

# Theoretical and practical considerations in the creation of a disaster risk reduction educational strategy at the primary education level: A case study of Mexico City

Blinded Manuscript

December 21, 2023

## Abstract

Educational settings present both opportunities and challenges for students, teachers, and decision-makers in terms of creating a disaster risk reduction culture. The selection of a framework, the creation of adequate materials, and the choice of dissemination mechanisms are as important as the contents and the targets prioritized. This study reviews the disaster risk reduction educational strategy implemented in Mexico City schools since 2019 and analyzes the outcomes by 1) surveying the principals and teachers (1,788) at 714 schools, 2) conducting interviews with high-level authorities and field personnel from several agencies involved in the strategy (12), 3) reviewing official databases and actual compliance with regulations and, 4) evaluating the memorability and efficiency of educational activities and materials. The results revealed a complex network of elements associated with the implementation of the strategy, with the most important and easiest to target being a “belief of self-efficacy when facing an emergency situation” as a factor affecting involvement, a sense of self-responsibility, risk perception, and even preference regarding the type of knowledge to deliver to schoolchildren. Regarding the activities and materials implemented, different degrees of success were observed, with the highest being those related to psychosocial support (addressing actual needs during the COVID-19 pandemic) and disaster-response plans (compliance with regulations), while the modality of interaction revealed that activities involving machine interactivity had higher efficiency rates compared with human interactivity or no interactivity. The findings extracted from this case study of Mexico City have the potential to help other cities develop better policies.

**Keywords:** Disaster risk reduction, Educational strategy, Self-efficacy, Training materials, Primary education, Mexico City

## 1 Introduction

As natural hazards occur more frequently and with greater intensity (IASC, 2022), it becomes important to involve children and youth in disaster risk reduction (DRR) programs, with the aim of enhancing their ability to cope with and recover from disaster situations. A natural place to focus is schools because of their social role in providing education. By including DRR education in schools, “children will have the potential to reduce their own vulnerability and the vulnerability of others in the community” (Apronti et al., 2015) because they will become active agents capable of identifying potential hazards and promoting risk reduction in the long run (Nakano et al., 2020, Okada and Yamori, 2020). In this regard, the Sendai Framework recommends that “policies and practices for disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment...for the purpose of pre-disaster risk assessment, prevention, mitigation, and for the development and implementation of appropriate preparedness and effective response to disasters” (Assembly, 2015a), while the United Nations’ Sustainable Development Goals (SDGs) emphasize “the acquisition of foundational and higher-order skills” as well as the “knowledge and values needed to function well and contribute to society” (Goal 4) and state that “urgent action is needed not only to combat climate change and its impacts but also to build resilience in responding to climate-related hazards and natural disasters” (Goal 13) (Assembly, 2015b). However, when we reflect on DRR educational strategies (DRRES)<sup>1</sup>, some problems arise, starting with the “slippery nature of the concept of education,” as mentioned by Matheson (Matheson, 2015), and its relation with other equally difficult concepts such as “learning”<sup>2</sup>, “knowledge”<sup>3</sup>, and “understanding” because they are related to risk reduction. We recognize that there is no unifying theory of education that fits all criteria. Even so, Peters’ definition of “education” as something worthwhile

<sup>1</sup> Understood as the group of activities, materials, exercises, and so on that are utilized to deliver DRR education to a targeted group.

<sup>2</sup> Hamm describes learning as “an activity that one engages in with purpose and intention to come up to a certain standard” (Hamm, 2003), while other authors claim that learning is a constant activity: “Learning, like breathing, is something everyone does all the time” (Tight, 1996).

<sup>3</sup> Knowledge can be thought of as having several components such as “how” to do things or information about certain things, such as its true value, its existence, and so on, but differs from understanding in that, according to Peters, “understanding” surpasses simple knowledge because it “allows us to grasp underlying principles, the capacity to explain why things are the way they are” (Peters, 2015).

that is “intentionally transmitted in a morally acceptable manner” (Peters, 2015) serves as a reference point that calls our attention to recognize the importance of elements like intentionality, the method of transmission, the criterion for ascribing value, and acceptability in relation to the social goal of education (Matheson, 2015) of DRRES. Equally important for understanding its underlying value is recognizing the approach to “learning” that is prioritized. One approach might be more experience-centered, while others might be more information-centered, thus influencing the selection of materials or the design of activities.

Constructivist approaches assume that learners interact with the world by building knowledge and understanding through the use of reason in interactive experiences within the subject as well as its environment. This mechanism accounts for the creation of meaning and beliefs that later form the superstructure of mental models<sup>4</sup>; therefore, individuals should be viewed as active agents rather than passive receivers of knowledge. In contrast, rationalist approaches in education tend to prioritize learning from texts in a systematic and hierarchical approach, which is believed to be necessary for the later performance of actions, which is reinforced through experiential situations, thereby consolidating what has been learned before. An example of the former is illustrated by Miller’s triangle (Miller, 1990), in which knowledge forms the foundational bottom level and justifies the amount of effort devoted in education to helping learners “know” things. Accordingly, the traditional method of transmitting knowledge is through reading and listening, which paradoxically are the learning activities that result in less retention, as Dale’s Cone of Experience shows (Figure 1). Taken together, the above suggests that the traditional ways of teaching at schools should be re-examined in order to obtain better results, particularly in areas such as DRR.

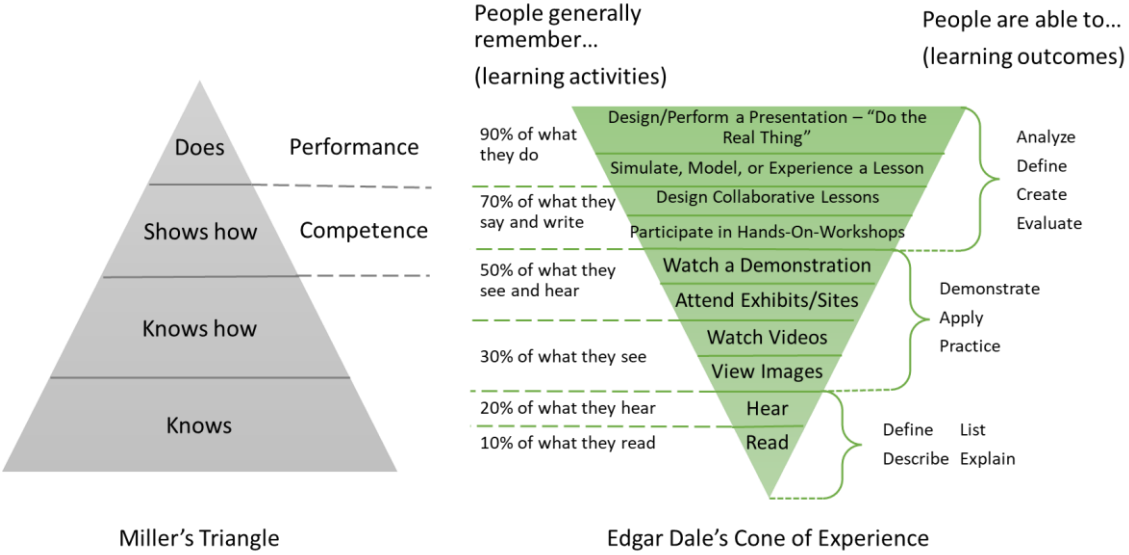


Figure 1: Edgar Dale’s Cone of Experience and Miller’s Triangle (Miller, 1990), adapted from Wikimedia commons, Jeffrey Anderson, <https://commons.wikimedia.org/w/index.php?curid=37711912>

Consequently, with an eye toward realizing competence and performance, mechanisms have been proposed to explain the memorability of experience, in which external experiential components are integrated into the cognitive world of learners. One useful model is Kolb’s experiential learning theory (ELT) (Kolb, 2014), in which transformation and movement between the inner and the outer worlds through reflective observation and active experimentation are believed to account for the phenomenological and constructivist dimensions of knowledge. These elements gain particular importance when we consider DRRES, the objective of which is to enhance “preparedness, prevention, and mitigation” (Tatebe and Mutch, 2015) and thereby save lives. This implies that the ultimate goal should manifest in behaviors and attitudes of the entire school community across everyday activities based on the multi-disciplinary and multi-level nature of DRR preparedness. From this perspective, a constructivist (experience-based) approach toward disaster education would seem to be suitable, wherein children understand DRR concepts through interactions with their environment as well as contrasting the learned information with their experiences in everyday life. However, many educational systems call for mixed-approach programs in which information-centered activities are implemented together with experience-centered ones.

