not specified (with parents)	Not specified	<b>Mostly positive:</b> teaching by glove puppets proved to be the most effective method in this study. There was no sign of fear in children on the earthquake issue if they were taught with amusing methods. The degree of retention on taught earthquake issues was high.
(12) Future perspective of school disaster education in Nepal [69]	Effectiveness and implementation of the School Earthquake Safety Program (SESP) in Nepal	Impact	Teens, age 15–16 (452) Teachers	Mixed methods: ● Correlational – observational study ● Descriptive – interviews	Quantitative questionnaire Individual interviews	Quantitative analysis advanced – cross tabulation, chi-square	<b>Mixed:</b> SESP has a positive effect on student's intention to take measures, however the program itself does not cause hazard adjustments. Community activities are more effective.
(13) How intercultural disaster reduction education change students: A case study of an evening course senior high school in Hyogo, Japan [44]	Effectiveness of a model of online international collaborative learning on disasters	Impact	Teens, ~age 17–18 (32)	Descriptive – case study	Observations	Case study	<b>Mixed:</b> student awareness and attitudes about disaster reduction changed: students gathered information about disasters without prompting and no negative emotional distress was witnessed. However, one



(14) Big Bird, Disaster Masters, and high school students taking charge: The social capacities of children in disasters education [81]	Effectiveness of the <i>Friends to the Rescue</i> Sesame Workshop video, <i>Masters of Disaster</i> , and <i>I Don't Fit Under the Desk: Advanced Earthquake Safety</i> video	Impact	n/a (case studies)	Descriptive – case study	Content review	Content analysis	case study is not enough for generalization. <b>Not conclusive:</b> the three programs positively consider the capacities of children but more systematic research and outcomes based assessment is needed.
(15) Emergency management in schools – Wellington survey [15]	Implementation of non-specific hazards education in schools in the Wellington region	Process	School representatives (101)	Descriptive – survey	Mixed methods questionnaire	Quantitative analysis basic Qualitative analysis – categorization	<b>Mostly Positive:</b> the majority of schools (86%) have Emergency Management (EM) education as part of their curriculum and almost all schools reported discussing EM procedures with their students, among other findings.
(16) Proactive co-learning: A new paradigm in disaster education [68]	Effectiveness of the Environment and Disaster Mitigation course at Maiko High School compared to courses in other high schools in Japan	Impact	Teens, age 15–16 (1065)	Correlational – observational study	Quantitative questionnaire	Quantitative analysis advanced – cross tabulation	<b>Mostly positive:</b> students that participated in the pro-active co-learning at Maiko High School had higher rates of learning and actions compared to other schools.
(17) READY Evaluation Report 2008 [45]	Impact of <i>READY Camp</i> and <i>READY Classes</i>	Impact and process	Children and Teens, age 11–18 (767) Instructors	Mixed methods: • Quasi-experimental one group pretest-posttest • Descriptive – observations	Quantitative questionnaire Observations	Quantitative analysis advanced – correlation analysis	<b>Mixed:</b> five units made a significant difference however the other two, Emergency Preparedness and Terrorism, did not. Campers acted with relatively high effectiveness during the mock drill. Lack of data made it difficult to draw other conclusions
(18) Involving youth in community emergency preparedness: Impacts of a multistate initiative [51]	Impact of the <i>Alert, Evacuation and Shelter</i> program on knowledge of emergency management and geospatial technology	Impact	Teens (no age given) and adults (146)	Mixed methods: • Quasi-experimental – One group retrospective pretest/posttest • Descriptive – interviews	Quantitative questionnaire Individual interviews	Quantitative analysis advanced – Wilcoxon non-parametric statistical query Qualitative analysis	<b>Mostly positive:</b> survey results immediately following trainings revealed statistically significant increases in participant knowledge gain regarding emergency preparedness. Follow-up evaluations indicate the success of this project in meeting community preparedness goals.
(19) The communication of disaster information and knowledge to children using game technique: The Disaster Awareness Game (DAG) [13]	Effectiveness of the Disaster Awareness Game (DAG)	Impact	Children, age 9–12 (75)	Quasi-experimental – One group pretest/posttest	Quantitative questionnaire	Quantitative analysis basic	<b>Mostly positive:</b> the results from preliminary testing of the DAG indicate that these design considerations are for the most part effective in promoting awareness among children.
(20) The effect of different educational interventions on school children's knowledge of earthquake protective behavior in Israel [71]	Effectiveness of attending an earthquake lecture, participation in an earthquake drill, and a combination of a lecture and drill	Impact	Children, ~age 10-12 (2648)	Correlational – observational study	Quantitative questionnaire	Quantitative analysis advanced – ANOVA and the Kruskal-Wallis test	<b>Mostly positive:</b> earthquake education in 5th and 6th graders, especially if it consists of combined lectures and drills, will improve children's knowledge of appropriate behaviors.
(21) Training youth to prepare communities for disasters [52]	Effectiveness of 4-H Teen Cert in Oregon	Impact	Teens, age 14+ (14) Adults (7)	Quasi-experimental – One group retrospective pretest/posttest	Quantitative questionnaire	Quantitative analysis advanced – paired t-test	<b>Mostly positive:</b> follow-up survey results revealed statistically significant increases in youth participant knowledge, attitude change and skill

Table 2 (continued)

Study	Object	Type	Participants	Design	Data tools	Analysis	Findings (includes statistical significance)
(22) An earthquake education program with parent participation for preschool children [28]	Impact of the <i>Earthquake Education Program</i> for preschool children and influence of parent participation	Impact	Children, age 5–6 (93)	Experimental – randomized treatment and control pretest-posttest	Mixed methods questionnaire	Quantitative analysis advanced – ANOVA frequency group comparison	acquisition for 19 of the 21 topics queried. <b>Mostly positive</b> <sup>*</sup> : there were significant differences in the pre and posttests for the two experimental groups. Effective in increasing knowledge. Parent participation seemed to be more effective than no parent participation.
(23) Young children's demonstrated understanding of hurricanes [8] AND Consequences for classroom environments and school personnel: Evaluating Katrina's effect on schools and system response [9]	Indicators of non-specific classroom teaching and discussion about hurricanes	Impact and process	Children, ~age 5–9 (84) School teachers (592)	Correlational – observational study	Individual interviews (children) Mixed methods questionnaire (school teachers)	Quantitative analysis advanced – chi-squared Qualitative analysis – constant comparative method Qualitative analysis – video coding	<b>No effect</b> <sup>*</sup> : children's knowledge was not related to participation in teacher-planned classroom activities. The main predictors were age, class size and teachers' years of experience.
(24) Correlates of hazards education for youth: a replication study [56]	Effectiveness of hazard education programs for youth (non-specific) in increasing community resilience	Impact	Children and teens, age 7–18 (407)	Correlational – observational study	Quantitative questionnaire	Quantitative analysis advanced – chi squared, <i>t</i> -tests, ANOVA	<b>Mostly positive</b> <sup>*</sup> : youth involved in programs reported a greater number of home-based hazard adjustments, had more correct knowledge of emergency management-related readiness and response behaviors, and lower levels of incorrect knowledge.
(25) Hazard perceptions and preparedness of Taranaki youth [24]	Effectiveness of hazard education for children (non-specific)	Impact	Teens, age 13–18 (282)	Correlational – observational study	Quantitative questionnaire	Quantitative analysis advanced- chi-squared	<b>Mostly positive</b> <sup>*</sup> : students who participated in hazard education programs have better knowledge of safety behaviors and report higher levels of household preparedness. Little effect on emergency plans and practices, except for school practices.
(26) Preparing children for disasters: Evaluation of the Ready and Resilient program [7]	Effectiveness of the <i>Ready &amp; Resilient</i> program by Save the Children	Impact and process	Children and Teens age 8–17 (305) Observers	Descriptive – survey	Mixed methods questionnaire Individual interviews	Qualitative analysis Quantitative analysis basic	<b>Mostly positive</b> <sup>*</sup> : 91.9% said they felt at least 'somewhat' more prepared as a result of the workshop.
(27) Promoting disaster awareness in multicultural societies: the DAG approach [14]	Effectiveness of the <i>Disaster Awareness Game (DAG)</i> for non-English speakers; Equity of access to the information content	Impact	Children, ~age 10 (~55)	Quasi-experimental – One group pretest/posttest	Questionnaire – not specified	Quantitative analysis basic	<b>Mostly positive</b> <sup>*</sup> : application of the DAG in the Turks and Caicos Islands demonstrates that the technique is effective in addressing the multicultural challenges.
(28) Student Tools for Emergency Preparedness (STEP) Draft Evaluation Report [21]	Implementation and effectiveness of <i>Student Tools for Emergency Preparedness (STEP)</i>	Impact and process	Children, ~age 9–11 (244) School teachers (11)	Mixed methods: • Descriptive – diary	Mixed methods questionnaire	Qualitative analysis	<b>Mostly positive</b> <sup>*</sup> : the program has proven to be effective in increasing youth's awareness of local disasters



			School representatives (7)	<ul style="list-style-type: none"> <li>• Descriptive – interviews</li> <li>• Quasi-experimental – One group pretest/posttest</li> </ul>	Individual interviews Group interviews Diary	Quantitative analysis basic	and knowledge of protective actions, and promoting healthier attitudes towards preparedness.
(29) 4-H Teen CERT: An evaluation of a two-day Nevada training [53]	Effectiveness of the 4-H Teen CERT training program in Nevada	Impact	Teens, age 14+ (17)	Quasi-experimental – One group retrospective pretest/posttest	Quantitative questionnaire	Quantitative analysis advanced – paired T-test Content analysis Quantitative analysis basic	<b>Mostly positive</b> : found statistically significant increases in participant knowledge, attitude change and skill acquisition. <b>No effect</b> : the websites did not meet the criteria for usability. From an exploratory look at the three websites, there appears to be room for improvement.
(30) Disaster on the web? A qualitative analysis of disaster preparedness websites for children [29] AND Ready or not, here it comes: Disaster preparedness messages on children's websites in the USA [63]	Effectiveness of three federal children's websites on disaster preparedness	Impact	n/a (case studies)	Descriptive – case study	Content review	Quantitative analysis basic	<b>Mixed</b> : teachers are satisfied with the resource, but there is low and infrequent use. Half of the participants were not aware of the resource before the focus group.
(31) Disaster preparedness education in schools: Recommendations for New Zealand and the United States [33]	Success of national implementation of <i>What's the Plan, Stan?</i> in New Zealand primary schools	Process	School teachers and school representatives (49) Emergency managers	Descriptive – focus groups	Focus groups  Mixed methods questionnaire Group interviews	Qualitative analysis Quantitative analysis basic	<b>Mostly positive</b> : when compared to Scouts and non-Scouts, Eagle Scouts exhibit significantly higher levels of service and leadership, environmental stewardship, goal orientation, planning and preparedness.
(32) Eagle Scouts Merit Beyond the Badge [32]	Effectiveness of the <i>Eagle Scout</i> program	Impact	Adults (2512)	Correlational – observational study	Quantitative questionnaire	Quantitative analysis advanced – correlation analysis	<b>Mostly positive</b> : results revealed statistically significant increases in participant knowledge, skill development, attitude, and behavior.
(33) 4-H Teen Community Emergency Response Team (CERT) [6]	Effectiveness of 4-H Teen CERT program	Impact	Teens, age 15+ (33)	Quasi-experimental – One group pretest/posttest	Quantitative questionnaire	Quantitative analysis advanced – paired T-test	<b>Mostly positive</b> : hazards education program did lead to a significant increase in the number of hazards adjustments reported, an increase in correct responses, increased awareness of the alert, and reduced level of fear.
(34) Community readiness for a new tsunami warning system: Quasi-experimental and benchmarking evaluation of a school education component [57]	Effectiveness of the education program corresponding to the rollout of a new tsunami warning system	Impact	Children and teens, age 8–17 (213)	Quasi-experimental – One group pretest/posttest with benchmarking	Quantitative questionnaire	Quantitative analysis advanced – paired T-test	<b>Mostly positive</b> : participatory mapping seems to be an interesting tool for enhancing youth awareness of disaster risk as it makes disaster-related concepts tangible to everyone. It may further enable to integrate scientific knowledge provided to the pupils and students by the teacher or visiting scientists.
(35) Participatory mapping for raising disaster risk awareness among the youth (Gaillard and Pangilinan 2010) AND Integrating knowledge and actions in disaster risk reduction: The contribution of participatory mapping [10]	Effectiveness of Participatory 3-Dimensional Mapping (P3DM) to raise disaster risk awareness among the youth	Impact and process	Teens, age 16 (70)	Descriptive – case study	Observations	Case Study	

\*\* 'Quantitative analysis basic' includes basic mathematical methods such as counting, percentages and averages to describe results.

\*\*\* 'Quantitative analysis advanced' includes advanced statistical methods such as paired *t*-tests, regression, chi-squared tests, ANOVA and cross-tabulation.

**Table 3**  
Numbers of study participants.

Bucket	No. of participants	No. of studies	(%) of studies
0	0	2	(6)
1–100	17–93	11	(31)
101–300	101–282	7	(20)
301–500	356–452	6	(17)
501–1000	560–767	3	(9)
1001–3000	1065–2648	5	(14)
3001+	9000+	1	(3)
<i>Total</i>		35	

The majority, 31 studies (89%), used an opportunity sample of respondents who were purposely selected for the study. The use of classrooms of school children was common and was often justified by the need to access groups of children, gain parent consent and more easily collect data. Only three studies used random sampling techniques for the study design: Gulay's [28] evaluation of an earthquake education program for preschool children, which selected schools randomly for participation and also assigned children randomly to experimental and control groups; the evaluation of the Eagle Scouts program [32], which used a nationwide random-digit telephone dialing sampling design for a survey of adults, and; the evaluation of the national disaster education program in Turkey [74], which used randomly selected provinces and random samples and clustered samples of teachers and participating children for the multi-method study design.

It was common to incorporate children as research participants, but much less common to involve children's parents and teachers (Table 4). Thirty studies (86%) incorporated children and teens age 18 and younger as research participants, including four (11%) with children age six and younger, 14 (40%) with children between the ages of seven and 13, and 16 (46%) with teens age 14–19. The two most frequent age ranges of child research participants were ages 11–12 and 15–16. The next most common research participants were school teachers, featured in seven studies (20%), and program instructors who are not school teachers, featured in four studies (11%). Three evaluations (9%) included parents and three (9%) included school representatives like principals. Program instructor trainers, adult observers and members of the general adult public were featured in one evaluation respectively (3% each). Two studies (6%) were content reviews with no research participants.

Twenty-seven studies (77%) provided some demographic information about research participants. The most common demographic information provided was gender, in 18 studies (51%) and age, in 17 studies (49%). Eight studies (23%) described participants' ethnicities. Family socioeconomic status was reported in only two studies: an impact analysis of the Canadian Red Cross *Expect the Unexpected* program [19] and an evaluation of a participatory mapping project in the Philippines [27,10]. Two unique participant demographics that were gathered in some of the studies were personal experience with disasters, asked in seven studies (20%) and previous exposure to disaster education, asked in six studies (17%).