A meta-analysis published by Tatebe and Mutch (2015) found that school programs for DRR could be grouped into three main areas: 1) prevention and planning, 2) disaster management, and 3) education-focused studies. Local differences were observed in terms of the amount of time allotted for each area. Naturally, different activities

<sup>4</sup> An example can be seen in proposals aimed at understanding inferential processes such as Garibay Rubio, 2018.

pursued different objectives. For example, one activity aimed to promote risk awareness and onsite preparedness (Apronti et al., 2015), while another aimed to develop social networking with stakeholders (Okada and Yamori, 2020). It is expected that transversal elements or traits—a “child-centered DRR” approach (Petal et al., 2020), risk perception, self-efficacy<sup>5</sup>, involvement, and practices related to the transmission of knowledge—are common among activities that successfully facilitate the growth and development of children in structured environments such as schools.

It is worth noting that DRRES tend to be part of broader DRR policies, which necessarily involve a wide scope of actions and partners. One such example is the Bihar province project 6, which, after settling on 10 governmental commitments, developed a 15-year roadmap targeting the reduction of mortality. The project used affected people and economic losses as the starting baselines and implemented a “state-wide public awareness and education campaign launched at all levels” as one of the pathways for developing its strategy. In the present study, we focus on training and the dissemination of materials in Mexico City’s DRR program for schools, which has been implemented since 2019, as a case study, with the aim of identifying the contribution of shared elements (responsibility, involvement, risk perception, and self-efficacy) among successful DRRES activities in order to further develop the program.

DRR in Mexico City is interesting, considering the city’s history and unique geographical qualities<sup>7</sup>. Located in the south-central part of the country, Mexico City is home to more than nine million people, 19% of whom (1,780,113) are children aged 0–15 years, with a school attendance rate of 95%<sup>8</sup>.

The city is built on a dried lakebed composed of soft materials (sand and clay) surrounded by areas covered with volcanic rocks, with transition soils in between. Consequently, during an earthquake, a particular seismic behavior is observed in which ground accelerations are amplified and differential accelerations are produced due to the different types of soil. This makes some parts of the city vulnerable to earthquakes, even those that originate on the coast<sup>9</sup>. In line with the multiple streams approach proposed by Kingdon (mentioned in Olson et al., 2020), after the 1985 earthquake, the political conditions were favorable for the development of a legal framework to regulate DRR measures (Watson et al., 2015) as well as the creation of an early warning system (in place since 1989) to issue public alerts about imminent earthquakes<sup>10</sup>. The National Civil Protection System (developed in 1986) can be considered the result of interlinkages between federal and state regulations<sup>11</sup> for responding to national emergencies.

In Mexico, the federal government prepares a National Development Plan to serve as a roadmap. This document outlines sectoral, institutional, and other programs with specific objectives, strategies, and projects for each government agency. Likewise, state governments have prepared their own development plans, which tend to be consistent with national planning. Following these guidelines, states adapt their own regulations and develop inter-agency plans that are implemented at the ground level in the form of operative guides.

The opportunity for Mexico City to develop a DRR program targeting schools arises (according to Kingdon) from the convergence of a “problem stream,” specifically the damage caused by Mexico City’s September 19, 2017 earthquake, including the unfortunate collapse of a private school building in which 19 children died; solution proposals arising from the private, social, and public sectors (solution stream), as well as commitments by politicians during the election campaign and at the start of the government session beginning in January 2019 (political stream). Such an event highlights the necessity of a DRR program targeting schools, the rather scarce DRR contents in the national syllabus, and the high exposure and vulnerability of the city to natural hazards and the effects of climate change because of its geographical characteristics. Finally, the Mexican Government’s adherence

---

<sup>5</sup> We consider self-efficacy to be the magnitude of confidence that a person has in their own ability to respond in the event of an emergency, as opposed to their actual competence to do so.

<sup>6</sup> The master chart can be accessed at the following URL: <https://www.unicef.org/india/media/2786/file/DRR-Roadmap-Bihar.pdf>.

<sup>7</sup> Mexico is located on the American continent, where the risk index has continued to rise over the last few years. In 2022, Mexico’s score was 4.9 out of 10, categorizing it as a medium-risk country (IASC, 2022) prone to storms and floods, even if historically the most deadly and costly events have been earthquakes (1985, 2017)(Bello, Bustamante, and Pizarro, 2020). In 2021, meteorological events affected more than 789,127 persons, with an estimated economic loss of 27,108,736 Mexican pesos (CENAPRED, 2021), which is important due to the direct proportional relation between a country’s risk index score and the likelihood of a national crisis due to the effects of hazard events. In 2021, 40% of medium-risk countries such as Mexico experienced a crisis, compared with just 14% of low-risk countries.

<sup>8</sup> INEGI: <https://www.inegi.org.mx/default.html>.

<sup>9</sup> There are reports of damage to school buildings, including collapse, caused by earthquakes in 1957, 1979, 1985, 2012, and 2017.

<sup>10</sup> The system can issue alerts up to 50 sec before the arrival of S waves when the earthquake originates on the coast. The detection of P waves triggers a public address system comprising 12,826 speakers installed throughout the city, which warns residents that the ground will soon shake. It is likely that many citizens developed their own DRR response practices around this early warning system and the authorities have come to rely on it as well.

<sup>11</sup> Mexico is a federal republic; therefore, home rule allows the states to develop their own legislation as long as it does not violate the Constitution of Mexico (Political Constitution of the United Mexican States).

124 to international agreements and initiatives such as the Sendai Framework and the SDGs contributed to a political  
125 willingness to address the matter, with the goal of ensuring a resilient education system.

126 The legal framework for Mexico City's DRR program for schools is as follows: 1. the Mexican Constitution (Article  
127 3. Right to education and determination of schools as the fundamental space for education. Educational plans...  
128 should include those that promote healthy lifestyles and others), 2. the National Development Plan (Axis 1. Politics  
129 and Government, ii. Guarantee employment, education, health and wellbeing; ix. Rethinking national security and  
130 army visions), 3. the National Plan for Civil Protection (Priority Objective 2. Improve coordination for emergency  
131 management; Priority Objective 3.1.2 Coordinate regulations for civil protection in partnership between federal  
132 agencies and states), 4. Organic Law of the Executive and Public Administration of Mexico City (Article 33.  
133 Coordinate with authorities to include and increase DRR contents in the educational sector of Mexico City at all  
134 levels, both in terms of curriculum and teacher training development), 5. the DRR and Civil Protection Law in  
135 Mexico City (Article 7. Promote, starting with the primary education level, a DRR culture centered on prevention  
136 and self-help), 6. Reference terms for developing Civil Protection School Response Plans at the Primary Educational  
137 Level TR-SGIRPC-PIPC-ES-001-2019, and 7. the Operative Guide for the functioning of educational services,  
138 including primary, special, and adult education, in Mexico City schools.

139 As described above, the complexity of the multilevel governmental regulatory framework involved makes it  
140 difficult to change elements such as school curricula. A review of the primary education syllabus revealed that DRR  
141 contents were included in only a few subjects taught in the 5th and 6th grades of elementary school (geography  
142 and natural sciences). However, the Mexico City government, through state autonomy, established a  
143 complementary institutional strategy to improve DRR in primary education<sup>12</sup>. The program, called "Gestión  
144 Integral de Riesgos en Escuelas" (GIRE)<sup>13</sup>, was implemented in 2019 as a joint effort by the Ministry for Risk  
145 Reduction and Civil Protection of Mexico City (SGIRPC) and the Federal Educational Authority at Mexico City  
146 (AEFCM). The general objective of this program is "to promote the involvement of the school community in DRR,  
147 with the aim of making public and private schools in Mexico City safe and resilient places with children at the center  
148 (child-centered), thereby enabling children to actively participate in the decision-making process toward realizing  
149 self-help and risk reduction" through the following seven core group actions:

- 150 1. Establish procedures to evaluate the fulfillment of civil protection regulations at each school.
- 151 2. Evaluate the vulnerability of schools based on their geographical characteristics and historical background  
152 and determine prioritization.
- 153 3. Develop a legal framework that facilitates cooperation and collaboration among social sectors and the  
154 various levels of government.
- 155 4. Develop and implement DRR training activities for basic education facilities in Mexico City.
- 156 5. Promote the adoption of a civil protection culture at schools.
- 157 6. Enhance disaster preparedness and response measures at schools.
- 158 7. Increase infrastructure resilience and reduce the time needed for education services to resume after a  
159 disaster.