**Table 4**  
Types of study participants.

Type	No. of studies	(%) of studies
Children and/or teens	30	(86)
Young children ( <i>age 6 and younger</i> )	4	(11)
Children ( <i>age 7–13</i> )	14	(40)
Teens ( <i>age 14 and older</i> )	16	(46)
School teachers	7	(20)
Program instructors ( <i>who are not school teachers</i> )	4	(11)
Parents	3	(9)
School representatives (e.g., <i>principal or emergency management lead</i> )	3	(9)
Program instructor trainers	1	(3)
Emergency managers	1	(3)
Observers	1	(3)
Adults ( <i>general public</i> )	1	(3)

Thirteen studies (37%) measured the effects of demographic variables, although these primarily represent studies that measured the effects of previous exposure to disaster education, analyzed in six studies (17%) and personal experience with disasters, analyzed in four studies (11%). For the former, all six of these studies found a higher frequency of positive outcomes among children who participated in disaster education compared to those who had participated in less or no programs, including higher frequencies of correct knowledge and awareness of appropriate disaster responses [56,71,66,58], more reported household preparedness activities [24,56,58] and fewer hazards-related fears [56,61]. Findings regarding the differential effect of personal experience with disasters were mixed. One evaluation found that children who reported personal experiences with disasters had more accurate risk perceptions [21], and one study [19] concluded, based on a cross tabulation analysis, that the hazard perceptions of respondents is likely shaped by their experience with disasters. In contrast, two studies found no significant effect of disaster experience on respondents' disaster knowledge [9,74].

Among the few studies that analyzed age and ethnicity effects, the conclusions were mixed. In some studies, older children were found to have more correct knowledge, which could be a result of maturation [41,71,58], while in another, younger age was found to correlate significantly with a more instances of home preparedness measures, interaction with parents and family planning [56]. In two studies, girls were found to be more knowledgeable than boys [56,58], while a large-scale evaluation of Turkey's *Basic Disaster Awareness Curriculum* [74] and an evaluation of a disaster education program in Israel [71] found no significant differences in disaster knowledge by gender. The only study that assessed the differential effect of ethnicity [14] found no differences in correct risk perceptions or household preparedness levels but identified differences in hazard awareness, although the statistical significance of these differences were not reported.

### 3.4. Research designs

The analysis identified a strong preference for measuring learning outcomes and less attention to process outcomes. Twenty-three studies (66%) were exclusively impact evaluations that measured learning and behavioral outcomes, and two studies (6%) were exclusively process evaluations that studied the execution and implementation of the program. Ten studies (29%) measured both impact and process outcomes, although in most cases, the process outcomes represented only a small portion of the studies' outcome indicators.

The most common research designs were descriptive, quasi-experimental and correlational study designs (Table 5). Only one of the 35 studies, an evaluation of an earthquake education program for preschoolers in Turkey [28], used an experimental design including the randomization of children to treatment and control groups. The majority, 28 studies (80%), used a single research method, most commonly a descriptive method such as a cross-sectional survey or interviews, used in 10 studies respectively (29% each), a correlational design comparing the outcomes of existing groups, used in 10 studies (29%), or a quasi-experimental design, such as a one group pretest-posttest, used in seven studies (20%). Seven studies (20%)

**Table 5**  
Evaluation designs.

Evaluation designs	No.	(%) of studies
One method studies	28	(80)
• Descriptive	10	(29)
• Correlational	10	(29)
• Quasi-experimental	7	(20)
• Experimental	1	(3)
Mixed methods studies	7	(20)
<i>Total no. of studies including:</i>		
Descriptive methods	17	(49)
• Cross-sectional survey	5	(14)
• Interviews	5	(14)
• Case study	2	(6)
• Longitudinal time lag <sup>a</sup>	2	(6)
• Naturalistic observation	2	(6)
• Content review	2	(6)
• Focus groups	1	(3)
• Diary	1	(3)
Correlational observational methods <sup>**</sup>	11	(31)
Quasi-experimental methods	12	(34)
• One group pretest-posttest	7	(20)
• One group posttest with retrospective pretest questions	3	(9)
• One group pretest-posttest with benchmarking <sup>a</sup>	1	(3)
• Treatment and control group pretest-posttest	1	(3)
Experimental design <sup>b</sup>	1	(3)

\* Multiple surveys over time, using the same tool with different groups of people in the same location.

\*\* Outcome comparison of two or more existing groups based on tests for statistical relationships between variables.

<sup>a</sup> Benchmarking from a previous quasi-experimental study to compare intervention-produced results.

<sup>b</sup> Random assignment to treatment and control groups with matched participants.

**Table 6**  
Data collection methods.

Types	No.	(%) of studies
Quantitative questionnaire	22	(63)
Mixed methods questionnaire	7	(20)
Individual interviews	5	(14)
Evaluator observations	5	(14)
Focus groups	2	(6)
Group interviews	2	(6)
Content review	2	(6)
Diary	1	(3)

used mixed methods. Other findings include: 10 studies (29%) used a pretest to gather baseline data and four studies (11%) included control groups. Table 5 presents the frequencies of designs and data collection methods.

The analysis revealed that quantitative questionnaires were the most common data collection method (Table 6). Quantitative questionnaires using multiple choice questions or Likert-type scales were used in 22 studies (63%), including 21 studies (60%) that used a quantitative questionnaire as the sole data collection method. Tools less commonly used were mixed methods questionnaires that included both quantitative and open-ended questions, used in seven studies (20%), qualitative individual interviews, used in five studies (14%), and evaluator observations, used in five studies (14%). Qualitative focus groups, group interviews and content reviews were featured in only two studies respectively (6% each), and only one study used a qualitative diary method (3%).

The approaches to data analysis varied but less than a quarter of studies incorporated qualitative analysis, illustrating a preference for numerical measurements of program outcomes. Nineteen studies (54%) analyzed quantitative data using advanced statistical methods such as paired *t*-Tests, regression, chi-squared tests, ANOVA and cross-tabulation, including 16 studies (46%) that reported statistical significance. Twelve studies (34%) with quantitative methods used basic mathematical methods such as counting, percentages and averages to describe results. Seven studies (20%) included qualitative data analysis, such as categorization or thematic coding of interview transcripts and open-ended responses on written surveys. Two evaluations (6%) were descriptive case studies of programs, two (6%) analyzed website content, and one (3%) did not describe the analysis method.

One variable of interest was the methods used to measure learning outcomes of children age six and younger. Four studies (11%) had research participants age six and younger, and of these, two used a written quantitative questionnaire as the sole data collection method [61,28]. One study used qualitative individual interviews [9] and one study used mixed methods of observations and qualitative individual interviews [30]. Some of the difficulties in doing research with children of this age were noted in the papers. In a cross-sectional survey of children, Ronan et al. [61] noted that children age five and six had difficulty filling out the written surveys and consequently 31 surveys (7% of the sample) were discarded because the responses were unintelligible. Gulay [28] used a mixed methods

questionnaire with children age five and six, which included one open-ended question ('What are the three most important things that should be available in the earthquake bag?') and three or four-point Likert-type scale questions. While Gulay found a statistically significant intervention effect, he also reported a high degree of non-responses, particularly for the open-ended question.

Citing the unsuitability of formal testing, Buchanan et al. [9] chose a qualitative interview method and assessed the impact of post-disaster classroom activities on children's knowledge of hurricanes using an adapted Narrative Story Stem Technique (NSST), which examines children's oral narrative structures to characterize children's knowledge and risk perceptions. The authors pursued a high degree of rigor in their analysis method. With the guidance of NSST experts, they piloted the technique with a small group of children before research began. For the coding of the videotaped interviews, they used five trained coders with an interrater reliability of 81, as well as an additional reliability judge. In their analysis, they found many children understood the destructive nature of hurricanes and some of the consequences such as power outages and evacuations, but this knowledge was not significantly correlated to participation in teacher-planned activities on hurricanes or personal experience in a disaster. This method may be a promising practice for future research with young children.

### 3.5. Outcome indicators

Several patterns were identified in the outcome indicators used across the 35 studies. Table 7 provides the outcome indicator codes and their frequencies.

Across the 35 studies, there was a predominance of knowledge-based outcome indicators, which demonstrates a propensity to define program effectiveness by children's correct answers to knowledge-based questions. The most frequent outcome indicators were children's knowledge of hazards risks, measured in 22 evaluations (63%) and children's knowledge of protective actions during disasters, such as 'drop, cover and hold' during earthquakes, measured in 18 evaluations (51%). The latter is distinct from demonstration of protective actions, an indicator used in only two studies that incorporated a disaster drill observed by the evaluators (6%).

Another common indicator used in 16 evaluations (46%) was reported home hazards adjustments, including household disaster preparedness kits, family communication plans and bolted furniture in preparation for earthquakes. While this outcome indicator is a direct measurement of participants' household disaster preparedness, 11 of the studies only measured the correlational relationship between home hazards adjustments and self-reported participation in a disaster education program. Also, due to the limitations of the research designs, these studies did not systematically rule out other explanations for differences in children's household hazards adjustments. In most cases, records of these adjustments were based on child reports. Only two of the studies measuring home hazards adjustments incorporated children's parents as research participants. One study, which was a correlational observational study with parents and

**Table 7**

Frequencies of impact outcome indicators.

Outcome indicators	No. (%) of studies
Knowledge of hazard science	3 (9)
<b>Knowledge of hazard risks</b>	23 (66)
Knowledge of causes of injury	2 (6)
<b>Knowledge of protective actions during an emergency</b>	19 (54)
Demonstration of protective actions	2 (6)
<b>Knowledge of preparedness actions and resources</b>	12 (34)
Knowledge of mitigation actions	4 (11)
Knowledge of recovery actions	1 (3)
<b>Discussion with household members – indicated as done</b>	14 (40)
Discussion with household members – intended	4 (11)
Discussion with peers	4 (11)
Discussion with teachers	3 (9)
<b>Home hazards adjustments – indicated as done</b>	16 (46)
Home hazards adjustments – intended	4 (11)
Home-based practice –indicated as done	5 (14)
<b>Family emergency plan – indicated as done</b>	11 (31)
Family emergency plan – intended	0 (0)
School hazards adjustments – indicated as done	2 (6)
School drills – indicated as done	2 (6)
School drills – desired	2 (6)
<b>Anxiety level – personal</b>	12 (34)
<b>Anxiety level perceived in parents</b>	8 (23)
Perceived coping ability – personal	5 (14)
<b>Confidence level – stated</b>	7 (20)
Confidence level – observed by the evaluator	2 (6)
Actions during an emergency in the past <sup>*</sup>	2 (6)
Identification of helpful people or networks	3 (9)
Information seeking about disasters	4 (11)
<b>Preparedness attitudes</b>	12 (34)
<b>Perceived knowledge and learning<sup>**</sup></b>	8 (23)
CPR and other responder certifications	2 (6)
<b>Interest in the subject matter</b>	7 (20)
Usability criteria	1 (3)
Adaptive capacities <sup>***</sup>	3 (9)
Other	2 (6)
Public service career intentions	1
Drug related risk behaviors	1

\* e.g., 'Did you 'drop, cover and hold' during the 2011 earthquake?'

\*\* e.g., The survey asked 'Did you learn something new?'

\*\*\* Ability to solve a new problem/decision-making skills.

children age seven to 13, found a significant correlation between child- and parent-reported hazards adjustments [58]. The other study, a quasi-experimental pretest-posttest design with parents and children age 11–13, also found a significant correlation and large intervention effect on the reported hazards adjustments, but noted that the parent pretest may have artificially initiated increased communication and activity at home and school [59].

Other common outcome indicators relating to household preparedness include child reports of discussion with household members, used in 14 studies (40%), which reflects the value placed on knowledge transfer from children to parents. Knowledge of preparedness actions and resources, such as what to put in a disaster preparedness kit, was measured in 12 studies (34%), and child reports of family communication plans were gathered in 11 studies (31%). A less common indicator was reported practice of family plans, gathered in five studies (14%).

Attitudes towards disaster preparedness were measured in 12 studies (34%). For example, in an evaluation of the 4-H Teen Community Emergency Report Team (CERT) program in Oregon, Black and Powell [6] used identical five-point Likert-type scale questions in a pretest and posttest to measure program-induced changes to participants' rating of statements such as 'It is important to review my family's emergency plan yearly' and 'I have a lot to offer my community as a volunteer.' The authors found statistically significant changes to the participants' attitudes towards preparedness, which they attributed to the program.

Several studies aimed to measure the emotional impacts of a program or the subject of disasters on children, since disaster education inherently touches on topics dealing with injury, death and loss. Ten studies (29%) measured children's personal anxiety level when thinking about or discussing disasters. Seven studies (20%) also measured children's rating of their parents' anxiety levels, since children's perception of their parents' level of distress has been found to influence and predict their own anxiety levels (see [54,59]). Five studies (14%) also asked children questions regarding their perceived ability to emotionally cope in a future emergency. Overall, most studies concluded that the programs had no significant impact on children's reported levels of fear, and in some cases, education appeared to reduce disaster-related fears [57,61]. An evaluation of Save the Children's *Ready and Resilient* program [7] reported that about half of participants indicated increased worry about disasters after the program, but the authors concluded this result could be interpreted as either a positive or negative outcome since anxiety has been associated with higher levels of coping potential and household preparedness (see [40]).

In seven studies (20%), evaluators assessed children's reported sense of self-efficacy, or self-confidence, in carrying out preparedness activities or improving their own outcomes in a disaster. For example, in a correlational study of the relationship between disaster education and children's risk perceptions, Johnston and colleagues [35] measured children's self-confidence in their ability to cope psychologically by using a multi-choice question: 'If an emergency happened, some kids and adults get upset. That is normal. If you got upset, do you feel you, your family, or school would be able to help you feel less upset?' Also, in two studies (6%), evaluators reported their personal observations of children's improved self-efficacy during their participation in program activities [44,30]. Although some of the studies concluded that a program improved children's self-efficacy, the effects of those outcomes on children's actions or intentions to prepare for disasters were unclear. For example, in the evaluation of the 4-H Teen CERT program, which reported statistically significant changes in reported self-confidence, Black and Powell [6] concluded, 'Despite the training and personal actions taken to prepare for a disaster, youth indicated they still do not believe there is any cause for concern regarding [disasters], nor do they believe a disaster will occur in their community in the next 10 years.'

Children's interest in the subject matter and children's perceived knowledge and learning using questions regarding

whether they learned something new were measured in seven studies respectively (20% each). These outcome indicators can reflect the quality of children's engagement with the information. All of the studies that measured student interest concluded that students expressed a strong interest in disaster education and perceived that they learned something new.