160 This study focuses on the fourth core action, the purpose of which is to develop DRRES that promote an  
161 "understanding" of risk as well as increase the amount of DRR actions performed in the disaster preparedness  
162 cycle<sup>14</sup>. Here, the emphasis is on preparedness and early action, which is accomplished by providing DRR  
163 information, creating opportunities to experience DRR activities, promoting positive attitudes and beliefs, and  
164 developing local response plans. In addition, importance is placed on the acquisition of DRR tools through  
165 education, training, and dissemination of materials (detailed in later sections), which in principle would enable  
166 school communities to perform local DRR actions, thereby benefiting the lives of students and their families directly.

167 According to information retrieved from the documentation of the program as well as from the interviews with  
168 the designers of the strategy, to realize the fourth core group action of the GIRE program, it was necessary to first  
169 review the legal framework at the state and national levels and outline the legal jurisdictions and responsibilities  
170 of each ministry and its activities in schools. Based on this review, it was possible to define the mechanisms for

---

<sup>12</sup> Primary education level refers to kindergarten, elementary school, and middle school.

<sup>13</sup> A reference to the document can be seen at <https://proteccioncivil.cdmx.gob.mx/comunicacion/nota/estrategia-para-la-gestion-integral-de-riesgos-en-escuelas-y-apoyo-socioemocional>, while the whole document can be accessed by request to the SGIRPC.

<sup>14</sup> Risk identification, forecasting, prevention, mitigation, preparation, relief, recovery, and reconstruction.

inter-institutional cooperation and identify the laws and regulations that need to be introduced, revised, and clarified.

At the same time, efforts were made to facilitate the exchange of school-related among the various government agencies, which uncovered the need to standardize and validate this information as well as to complement it with geospatial information. Using this information along with historical records of death tolls and economic losses in past disasters (e.g., earthquakes and floods) to weight the hazard impacts at the basic geo-statistical area (AGEB), SGIRPC developed a new risk map (Figure 2) to prioritize schools<sup>15</sup>. DRRES that addressed the school's conditions were developed later.

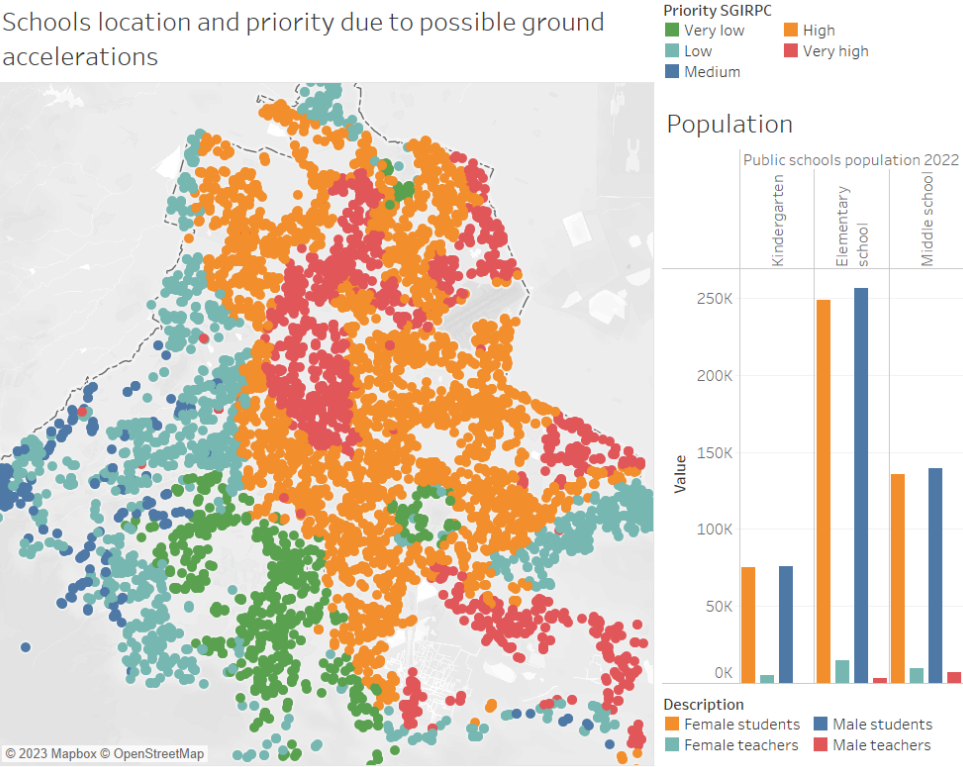


Figure 2: Map showing the priority tags of all schools in Mexico City according to geographical areas.

### 1.1 Mexico City DRRES

DRRES are understood to be part of general DRR programs, comprising the design, creation, implementation, and dissemination of educational materials and activities that enable the school community to learn about DRR, thereby influencing their actions, beliefs, and attitudes toward promoting self-help, mutual-help, and community-help activities.

Accordingly, we believe that through the analysis (qualities, scopes, paths of dissemination, modalities, types of interaction, and objectives) of core DRR educational activities (courses, training, and workshops) as well as materials (guidelines, comic books, risk maps, formats, and other documentation) implemented and disseminated through the school system in Mexico City, it may be possible to grasp trends of DRRES and extract relevant lessons about the elements common to the most effective activities and their impacts on the general development of a school environment conducive to DRR.

Against this background, this study has the following objectives: 1) to evaluate the impact and efficiency of DRR materials and activities used by the school community in Mexico City from January 2019 to August 2022; 2) to determine whether there are relationships among the proposed relevant elements<sup>16</sup> that can guide the planning of DRRES; 3) to identify key actions and problems to consider for future development, particularly around early action,

<sup>15</sup> In the 2020–2021 school year, Mexico City had a total of 3,980 public schools and 3,411 private schools at the primary level covering kindergarten, elementary school, middle school, and special education, with close to 80,000 teachers, supervisors, and other school authorities serving a student population of about 1.45 million. The administrative management of public schools is the responsibility of AEFCM, while SGIRPC handles the development of DRR programs.

<sup>16</sup> School position (e.g., teacher, principal, support staff) and the belief in responsibility for implementing DRR activities; Risk perception inside and outside schools and the type of knowledge most important to teach school children; The relation within beliefs of self-efficacy as important for promoting involvement in DRR activities as well as the number of activities performed; Degree of perceived DRR involvement and its relation with perceived responsibility

196 considering the following questions in order to identify the conceptual relationships and effects of well-known  
197 relevant concepts in education, including responsibility, involvement, self-efficacy, and risk perception.

- 198 1. Does a person's position affect the beliefs about which personnel should be responsible for implementing  
199 DRR activities?
- 200 2. Does a person's position affect the type of knowledge considered preferable to teach to the school  
201 community?
- 202 3. Does the degree of involvement in DRR activities affect the beliefs about which personnel should be  
203 responsible for implementing DRR activities?
- 204 4. Does risk perception affect the degree of involvement in DRR activities?
- 205 5. Does risk perception affect the beliefs about which personnel should be responsible for implementing DRR  
206 activities?
- 207 6. Does risk perception affect the type of knowledge considered preferable to teach to the school community?
- 208 7. Do people with beliefs of high self-efficacy in terms of emergency response perform a larger number of  
209 actions compared with those with beliefs of low self-efficacy?
- 210 8. Which types of activities and materials were more effective?
- 211 9. Which activities and materials had better recognition?
- 212 10. Which types of materials were preferred by teachers?
- 213 11. Do the interactivity characteristics of the materials relate to their efficiency?
- 214 12. Do mandatory regulations increase the usage of materials and activities?
- 215 13. Do priority areas identified using GIS correlate with risk perception at those schools?
- 216 14. What are the most commonly identified problems and deficiencies that prevent achieving high rates of  
217 recognition?

218 As a starting point, we hold the following assumptions. 1. The way in which school personnel ascribe  
219 responsibility and are involved with DRR activities is influenced by their position<sup>17</sup>. 2. The degree of a person's  
220 involvement mediates the number of activities that they perform. 3. As more actions are performed, a sense of self-  
221 efficacy emerges. 4. Higher levels of involvement lead to stronger beliefs regarding self-responsibility across  
222 positions. 5. Risk perception is related to the number of DRR actions implemented; although it is not a sufficient  
223 condition guaranteeing action (Bubeck, Botzen, and Aerts, 2012), it is nevertheless related to general performance.  
224 6. Modalities (face-to-face, online, massive online open courses [MOOCs], and other means of distribution) in which  
225 contents and educational opportunities are delivered are important factors influencing the memorability, range,  
226 and effectiveness of the activity. 7. Situational pressures, including the fulfillment of regulations and the immediate  
227 attention of needs, are drivers for the usage of certain materials and courses.