The analysis also identified less commonly used indicators. Adaptive capacities, defined as measurements of children's abilities to solve problems using newly learned or existing knowledge, were measured in four studies (11%). For example, in a descriptive case study of a participatory mapping project, the authors observed children identifying their flood risks and evacuation routes on a map of their community using their own local knowledge [27]. Also, individual information seeking about disasters and knowledge of mitigation actions (e.g., avoiding residence in high-risk zones) were measured in four studies respectively (11% each). Outcomes such as knowledge of hazard science, identification of helpful people and networks, responder skills and certifications such as Cardiopulmonary Resuscitation (CPR), knowledge of the causes of injury during disasters, and school-based hazards adjustments were measured in three studies respectively (9% each). Discussion with peers, an indicator of peer-to-peer learning, was also measured in three studies (9%).

Indicators that measured achievements or challenges to a program's delivery and implementation were less common. Twelve studies (34%) included questions about the program's implementation. The most common indicators include program instructors' satisfaction with the learning tools provided, used in six studies (17%), and motivators to use of the program, used in five studies (14%). Deterrents to use, frequency of use, and satisfaction with the overall education program were measured in four studies respectively (11% each). Four studies (11%) also gathered suggestions for improvements from instructors, and three studies (9%) assessed uptake of voluntary teaching and self-study resources. Children's preference for different types of learning tools, content used or not used, and the level of instructor preparation needed to deliver the program were measured in only two studies respectively (6% each). While seven studies assessed the impacts of national disaster education programs for children, only two assessed the success of the program's implementation. The evaluation of an ambitious national initiative in Turkey that trained 13,500 volunteer instructors reported successfully delivering disaster education to 2.4 million school children [74]. In contrast, the evaluation of a nationally-distributed teaching resource on disaster preparedness for New Zealand school teachers found that teachers rated the resource highly, but use of the resource was low and infrequent [33].

A significant finding was that most authors did not articulate an explicit theory or model of how the program would enable specific learning outcomes, or how program outcomes would achieve wider impacts such as improved disaster resilience. The majority of studies, particularly those using an experimental, quasi-experimental or correlational paradigm, were simple hypothesis testing frameworks of limited scope. While immediate and easily measured program outcomes were identified, such as improvements in



children's knowledge and attitudes, intended program impacts related to instrumental action or changes in social norms were not well defined in the studies.

### 3.6. Evaluation conclusions and research limitations

Despite the exploratory nature of many of the studies and limitations to the research designs and data collection tools, the majority of the studies concluded that a specific intervention, or disaster education for children in general, produces benefits to children and the wider community (see Table 2). Twenty-three studies (66%) drew mostly positive conclusions affirming that a program caused or was related to outcomes such as children's increased knowledge and awareness of disaster risks, improved attitudes towards disaster preparedness or increased household preparedness. Twelve of these studies (34%) came to a positive conclusion based on statistically significant increases in correct knowledge and risk perceptions among children. In contrast, seven studies (20%) drew a mixed conclusion that the program had both positive effects and no effects for different outcomes of interest, including two that tested for statistical significance [45,61]. Four studies (11%) concluded that education did not improve children's correct knowledge, including two that tested for statistical significance [9,36]. Two studies (6%) were inconclusive, one due to a lack of conclusive data [19] and the other due to the limitations of the research method [81]. Twenty-one studies (60%) provided recommendations on ways to improve the content or delivery of the program.

Although 14 studies (40%) did not report research limitations, several types of reported limitations were common to multiple studies. The most frequent limitation was a weakness of the data collection tool, reported in seven studies (20%). For example, some studies reported children had difficulties responding to written questionnaires [13,61] and one analysis was limited by a questionnaire that was changed between assessments [45]. Six studies (17%) discussed weaknesses in their data collection method, such as the limitations of a longitudinal time-lag analysis that did not survey the same exact group [35]. Six (17%) stated that the study only measured short-term outcomes and could not gauge long-term impacts, although this was a limitation in almost all of the studies. Five studies (14%) acknowledged the limitations of a study's small sample, and four studies (11%) stated the research was exploratory in nature and more research is needed to draw conclusions. Other findings include: four studies (11%) noted the potential confounding factors to the intervention effect such as media about a recent disaster or other community-wide disaster education initiatives; three studies (9%) acknowledged the lack of randomly selected or randomly assigned research participants, and; two studies (6%) acknowledged the potential bias caused by a low response rate.

## 4. Summary and discussion

The purpose of this methodological review was to characterize the current state of evaluation of disaster education programs for children and identify opportunities for improvements in evaluation practice. The search found there are more evaluations available than presumed in previous

literature reviews. Thirty-eight papers representing 35 studies were identified as a result of a broad search of evaluations of disaster education programs for children. Of the papers, 40% were found in the gray literature. However, there is still a large number of disaster education programs for children internationally that have not been evaluated. Of the portion of program coordinators who responded to an email inquiry for evaluations, half replied that they had not done an evaluation of their program, reporting time, staff and funding constraints. Although most disaster education programs for children are developed by non-formal educators like emergency management agencies, evaluation remains almost entirely in the purview of academic researchers, many of whom do not appear to be directly involved in the development and execution of programs at the school and community level. It remains unclear if and how well evaluation research is being applied to improve programs, particularly since most authors concluded that the programs were effective despite limited measures of impacts.

The contexts of the evaluation studies allude to some of the logistical challenges faced by program evaluators [3]. Most of the studies took place in school settings and included children as research participants, normally as an opportunity sample. The ability to access children in a school setting, where researchers can more easily obtain parent consent and involve stakeholders, may outweigh some of the research limitations authors reported, such as the inability to randomize children to treatment and control groups. Several authors mentioned challenges to their research with children, including poor quality responses to questionnaires, particularly those administered to very young children. Also, most studies used a single method of data collection with children and did not include teachers or parents as research participants, which may be due to other logistical or resource challenges. For example, voluntary take home surveys often have a low response rate, and some evaluators may not have had the time or human resources to add other data collection methods to their research design. Future studies would benefit from the inclusion of parents and teachers who can provide validation of child reports and useful perspectives on program impacts.

A significant finding is that most of what is known about the effectiveness of disaster education programs for children is based on results of quantitative studies with children that generally focused on measuring children's knowledge of disaster risks and protective actions and child reports of preparedness actions. Most studies used descriptive, correlational and quasi-experimental designs and most collected data through written questionnaires with multiple-choice or Likert-type scale questions. The majority of descriptive and quasi-experimental studies concluded that programs were effective based on the portion or positive change in children's correct answers on surveys, and most correlational studies concluded positive outcomes such as household preparedness were associated with children's participation in disaster education programs. However, many of the studies had significant methodological limitations such as small samples and lack of baseline data or a control group, and most correlational studies measured exposure and outcomes through child reports, which are subject to memory and response biases.



Mixed method designs, and qualitative methods in general, were uncommon. While many studies incorporated questions measuring children's knowledge of protective actions during disasters, such as 'drop, cover and hold' for earthquakes, only two studies included evaluator observations of children practicing protective actions or other measures of children's competency. In sum, while there is significant evidence of valuable knowledge change, there is still very limited empirical evidence of how disaster education programs facilitate children's roles in household preparedness, their self-protective capacities, or their likelihood of preparing for disasters as adults.

The concentration on changes in knowledge and attitudes in disaster education and program evaluation fails to acknowledge the psychology of social norms and norms adherence. Jacobs et al., [31] describe how information-based education programs can effectively change the way people *speak* about program goals, like disaster preparedness, but in the absence of immediate consequences for failure to take action, people's reported change in their awareness and attitudes does not mean that instrumental action will occur. Contemporary research in risk communication has found that the relationship between knowledge of preparedness strategies and preparedness actions is tenuous, at best [4,48]. Three studies that measured both knowledge and home hazards adjustments found that school-based education increased children's knowledge but had no effect on preparedness actions [66,69,61]. Findings from Shiwaku et al. [69] and Jang et al. [32] suggest that experiential, community-based activities are more effective than information-based education at instigating preparedness activities.