## 228 **2 Methods**

229 This research uses a mixed-methods approach to evaluate the qualities and effects of the various elements of  
230 Mexico City DRRES.

### 231 **2.1 Data collection strategy**

232 The study collected information in three main ways: 1) by analyzing the wide scope of core activities developed as  
233 part of the program, 2) by implementing an electronic survey of teachers, supervisors, principals, and  
234 administrative personnel at different primary education levels, and 3) through interviews and information  
235 exchanges with key authorities from several government agencies involved in implementing the DRR program for  
236 schools.

237 Information about the activities was retrieved from reports, descriptive charts, records, and the materials  
238 themselves, most of which are publicly available from SGIRPC and AEFCM, while the rest were provided for analysis  
239 directly by the institution's development teams.

---

<sup>17</sup> For principals, the normative responsibilities are higher, while for teachers, the perceived ability of children to look after themselves due to their school level influences their self-perception.

240 The survey was created using Microsoft Access and HTML<sup>18</sup> and was conducted in June and July of 2022 by the  
241 General Directorate for the Operation of Educational Services (AEFCM), collecting the opinions of 1,788 officials<sup>19</sup>  
242 at 714 public schools (Figures 3, 4), including teachers, school principals, and educational authorities<sup>20</sup>.  
243 The survey aimed to evaluate the acceptance, closeness, memorability, and perceived effectiveness of the various  
244 activities and materials over time as well as the perceived responsibility, involvement in DRR, perceived self-efficacy,  
245 reach, and other opinions about school personnel, using 59 items covering (i) basic socio-demographic  
246 information; (ii) opinions about the DRR activities and materials; (iii) opinions about what elements are important  
247 to promote in children early action and proper DRR responses, self-perceived efficiency in emergencies, degree of  
248 involvement in DRR activities, beliefs regarding responsibility, and risk perception of their school, other students'  
249 homes, and their own homes; and (iv) the relationship between regulatory changes and the perceived importance  
250 of certain mandatory elements for DRR. The survey was developed through inter-expert validation with  
251 participants from SGIRPC, AEFCM, and Kyoto University. A complete summary of the survey responses is shown in  
252 Annex Table A1<sup>21</sup>.

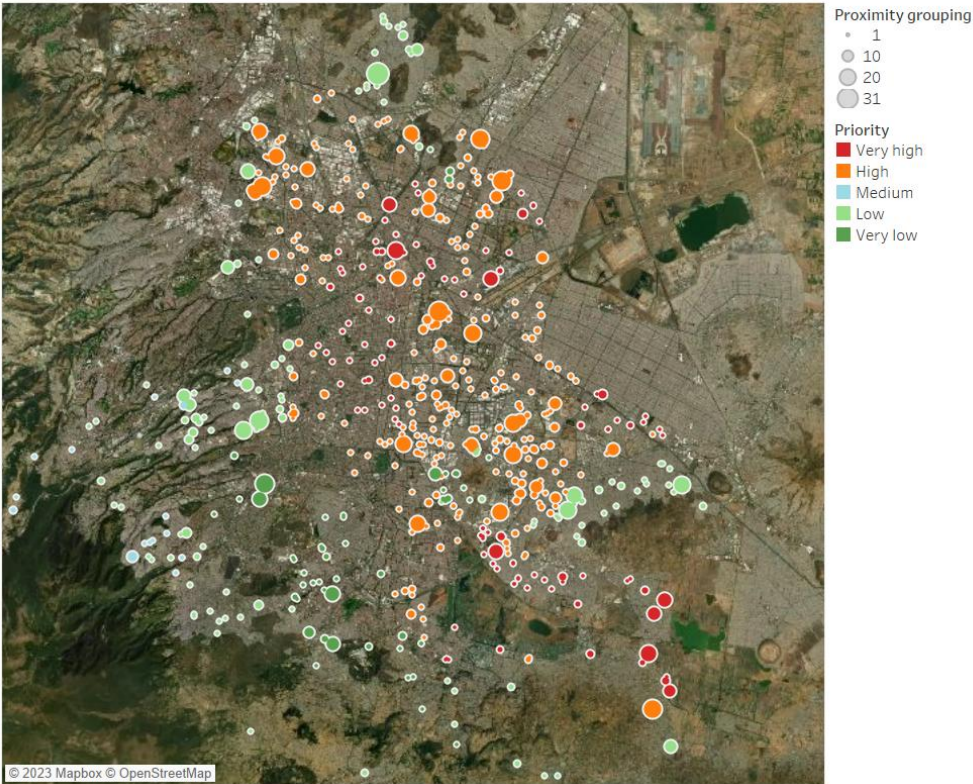


Figure 3: Distribution of sample

<sup>18</sup> The survey can be accessed at the following URL: <https://sagadatos.com/rodrigo/encuesta-aef/>.

<sup>19</sup> Of the 1,788 respondents, 5 answered only the demographic questions and nothing more; therefore, they were excluded from the statistical analysis.

<sup>20</sup> The survey targeted 714 schools, but four schools did not provide complete information.

<sup>21</sup> The survey was anonymous, which implies the possibility of having more than one response per respondent; however, in the analysis, only 63 records were considered to be possible duplicates.

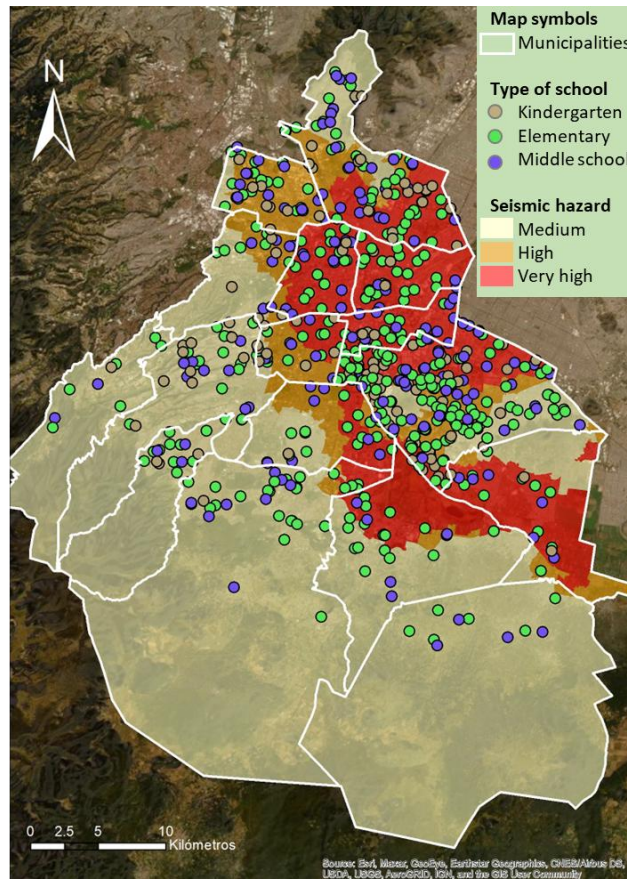


Figure 4: Location of surveyed schools regarding the seismic hazard map of the city.

Complementary to the survey, 12 semi-structured interviews (60–90 min. long) were conducted with principals, teachers, supervisors, and high-level authorities from AEFCM, SGIRPC, and the Japanese International Cooperation Agency (JICA), which participated in the development and implementation of the activities and materials. In-person interviews were recorded using a video camera, while online interviews were hosted and recorded using the videoconferencing application Zoom. Although a semi-structured approach was established for both groups of interviews, the opportunity to discuss memorable or problematic elements regarding DRR was given to each participant within the allotted time.

## 2.2 Data processing

Two activity matrices were created by comparing transversal elements (Table 1) as well as by extracting relevant information from the survey (Table 2). A detailed description, along with references, can be found in the annex section “Activity description” (A).

Table 1: Table of the main activities and materials used between 2019 and 2022.

| Activity                      | Target                | Modality                                        | Materials delivered          | Participants | Objectives              |
|-------------------------------|-----------------------|-------------------------------------------------|------------------------------|--------------|-------------------------|
| DRR workshop (M)              | Principals and staff  | On site (HI)                                    | Guide, manuals, and videos   | 6,216        | Cascade replication     |
| Socioemotional course (R)     | Teachers              | Online (MI)                                     | Course and guide             | 74,126       | Psycho-social support   |
| PIPCE course (M)              | Principals and staff  | Online (MI)                                     | Course and manual            | 11,357       | PIPCE Knowledge         |
| DRR activity guides (R)       | Teachers              | Official website and mail (NI)                  | Guide                        | 80,000       | Classroom activities    |
| Safe return to schools (R)    | Teachers              | Workshop and Mail (HI)                          | Workshop and guides          | 465          | Classroom activities    |
| Mental health (R)             | Teachers and students | Conference, website, and printed materials (NI) | Ollin comic book             | 7,000        | Knowledge dissemination |
| What to do after COVID-19 (R) | Teachers              | Workshop (HI)                                   | Workshop and recommendations | 6,500        | Awareness and tools     |
| PIPCE guide (M)               | Principals and staff  | Online dissemination and website (NI)           | Guide and formats            | N/A          | PIPCE creation          |
| DRR family plan (R)           | General population    | Website and printed materials (NI)              | Guide and formats            | N/A          | Family response         |
| Mexico City Risk Atlas (R)    | General population    | Course, website, and videos (MI)                | Personalized risk maps       | N/A          | Decision making         |

DRR, disaster risk reduction; PIPCE, (Programa Interno de Protección Civil Escolar) a compendium of school information and emergency response plans; M, related to mandatory regulation compliance; R, recommended activity; HI, human interaction; MI, machine interaction; NI, no interaction.

277  
278  
279  
280  
281  
282  
283  
284  
285

The survey database was compiled using R and R Studio, while the spatial analysis was performed using ArcGIS and Tableau Desktop. The main statistical analysis involved regressions and structural equation modeling using JMP software. The responses were grouped by location according to their seismic hazard and priority category in order to prevent biases due to geographic distribution or by differences in participation rate (Figure 3). The sample was considered to represent all school levels and all targeted areas of the city appropriately.

Table 2: Recognition of materials and activities, the people benefited, and the number of actions estimated.

| No. | Activity                       | Recog. | Recog. % | B. Kind. | B. Elem. | B. Mid. | B. Total | Mean | Median | A. 1-10 | A. 11-20 | A. 21-30 | A. ≥31 | Total A. |
|-----|--------------------------------|--------|----------|----------|----------|---------|----------|------|--------|---------|----------|----------|--------|----------|
| 1   | General actions                | 0      | 0        | 29870    | 219468   | 158961  | 408299   | 261  | 167    | 6720    | 4530     | 1550     | 1736   | 14536    |
| 2   | DRR workshop                   | 923    | 51%      | 16254    | 114671   | 78725   | 209650   | 255  | 162    | 3810    | 1560     | 475      | 589    | 6434     |
| 3   | Socioemotional course          | 922    | 51%      | 10890    | 94148    | 69248   | 174286   | 223  | 120    | 3920    | 1035     | 375      | 496    | 5826     |
| 4   | PIPCE course                   | 794    | 44%      | 11353    | 103539   | 69686   | 184578   | 260  | 178    | 3335    | 1020     | 400      | 589    | 5344     |
| 5   | DRR activity guides            | 371    | 21%      | 2684     | 45537    | 30978   | 79199    | 250  | 160    | 1550    | 510      | 225      | 93     | 2378     |
| 6   | Safe return to schools         | 647    | 36%      | 7934     | 69198    | 51233   | 128365   | 228  | 140    | 2440    | 1065     | 700      | 1395   | 5600     |
| 7   | "The Teachings of Ollin" comic | 478    | 27%      | 5820     | 46920    | 35084   | 87824    | 228  | 123    | 2045    | 405      | 200      | 155    | 2805     |
| 8   | What to do after COVID-19      | 187    | 10%      | 2707     | 15596    | 14485   | 32788    | 214  | 126    | 605     | 360      | 275      | 558    | 1798     |
| 9   | PIPCE guide                    | 660    | 37%      | 15442    | 89013    | 53027   | 157482   | 276  | 209    | 2585    | 1275     | 12100    | 310    | 16270    |
| 10  | DRR family plan                | 1619   | 91%      | 24341    | 151327   | 114032  | 289700   | 220  | 120    | 7530    | 1140     | 625      | 372    | 9667     |
| 11  | Mexico City Risk Atlas         | 611    | 34%      | 10692    | 59887    | 56279   | 126858   | 270  | 200    | 0       | 0        | 0        | 0      | 0        |

286

287 From the recordings of the interviews, the total number of times each educational material and elements related  
288 to those materials were mentioned was extracted (Annex Table A3) in order to assess concept saturation by  
289 evaluating memorability and closeness to the activities. In addition, the most salient reflections about triggers for  
290 action, as well as the most common problems and other remarks about the processes, were organized in a matrix  
291 (Annex Table A4). Relevant quotes are included in the Results and Discussion sections below.

## 292 2.3 Data analysis

293 The activity matrices identify the qualities of activities in relation to situational requirements, their targeted  
294 population, their modality/mechanism of delivery, their type of interactivity (grouped as "human interaction,"  
295 "machine interaction," and "no interaction"), the types of materials delivered, the initial participants, general  
296 objectives, recognition rate, and reach (the people who benefited from the activity and its impacts) as elements for  
297 the statistical analysis, which aimed to evaluate the efficiency, acceptability, and value of activities in terms of social  
298 goals.

299 There were different numbers of participants, modalities, scopes, and methods of delivery for the materials, as  
300 shown in Table 1, and the memorability, people benefited, and number of actions (Table 2)<sup>22 23</sup> were expected to  
301 vary accordingly. Higher recognition is usually related to greater usage and, consequently, a larger number of  
302 actions and people benefited. In addition, situational requirements (e.g., new needs resulting from the pandemic  
303 or mandatory regulations might drive the usage of materials, which would be reflected in an increase in  
304 memorability as well as developed actions. As a result, to ensure a fair comparison, a measure of efficiency was  
305 calculated using a linear fit model to compare the people benefited and the number of actions, with the resulting  
306 distance of the activity to the model taken as the efficiency (Figure 5).

<sup>22</sup> The actions estimation was calculated using the number of actions reported by range × the middle of the interval, except the last one, where 31 was used. Example: DRR Workshop (n = 762 (1–10) × 5, n = 104 (11–20) × 15, n = 19 (21–30) × 25, n = 19 (≥31) × 31).

<sup>23</sup> DRR, disaster risk reduction; PIPCE, Programa Interno de Protección Civil Escolar (a compendium of school information and response plans); B.Kind, report of benefited people in kindergartens; B. Elem., report of benefited people in elementary schools; B. Mid., report of benefited people in middle schools; B. Total., report of benefited people at all school levels; A. 1–10, number of actions calculated for the group that was reported to perform between 1 and 10 actions., Total A., Total of all calculated actions for the whole sample.

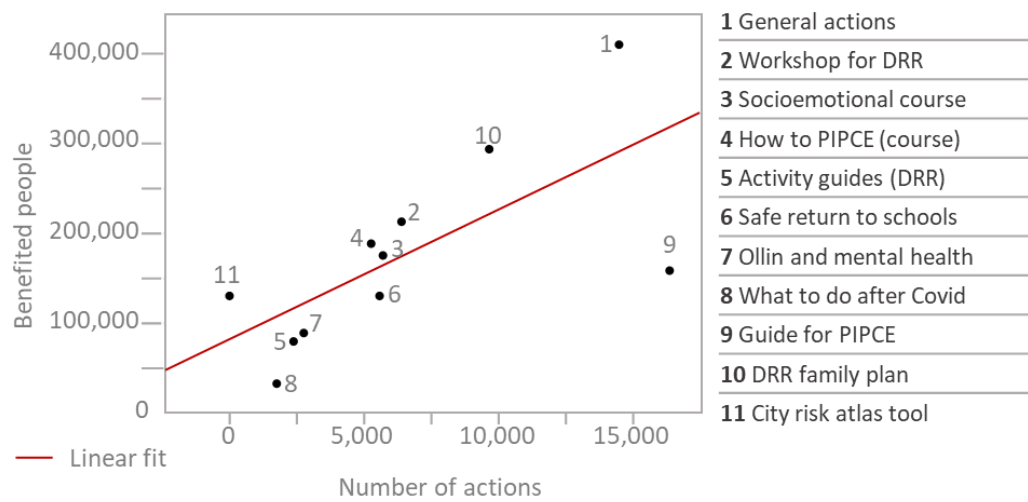


Figure 5: Model showing the efficiency of each activity by their corresponding number in Table 2. See also question 8.