The quantitative questionnaire was identified as the most common data collection tool and in the majority of studies, was the sole data collection method, which raises several concerns. Written questionnaires are problematic for assessing young children's learning; to enhance reliability and validity, questionnaires need to have an age-appropriate reading level, font size, length, syntax and number of answer selections, among other aspects [5]. Also, quantitative studies often do not gather results that explain why an outcome has or has not occurred, which can limit the evaluators' ability to make meaningful recommendations for program improvement. On the other hand, evaluators face the real world challenges of conducting research with children such as limited access, time, resources, and in some cases, evaluation expertise [3]. The benefits of quantitative questionnaires are that they can be administered to large groups, particularly children in a school setting, and numerical data is relatively simple to analyze compared to qualitative data. The incorporation of qualitative methods to gather in-depth data on the mechanisms of change would add significantly to the evidence base [39]. If evaluators continue to use quantitative questionnaires for research with children, which is likely, more meaningful outcome indicators of change beyond knowledge acquisition must be identified, tested and refined.

The practice of evaluating disaster education programs for children could be improved by the incorporation of program theory. Most studies did not discuss how program outcomes would contribute to a 'drastic shift' in risk perceptions,

attitudes and the proactive prevention of disasters, as urged by the United Nations [76]. Most outcome indicators used in evaluations to date measured limited intermediate outcomes rather than mechanisms of change or instrumental actions that improve individual and community resilience. The creation of a program model that describes the relationships between educational activities, desired outcomes and intended impacts can help clarify what evaluators should measure to determine effectiveness [1]. To develop or reconstruct program theories, evaluators often apply concepts from existing theories that are relevant, such as behavioral theory, learning theory, social-cognitive theory, or behavior-modification principles [38]. In this case, learning theory and behavioral theories of disaster preparedness should be applied to improve program theories. For example, several scholars have argued that factors such as self-efficacy, adaptive capacities, sense of personal responsibility, sense of community, trust in authorities, and discussion with peers are critical to people's motivations and intentions to prepare, and likewise, should be cultivated through public education programs ([4,40,47,49,69,83]; see also [80,11,46]).

This review identified several promising examples of tools to measure children's self-efficacy, adaptive capacities, subject comprehension and knowledge transfer. These examples include: measuring children's self-efficacy using Likert-type scale questions to rank statements related to personal self-confidence in achieving specific preparedness and response tasks [6]; documenting children's adaptive capacities by observing children's application of existing knowledge and problem-solving in a participatory mapping project of local risks [27]; and measuring young children's subject comprehension using a Narrative Story Stem Technique, which examines children's oral narrative structures to characterize children's knowledge and risk perceptions [9]. Also, children's discussion with household members was an indicator in almost half of all studies. Children's engagement with parents not only facilitates knowledge transfer from children to parents, but can also improve the quality of children's learning [18,12,17,2].

In addition to the need to identify and refine program theories and meaningful outcome indicators, there are several other gaps in the literature and opportunities for future research. Very few studies assessed the differential effects of age, gender, ethnicity and socioeconomic status on program outcomes. Also, except for a retrospective survey of adults who participated in Boys Scouts as children [32], no studies measured long-term outcomes of disaster education, including improvements in response to and recovery from an actual disaster. To achieve this, time series designs that are extended to cover the time-frames of disaster events are needed. Finally, few studies assessed process outcomes, such as uptake and instructor satisfaction with the learning tools. The studies that did assess process outcomes were able to provide more comprehensive recommendations of ways to overcome implementation challenges that hinder the delivery of disaster education to children.

To meet aspirational goals of changing the culture of safety and resilience, disaster education programs for children must be both effective and scalable. Most of the studies reviewed here measured outcomes of ad hoc disaster

education programs delivered to very small numbers of children. Considering the priority goal of the 2005–2015 *Hyogo Framework for Action* to embed disaster education in school curricula, the international community would benefit from research on national curriculum integration processes to help identify replicable, large-scale models, particularly ones that facilitate children's comprehension of science, geography, social studies and other academic elements.