The interactivity dimension is classified as follows. Human-interaction activities are those in which both sides in the communication process have the opportunity to respond to the other (e.g., an in-person class or an online seminar with a question-and-answer session), while machine-interaction activities facilitate interaction through activities and quizzes prepared by the authors in advance (e.g., MOOCs and informatics tools such as geographical information analysis systems). In contrast, no-interaction activities deliver information in a unidirectional manner, such as by sending emails or publishing content on websites. This enables us to evaluate whether there was a connection between the interactivity and the efficiency of the activities.

The survey responses allowed us to separate by school level, personnel position, school location, and activity, the respondents' opinions regarding the ascription of responsibility, involvement, risk perception, beliefs of self-efficacy, actions developed and the people who benefited from them<sup>24</sup>, and the type of materials and subjects (self-help, mutual help, and community help). These data were used in the statistical analysis, and the structural equation model suggested relationship directions regarding the relevance of certain elements when selecting activities.

Interviews were divided into two groups: (i) interviews with school personnel aimed at identifying the most useful activities and materials, barriers to implementing DRR activities, and elements perceived as triggers for early action when facing early warnings; and (ii) interviews with high-level authorities involved in the development of the GIRE program aimed at identifying the key elements for successful implementation of core program actions as well as areas of opportunity for future collaborative projects among agencies. The opinions collected through these interviews suggest that lessons learned through implementation led to subsequent improvements in the program.

## 2.4 Limitations

It is important to consider the impact of the COVID-19 pandemic on the education sector. Schools were forced to shift to online learning for 17 months, changing in an important way how more than one million students interacted with their environment as well as their exposure (frequency) to DRR activities. During the 2019–20 school year, only 28% of the actions reported in the 2018–19 school year were performed, dropping further in the 2020–21 school year to just 16%. Considering the importance of experiential learning and practice in the context of DRR, together with reports that the primary strategy adopted by schools for developing DRR knowledge is related to familiarization with the actual school grounds and conducting drills (the most mentioned elements in the memorability item (52) (see Table A2)) a decreased response capacity was not entirely unexpected. Even so, the use of online activities and materials mitigated this decrease, demonstrating that these educational methods are well-suited for remote learning. It is important to note that the survey was conducted more than half a year after schools had returned to regular operation and DRR activities had resumed.

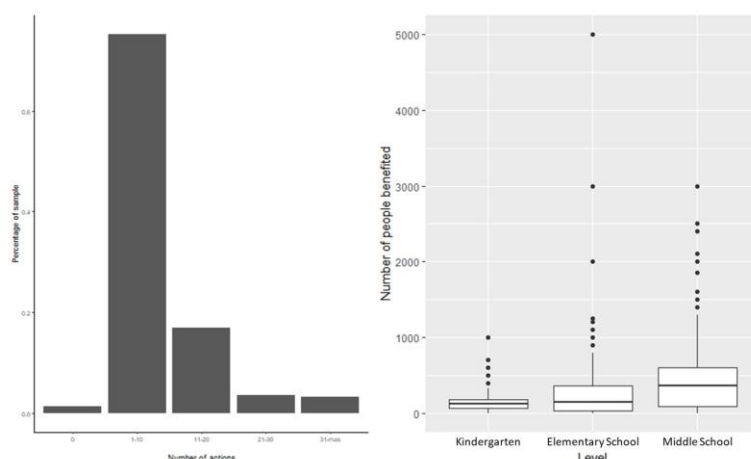
<sup>24</sup> In addition to the responses for different activities, an additional question asking about "General DRR actions" was also included.

### 3 Results

#### 3.1 Efficacy, memorability, and normative compliance

Analysis of the efficiency (5) and memorability of the activities and materials (2) enables us to identify the actions that had a higher dissemination and usage rate as well as those that left a more profound cognitive impression (see question 10). On the memorability (recognition) dimension, the item that had the highest recognition (91%) was the DRR family plan that had been distributed throughout the city for more than ten years and was directly related to the annual national drill, so its high recognition rate was to be expected. Activities related to the development of mandatory response plans (PIPCE) were also well recognized (PIPCE course, 44%; PIPCE guide, 37%), supporting the idea that compliance with regulations is an important driver of promoting actions (see question 12).

Most of the participants reported having developed between 1 and 10 DRR activities. In addition, middle schools were found to be performing the greatest number of actions and benefiting the most people across all activities, which we believe to be due to the fact that children are involved in more DRR activities at this school level.



353

354 Figure 6: Graphs showing the number of actions and people benefited by the reported general DRR actions.

355 It is also worth noting that the DRR workshop and the socioemotional course were similar in terms of recognition  
 356 (both 51%), number of actions (6,434 and 5,826, respectively), and people benefited (209,650 and 174,286,  
 357 respectively), even though their initial participant rates were very different (6,216 and 74,126 respectively) (Table  
 358 1). The comments extracted from the interviews suggest that the variety of materials and tools delivered to the  
 359 participants of the DRR workshop in an easily shareable fashion (Google Drive) might have played an important  
 360 role in the further dissemination of the materials. In addition, the preferred types of materials (see Table A2) were  
 361 ones that mixed fun elements with experiential elements, including games (34%), experiments (16%), videos  
 362 (14%), and simulations (12%), all of which have high memorability.

363 The return to in-person classes placed a heavy burden on principals and teachers, who needed to deal with the  
 364 aftermath of the long absence of children in their classrooms, both in the academic sense and the emotional impacts  
 365 on the students. DRR contents related to mental health were incorporated to address the effects of isolation. The  
 366 needs of teachers were reflected in the high interest in and usage of DRR materials, as reported in the survey. The  
 367 socioemotional course had the second highest recognition rate (51%) and the most participants reported to date  
 368 (74,126), plus an estimated 174,000 people who benefited from it in the sample, predominantly at the elementary  
 369 school level (54%) followed by the middle school level (40%). These results are consistent with the high percentage  
 370 of psychosocial support reported in schools (71%). It is noteworthy that “The Teachings of Ollin,” a comic book  
 371 developed with the aim of addressing mental health and disseminated through conferences, mail, and print  
 372 distribution, showed a relatively small recognition rate (27%) and a lower efficiency rate (total benefited / total  
 373 actions) compared with the socioemotional course, suggesting that for teachers and principals, it was more  
 374 important to develop their own socioemotional capabilities through training<sup>25</sup> than it was to use the comic book as  
 375 a means to deliver these aspects to their students. These findings suggest that socioemotional-support contents  
 376 were useful for school communities to adjust to the “new normal” of the pandemic, although further research is  
 377 warranted to confirm whether this was indeed the case.

378 Additionally, the efficiency analysis revealed that the interactive characteristics (i.e., human interaction, machine  
 379 interaction, or no interaction) of the activities played an important role in their efficiency. Interviews revealed that  
 380 in most cases, human-interaction activities were preferred, whereas the efficiency analysis revealed that machine-

<sup>25</sup> These types of actions are consistent with the coping style reported as “active” (83%).

381 interaction activities, such as self-paced online courses, tend to have a higher efficiency rate and a longer reach  
 382 compared with human-interaction activities (Garibay Rubio, 2017). We consider this result to be due to the  
 383 relatively shorter time that teachers and directors spend interacting with students in in-person courses compared  
 384 with the greater length of time available in self-paced online courses.

385 When comparing materials in terms of method of transmission, those that were distributed by postal mail,  
 386 printed material, electronic means, or official websites were considered to reach a larger number of people because  
 387 of the ease of these mechanisms, even if they deliver information without human or machine interaction (i.e., no  
 388 interaction). Accordingly, a higher memorability rate was expected, but this result was not observed.

389

390

391

392

| Table | Interactivity       | No. | Efficiency above fit | Percentage | 3: |
|-------|---------------------|-----|----------------------|------------|----|
|       | Human interaction   | 3   | 1/3                  | 33%        |    |
|       | Machine interaction | 3   | 3/3                  | 100%       |    |
|       | No interaction      | 4   | 1/4                  | 25%        |    |

393 Differences according to interactivity

394 It seems that machine-interaction activities in the form of MOOCs or self-paced courses have higher efficiency  
 395 rates (Table 3) and smaller implied resources compared with other activity modalities, even if human-interaction  
 396 activities are preferred and desired, as the collected comments suggest. Therefore, a mixed modality strategy will  
 397 probably lead to better outcomes (see question 11).

398 People's opinions and preferences regarding these modalities tend to differ according to factors such as their  
 399 schedule, informatics literacy, and budget, while organizations tend to develop or select certain strategies over  
 400 others based on factors such as size and structure (Garibay Rubio, 2017), preferring machine-interaction or no-  
 401 interaction activities due to their lower costs and higher scope compared with human-interaction activities.

402 Another factor revealed by the interviews—through responses regarding the memorability of activities and  
 403 materials such as the course on creating mandatory response plans (PIPCE) and the PIPCE guide, as well as the  
 404 socioemotional course—was that all the mentioned activities addressed school necessities (see question 9). The  
 405 response plans (PIPCE) were related to mandatory requirements, while the socioemotional course addressed a  
 406 need that arose due to the effects of the pandemic on children.

407 According to the evaluation of normative compliance among schools in the sample reported by SGIRPC in their  
 408 official records, the majority of schools had already submitted their mandatory emergency response plans (PIPCE)  
 409 (Figure 7), supporting the claim that institutionalized requirements and mechanisms should be one of the central  
 410 objectives of a broader DRR policy.

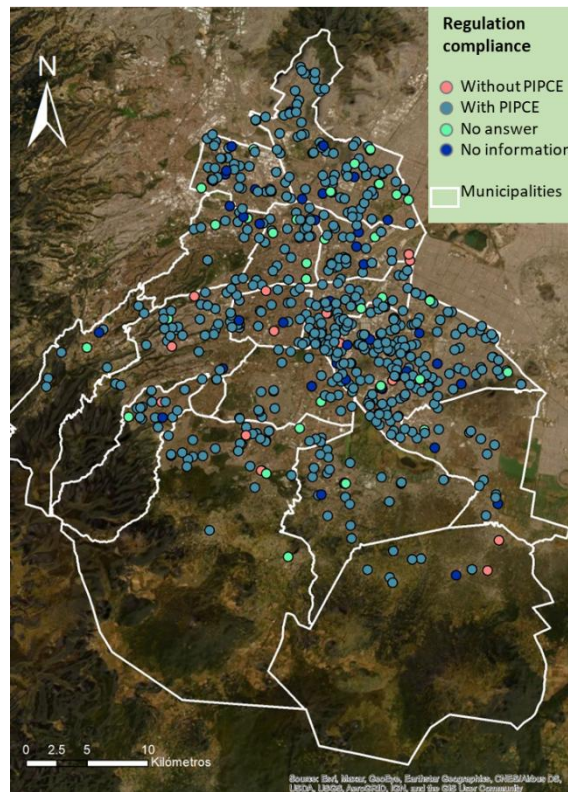


Figure 7: Schools with PIPCE registered at official databases.

Some of the key components mentioned in the interviews for the success of the activities were identified as the “construction of easy-to-grasp and action-oriented materials that consider the actual needs of the educational sector, centered on experience and knowledge development.” An example of these can be found in the mental health-oriented materials and in the guides for regulatory compliance. One participant said, “Regulations should be realistic and achievable in order to help the community fully realize their local risks.” To this end, it is important to democratize knowledge with the full commitment of all authorities involved in the process, not only school and educational authorities but also the entire government, in order to make schools and the areas surrounding them as safe as possible.

The interviews also revealed that attitudes toward DRR can mediate involvement, while the disposition to act is affected by leadership and the possibility of creating some sense of security through appropriate and timely messages aligned with agreed-upon actions and common sense. Habits developed through experiential learning, awareness of possible risks, previous experience, and the possibility of having peer-to-peer learning by students are important elements to consider when evaluating efficiency.

### 3.2 Responsibility, involvement, and self-efficacy

As mentioned in our hypothesis, it would be reasonable to assume that **position** (e.g., teacher or principal) and **school level** (e.g., kindergarten) imply different activities and responsibilities both in terms of “legal responsibility” and in the “relation/closeness” to students, which could lead to different perspectives about who should be responsible for promoting DRR measures and what type of knowledge should be prioritized, especially given the dichotomy between principals, who usually hold the major legal responsibility, and teachers, who tend to be closer to students because of the much greater amount of time that they spend with them. Such circumstances may vary depending on the particulars of the country and organization, but the results show that this is certainly the case in Mexico City, where poor self-ascription of responsibility for DRR is seen in teachers (26%) and principals (18%) across all school levels, which runs counter to what is stated in the actual regulatory framework. The highest self-assumed rates of responsibility were for elementary school teachers (29%) and middle school principals (25%). This finding may have been influenced by closeness to students as well as evaluations of students’ capacity to take care of themselves. The lower the school level, the higher the degree of children’s dependency on adults (Figure 8). In kindergartens, this is assumed to lead to doubts among the personnel, which is reflected in the self-efficacy rates for DRR response, where 53% of principals and 60% of teachers reported having “moderate confidence,” while the self-efficacy rates at elementary and middle schools trended toward “high confidence” in the response category.

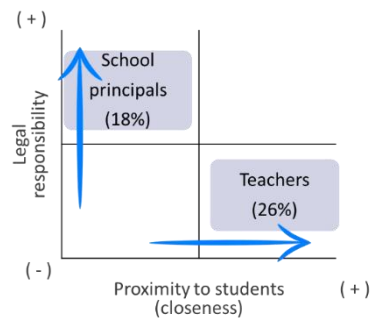


Figure 8: Percentage of self-ascription of responsibility given the legal responsibility and the proximity to students.

Upon closer examination, the analysis showed that position (i.e., principal or teacher) affects the belief about who should be responsible (we observe a significant association between position and self-responsibility<sup>26</sup> ( $X^2[6] = 1515.680, p = 0.0001$ ) (see question 1). At the kindergarten level, teachers believed that school authorities (29%) (not principals) and external DRR authorities (28%) should bear most of the responsibility for implementing DRR measures, even if they also consider themselves responsible for the school community (24%), as previously mentioned. That is not the case for school principals, who believe that the responsibility should be shouldered by the teachers (35%) or by other school authorities (21%) rather than themselves (19%), a surprising fact considering the high levels of involvement that they reported, including complete involvement (53%) and moderate involvement (39%).

Elementary school teachers showed the highest levels of self-responsibility (29%) regarding DRR, but still, a fair amount of them believed that school authorities (28%) (not principals) and external DRR authorities (25%) should have the greatest responsibility for implementing DRR measures. In contrast, relatively few teachers (12%) believed that principals should shoulder most of the responsibility, an opinion shared by the principals themselves (16%). Indeed, principals believed that teachers should bear most of the responsibility (28%) for DRR activities, along with external DRR authorities (28%) and other school authorities (24%). This is an unexpected finding, considering that principals are legally responsible for carrying out the activities specified in the school's PIPCE and ensuring other aspects of regulation compliance at schools. Middle school teachers were less likely to think that they should be responsible (19%), believing instead that school authorities (28%) (not principals) and external DRR authorities (29%) should bear most of the responsibility. This may be attributable to the sense of self-reliance exhibited by middle school students compared with elementary school students. It is interesting to note that middle school principals reported higher confidence in their ability to respond to an emergency (73%), and they were also the most likely to assume responsibility (25%) compared with principals at other school levels and were the only principals that preferred "mutual help" knowledge (47%) to "self-help" knowledge.

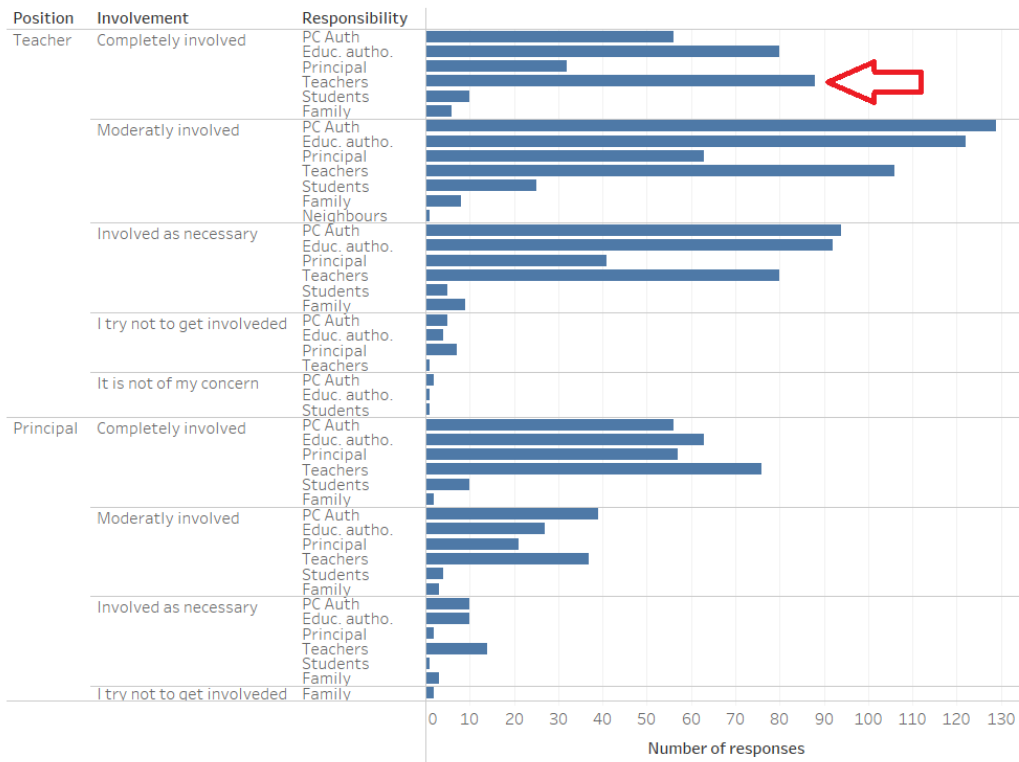
Principals reported consistently higher levels of involvement with DRR activities across all educational levels and positions, with 61% of them being completely involved in DRR compared with teachers, 43% of whom reported only moderate involvement in DRR. Teachers reported being "moderately involved" (41%) but believed that they should have a "greater responsibility." We found that self-responsibility and degree of involvement were related; that is, people's belief that they should be more responsible leads to higher levels of involvement ( $X^2[8] = 21.141, p = 0.0068$ ).