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## References

- [1] Astbury B, Leeuw FL. Unpacking black boxes: Mechanisms and theory building in evaluation. *Am J Eval* 2010;31(3):363–81. <http://dx.doi.org/10.1177/1098214010371972>.
- [2] Ballantyne R, Fien J, Packer J. Program effectiveness in facilitating intergenerational influence in environmental education: Lessons from the field. *J Environ Educ* 2001;32(4):8–15. <http://dx.doi.org/10.1080/00958960109598657>.
- [3] Bamberger M, Rugh J, Mabry L. *Realworld evaluation: Working under budget, time, data, and political constraints*. Thousand Oaks, CA: Sage; 2011.
- [4] Becker JS, Paton D, Johnston DM, Ronan KR. A model of household preparedness for earthquakes: how individuals make meaning of earthquake information and how this influences preparedness. *Nat Hazards* 2012;64(1):107–37. <http://dx.doi.org/10.1007/s11069-012-0238-x>.
- [5] Bell A. Designing and testing questionnaires for children. *J Res Nurs* 2007;12(5):461–9. <http://dx.doi.org/10.1177/1744987107079616>.
- [6] Black L, Powell P. 4-H teen community emergency response team (CERT). *J Ext* 2012;50(5) (5IAW4). <http://www.joe.org/joe/2012october/iw4.php?pdf=1>.
- [7] Blanchet-Cohen N, Nelems R. Preparing children for disasters: Evaluation of the ready and resilient program. *J Emerg Manag* 2010;8(4):17–24.
- [8] Buchanan TK, Casbergue RM, Baumgartner JJ. Young children's demonstrated understanding of hurricanes. In: Cherry KE, (editor), *Lifespan perspectives on natural disasters*, United States, Springer: 3–26 2009.
- [9] Buchanan TK, Casbergue RM, Baumgartner JJ. Consequences for classroom environments and school personnel: evaluating Katrina's effect on schools and system response. In: Kilmer RP, Gil-Rivas VE, Tedeschi RG, Calhoun LG, editors. *Helping families and communities recover from disaster: Lessons learned from Hurricane Katrina and its aftermath*. Washington, DC: American Psychological Association; 2010. p. 117–39.
- [10] Cadag JRD, Gaillard JC. Integrating knowledge and actions in disaster risk reduction: the contribution of participatory mapping. *Area* 2012;44(1):100–9. <http://dx.doi.org/10.1111/j.1475-4762.2011.01065.x>.
- [11] Cameron M. Peer influences on learning. *Set* 2002;3:36–40.
- [12] Campbell JR, Verna MA. Effective parental influence: Academic home climate linked to children's achievement. *Educ Res Eval* 2007;13(6): 501–19. <http://dx.doi.org/10.1080/13803610701785949>.
- [13] Clerveaux V, Spence B. The communication of disaster information and knowledge to children using game technique: the disaster awareness game (DAG). *Int J Environ Res* 2009;3(2):209–22.
- [14] Clerveaux V, Spence B, Katada T. Promoting disaster awareness in multicultural societies: the DAG approach. *Disaster Prevent Manag* 2010;19(2):199–218. <http://dx.doi.org/10.1108/09653561011038002>.
- [15] Coomer M, Johnston DM, Edmonson L, Monks D, Pedersen S, Rodger A. Emergency management in schools – Wellington survey. *GNS Sci Rep* 2008;4:32.
- [16] Donaldson SI. A practitioners guide for gathering credible evidence in the evidence-based global society. In: Donaldson SI, Christie CA, Mark MM, editors. *What counts as credible evidence in applied research and evaluation practice*. Thousand Oaks, CA: Sage; 2009. p. 239–51.
- [17] Dunst CJ. Family-centered practices birth through high school. *J Spec Educ* 2002;36(3):141–9. <http://dx.doi.org/10.1177/00224669020360030401>.
- [18] El Nokali NE, Bachman HJ, Elizabeth V. Parent involvement and children's academic and social development in elementary school. *Child Dev* 2010;81(3):988–1005. <http://dx.doi.org/10.1111/j.1467-8624.2010.01447.x>.
- [19] Falkner L. Impact analysis of the Expect the Unexpected program. Toronto: Institute for Catastrophic Risk Reduction; 2003.
- [20] Faupel CE, Kelley SP, Petee T. The impact of disaster education on household preparedness for Hurricane Hugo. *Int J Mass Emerg Disasters* 1992;10(1):5–24.
- [21] Federal Emergency Management Agency. Student Tools for Emergency Preparedness (STEP) draft evaluation report. Rockville, MD: ICF International; 2010a.
- [22] Federal Emergency Management Agency. Youth emergency preparedness education paper. Philadelphia, PA: Regional Advisory Council, FEMA Region III; 2010b.
- [23] Federal Emergency Management Agency. Catalogue of youth disaster preparedness education resources; 2013. (<http://www.fema.gov/media-library/assets/documents/30503>) 2011 version [accessed 01.05.12].
- [24] Fennis KK, Johnston DM, Ronan KR, White JD. Hazard perceptions and preparedness of Taranaki youth. *Disaster Prevent Manag* 2010;19(2):175–84. <http://dx.doi.org/10.1108/09653561011037986>.
- [25] Fournier DM. Evaluation defined. In: Mathison S, editor. *Encyclopedia of evaluation*. Thousand Oaks, CA: Sage; 2005. p. 139–40.
- [26] Frau Elena, Midoro Vittorio, Pedemonte Gian M. Do hypermedia systems really enhance learning? A case study on earthquake education. *Educ Train Technol Int* 1992;29(1):42–51.
- [27] Gaillard JC, Pangilinan MLCJD. Participatory mapping for raising disaster risk awareness among the youth. *J Conting Crisis Manag* 2010;18(3):175–9. <http://dx.doi.org/10.1111/j.1468-5973.2010.00614.x>.
- [28] Gulay H. An earthquake education program with parent participation for preschool children. *Educ Res Rev* 2010;5(10):624–30.
- [29] Hilyard KM, Hocke TM, Ryan EL. Disaster on the web? A qualitative analysis of children's disaster preparedness websites 2011;8(2): 1–18.
- [30] Izadkhalh YO, Heshmati V. Applicable methods in teaching earthquakes to preschool children. In: Proceedings of fifth international conference on seismology and earthquake engineering, Iran; 2007.
- [31] Jacobs WJ, Sisco M, Hill D, Malter F, Aurelio JF. Evaluating theory-based evaluation: Information, norms, and adherence. *Eval Progr Plan* 2011;35(3):354–69. <http://dx.doi.org/10.1016/j.evalproplan.2011.12.002>.
- [32] Jang S, Johnson BR, Kim Y. Eagle scouts: Merit beyond the badge. Waco, TX: Boy Scouts of America; 2011 (<http://www.scouting.org/About/Research/EagleScouts.aspx>) [accessed 04.08.12].
- [33] Johnson VA. Disaster preparedness education in schools: Recommendations for New Zealand and the United States. Wellington: Fulbright New Zealand; 2011.
- [34] Johnston D, Becker J, Coomer M, Ronan K, Davis M, Gregg C. Children's risk perceptions and preparedness: Mt Rainier 2006 hazard education assessment tabulated results. *GNS Sci Rep* 2006:16.
- [35] Johnston D, Ronan K, Becker J, Gregg C, Davis M. Children's risk perceptions and preparedness: Mt Rainier 2005 hazard education assessment tabulated results. *GNS Sci Rep* 2005:29.
- [36] Kurita T, Nakamura A, Kodama M, Colomage SRN. Tsunami public awareness and the disaster management system of Sri Lanka. *Disaster Prevent Manag* 2006;15(1):92–110. <http://dx.doi.org/10.1108/09653560610654266>.
- [37] Lintner T. Hurricanes and tsunamis: Teaching about natural disasters and civic responsibility in elementary classrooms. *Soc Stud* 2006;97(3):101–4. <http://dx.doi.org/10.3200/TSSS.97.3.101-104>.
- [38] Lipsey MW, Pollard JA. Driving toward theory in program evaluation: More models to choose from. *Eval Progr Plan* 1989;12(4): 317–28. [http://dx.doi.org/10.1016/0149-7189\(89\)90048-7](http://dx.doi.org/10.1016/0149-7189(89)90048-7).
- [39] Mertens DM, Hesse-Biber S. Mixed methods and credibility of evidence in evaluation. *New Dir Eval* 2013;138:5–13.
- [40] Mishra S, Suar D. Effects of anxiety, disaster education, and resources on disaster preparedness behavior. *J Appl Soc Psychol* 2012;42(5): 1069–87. <http://dx.doi.org/10.1111/j.1559-1816.2011.00853.x>.
- [41] Mitchell T, Haynes K, Hall N, Choong W, Oven K. The roles of children and youth in communicating disaster risk. *Child Youth Environ* 2008;18(1):254–79.
- [42] Mulyasari F, Takeuchi Y, Shaw R. Implementation tools for disaster education. *Commun Environ Disaster Risk Manag* 2011;7: 137–51. [http://dx.doi.org/10.1108/S2040-7262\(2011\)0000007013](http://dx.doi.org/10.1108/S2040-7262(2011)0000007013).

- [43] National Commission on Children and Disasters. 2010 Report to the President and Congress. Washington, DC: Agency for Healthcare Research and Quality; 2010. (<http://archive.ahrq.gov/prep/nccdreport/>).
- [44] Naya Y. How intercultural disaster reduction education change students: A case study of an evening course senior high school in Hyogo, Japan. In: Ishida T, Fussell SR, Vossen PTJM, editors. Intercultural Collaboration. Berlin: Springer; 2007. p. 368–81. [http://dx.doi.org/10.1007/978-3-540-74000-1\\_28](http://dx.doi.org/10.1007/978-3-540-74000-1_28).
- [45] Oganowski LJ, Wycoff-Horn M. 2008 READY evaluation report; 2008.
- [46] Pajares F. Self-efficacy beliefs in academic settings. *Rev Educ Res* 1996;66(4):543–78. <http://dx.doi.org/10.3102/00346543066004543>.
- [47] Paton D. Disaster preparedness: A social-cognitive perspective. *Disaster Prevent Manag* 2003;12(3):210–6. <http://dx.doi.org/10.1108/09653560310480686>.
- [48] Paton D, Sagala S, Okada N, Jang L, Buergelt PT, Gregg CE. Making sense of natural hazard mitigation: Personal, social and cultural influences. *Environ Hazards* 2010;9(2):183–96. <http://dx.doi.org/10.3763/ehaz.2010.0039>.
- [49] Peek L. Children and disasters: Understanding vulnerability, developing capacities, and promoting resilience – an introduction. *Child Youth Environ* 2008;18(1):1–29.
- [50] Peek LA, Mileti DS. The history and future of disaster research. In: Bechtel RB, Churchman A, editors. Handbook of environmental psychology. Hoboken, NJ: John Wiley & Sons Inc; 2002. p. 511–24.
- [51] Powell P, Lynette B, Marilyn S. Involving youth in community emergency preparedness: Impacts of a multistate initiative. *J Youth Dev* 2009;4:4.
- [52] Powell P, Lynette B, Marilyn S. Training youth to prepare communities for disaster. *Univ Nevada Coop Ext* 2009.
- [53] Powell P, Smith M, Lynette B. 4-H Teen CERT: An evaluation of a two-day training. *Univ Nevada Coop Ext* 2011 <http://www.unce.unr.edu/publications/files/cd/2011/fs1150.pdf>.
- [54] Proctor LJ, Fauchier A, Oliver PH, Ramos MC, Rios MA, Margolin G. Family context and young children's responses to earthquake. *J Child Psychol Psychiatry* 2007;48(9):941–9. <http://dx.doi.org/10.1111/j.1469-7610.2007.01771.x>.
- [55] Rogers PJ, Petrosino A, Huebner TA, Hasci TA. Program theory evaluation: Practice, promise, and problems. *New Dir Eval* 2000;87:5–13. <http://dx.doi.org/10.1002/ev.1177>.
- [56] Ronan KR, Crellin K, Johnston DM. Correlates of hazards education for youth: A replication study. *Nat Hazards* 2010;53(3):503–26. <http://dx.doi.org/10.1007/s11069-009-9444-6>.
- [57] Ronan KR, Crellin K, Johnston DM. Community readiness for a new tsunami warning system: Quasi-experimental and benchmarking evaluation of a school education component. *Nat Hazards* 2012;61(3):1411–25. <http://dx.doi.org/10.1007/s11069-011-0070-8>.
- [58] Ronan KR, Johnston DM. Correlates of hazard education programs for youth. *Risk Anal* 2001;21(6):1055–64. <http://dx.doi.org/10.1111/0272-4332.216174>.
- [59] Ronan KR, Johnston DM. Hazards education for youth: A quasi-experimental investigation. *Risk Anal* 2003;23(5):1009–20. <http://dx.doi.org/10.1111/1539-6924.00377>.
- [60] Ronan KR, Johnston DM. Promoting community resilience in disasters: The role for schools, youth, and families. United States: Springer; 2005.
- [61] Ronan KR, Johnston DM, Daly M, Fairley R. School children's risk perceptions and preparedness: A hazards education survey. *Australas J Disaster Trauma Stud* 2001 (2001–2001). <http://www.massey.ac.nz/~trauma/issues/2001-1/ronan.htm>.
- [62] Ronan KR, Briony T. Systems education for a sustainable planet: Preparing children for natural disasters. *Systems* 2014;2(1):1–23. <http://dx.doi.org/10.3390/systems2010001>.
- [63] Ryan EL, Hocke TM, Hilyard KM. Ready or not, here it comes: Disaster preparedness messages on children's websites in the US. *J Child Media* 2012;6(3):300–16.
- [64] Selby D, Kagawa F. Disaster risk reduction in school curricula: case studies from thirty countries. Geneva: United Nations Children's Fund (UNICEF), United Nations Educational, Scientific and Cultural Organization, UNESCO; 2012. (<http://www.unicef.org/education/files/DRRinCurricula-Mapping30countriesFINAL.pdf>).
- [65] Sharpe J, Kelman I. Improving the disaster-related component of secondary school geography education in England. *Int Res Geogr Environ Educ* 2011;20(4):327–43. <http://dx.doi.org/10.1080/10382046.2011.619810>.
- [66] Shaw R, Kobayashi KSH, Kobayashi M. Linking experience, education, perception and earthquake preparedness. *Disaster Prevent Manag* 2004;13(1):39–49. <http://dx.doi.org/10.1108/09653560410521689>.
- [67] Shiwaku K, Fernandez G. Chapter 6 Innovative approaches in disaster education. *Commun Environ Disaster Risk Manag* 2011;7:115–36. [http://dx.doi.org/10.1108/S2040-7262\(2011\)0000007012](http://dx.doi.org/10.1108/S2040-7262(2011)0000007012).
- [68] Shiwaku K, Shaw R. Proactive co-learning: A new paradigm in disaster education. *Disaster Prevent Manag* 2008;17(2):183–98. <http://dx.doi.org/10.1108/09653560810872497>.
- [69] Shiwaku K, Shaw R, Kandel RC, Shrestha NS, Dixit AM. Future perspective of school disaster education in Nepal. *Disaster Prevent Manag* 2007;16(4):576–87. <http://dx.doi.org/10.1108/09653560710817057>.
- [70] Smith K. Environmental hazards: assessing risk and reducing disaster. London: Routledge; 1993.
- [71] Soffer Y, Goldberg A, Avisar-Shohat G, Cohen R, Bar-Dayana Y. The effect of different educational interventions on schoolchildren's knowledge of earthquake protective behaviour in Israel. *Disasters* 2009;34(1):205–13. <http://dx.doi.org/10.1111/j.1467-7717.2009.01125.x>.
- [72] Anselm S, Corbin JM, editors. Grounded theory in practice. Thousand Oaks: Sage; 1997.
- [73] Tierney KJ, Lindell MK, Perry RW. Facing the unexpected: Disaster preparedness and response in the United States. Joseph Henry Press; 2001.
- [74] TR Ministry of Education, Boğaziçi University, Kandilli Observatory, Earthquake Research Institute. Basic disaster awareness in Turkish schools 2001–2005: Final report. (<http://ztscompany.com/>).
- [75] United Nations. Hyogo Framework for Action 2005–2015: Building the resilience of nations and communities to disasters; 2005 (<http://www.refworld.org/docid/42b98a704.html>).
- [76] United Nations Children's Fund. Children and disasters: building resilience through education; 2011. ([http://www.unicef.org/ceecis/Children\\_and\\_disasters\\_Building\\_resilience\\_through\\_education\\_final.pdf](http://www.unicef.org/ceecis/Children_and_disasters_Building_resilience_through_education_final.pdf)).
- [77] United Nations International Strategy for Disaster Reduction. Terminology. n.d. (<http://www.unisdr.org/we/inform/terminology>) [accessed 11.02.13].
- [78] United Nations International Strategy for Disaster Reduction. Towards a culture of prevention: Disaster risk reduction begins at school; 2007. (<http://www.u.org/we/inform/publications/761>).
- [79] United Nations Educational, Scientific and Cultural Organization. Disaster preparedness: Education for disaster risk reduction at UNESCO; 2013. (<http://www.unesco.org/new/en/education/themes/leading-the-international-agenda/education-for-sustainable-development/disaster-risk-reduction/>).
- [80] Vosniadou S. How children learn. In: Rao BD, editor. Successful schooling. New Delhi: Discovery Publishing House; 2003. p. 16–33.
- [81] Wachtendorf T, Brown B, Nickle MC. Big bird, disaster masters, and high school students taking charge: The social capacities of children in disaster education. *Child Youth Environ* 2008;18(1):456–69.
- [82] Wisner B. Let our children teach us! A review of the role of education and knowledge in disaster risk reduction. Geneva: International strategy for disaster reduction, inter-agency task force cluster group on education and knowledge; 2006.
- [83] Wood MM, Mileti DS, Kano M, Kelley MM, Regan R, Bourque LB. Communicating actionable risk for terrorism and other hazards. *Risk Anal* 2012;32(4):601–15. <http://dx.doi.org/10.1111/j.1539-6924.2011.01645.x>.