To summarize, in the position/involvement relation, a statistical significance was found (see question 3) ( $X^2[12] = 213.466, p = 0.0001$ )<sup>27</sup>, and all positions tended to report moderate-to-high levels of involvement. We expected that more principals, because of the nature of their position, would report that they should have higher levels of responsibility, but that was not the case. In general, every position tended to believe that others should have a greater responsibility than they should, except for teachers who were "**completely involved**" (see Figure 9). This finding only partially supports our initial hypothesis that higher involvement levels would lead to stronger beliefs regarding self-responsibility across positions (see question 3).

<sup>26</sup> To evaluate self-responsibility, three categories were created: 1) principals and teachers believed that they themselves should be responsible (Y), 2) principals believed that teachers should be responsible and vice versa (N), and 3) personnel in other positions do not believe that they should be responsible because of their particular characteristics or there was no response to the questionnaire item (NA).

<sup>27</sup> Given the characteristics of these variables and the categories in which the information is classified, it is possible that the p values may be inaccurate because 20% of the cells had an expected count of less than 5.

## Responsibility / Involvement



483

484 Figure 9: Graph showing the results of crossing responsibility with involvement for the different positions.

485 As previously mentioned, “degree of involvement” is considered to be a key element that affects several  
 486 dimensions, not only beliefs about who should be responsible. For example, the degree of belief in “self-efficacy,”  
 487 understood as the confidence in oneself to perform actions appropriately in the event of an emergency, showed  
 488 statistical significance ( $X^2[12] = 250.814, p = 0.0001$ ).

489 However, a lack of involvement in developing DRR activities, planning, and decision-making, which usually  
 490 happens in top-down policymaking, may increase their tendency to believe that others should have responsibility  
 491 instead of themselves, like being a spectator rather than a performer at an event. A similar analogy can be found in  
 492 the level of community response that occurs after an early warning message is issued in communities that worked  
 493 together with specialists and local governments to implement disaster response switches compared with those  
 494 that did not, to say nothing of the survival rates (Takenouchi and Yamori, 2020). We assume that being involved not  
 495 only in the disseminating information but also in developing DRR activities, planning, and decision-making leads  
 496 to a sense of recognizing problems and responding appropriately, thereby fostering a stronger sense of one’s own  
 497 responsibility and leading to higher involvement and greater confidence in one’s own and others’ beliefs about the  
 498 appropriate actions to take.

499 The responses to the last item of the survey suggest that there is a desire from the community to have more  
 500 training (109). In addition, there were complaints about the way the materials were distributed and their poor  
 501 reach (100)<sup>28</sup>, suggesting that improving awareness of the materials and activities that have been made available  
 502 might enhance the implementation of DRR activities. The present analysis revealed that 1,470,730 people<sup>29</sup> have  
 503 benefited from some of the activities and materials provided through the activities by the school personnel sampled,  
 504 representing only 2% of the general teacher population, suggesting that not only the school community but also  
 505 their families and the local community have benefited as well.

506 Self-efficacy is another key feature that relates importantly to several other concepts, including involvement and  
 507 the number of actions performed across the different materials and activities examined in this study (Figure 2). A  
 508 moderate belief in one’s self-efficacy tends to correlate with moderate involvement, even though it also tends to  
 509 lead to a greater number of general actions compared with lower levels of self-efficacy ( $X^2[12] = 360.278, p =$

<sup>28</sup> It seems that the survey made the participants aware that a lot of materials had been developed, but they were unable to access them (see question 14).

<sup>29</sup> The survey does not allow us to determine whether the people who benefited are all unique or whether some might be duplicates. Nevertheless, the strategy has proved to be effective.

0.0017)<sup>30</sup>. We could argue that to create efficient DRRES, strategies should be developed that increase the perceived sense of self-efficacy in relation to DRR, considering the relation to activity multiplication.

In other fields, the value of self-efficacy is already a well-known and important issue. For example, in the psychosocial support literature, self-efficacy is one of five areas targeted for support aimed at promoting mental health (Hobfoll et al., 2007). Accordingly, it is natural to assume that a strong sense of self-efficacy, together with a high level of involvement, would make it easier for people to perform actions (in this case DRR actions). In Figure 10, we can clearly see that the number of actions (in this case, actions related to a socioemotional course) increases with involvement in people who have high levels of self-efficacy (see question 7).

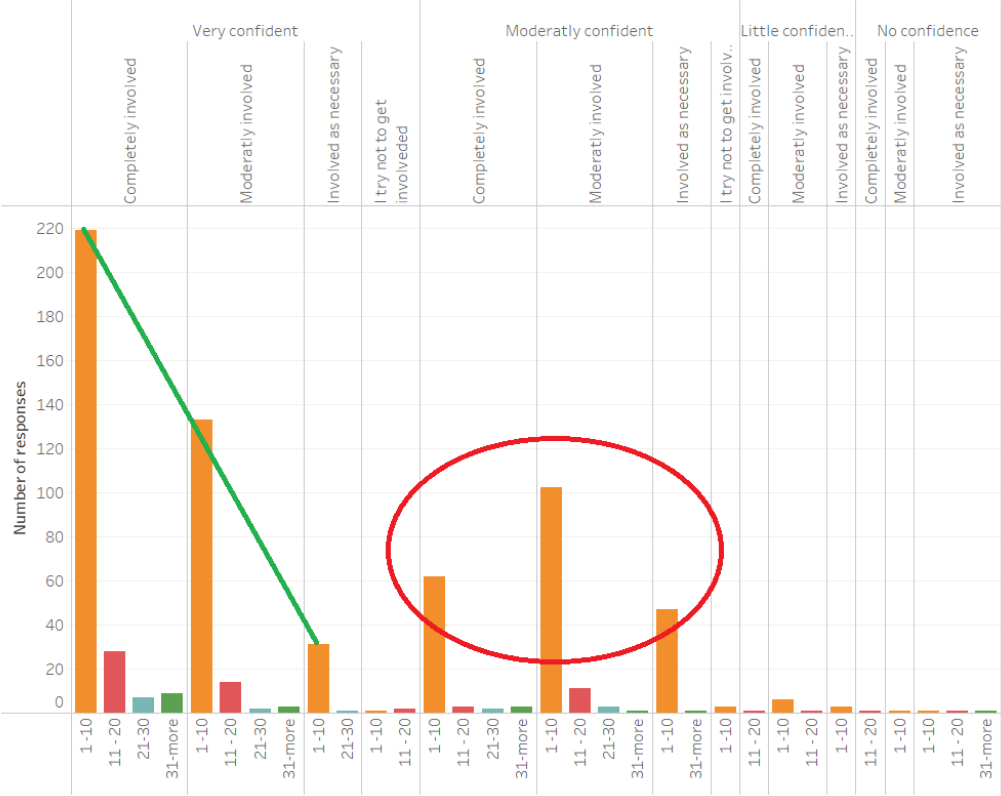


Figure 10: Relationship between self-efficacy and actions performed related to a socioemotional course. See also question 7.

Under these assumptions, promoting self-efficacy could be considered one of the main elements for improving the outcome of DRRES independent of the particular objectives that each one of the activities of the program aims to achieve.

### 3.3 Preferred knowledge and beliefs about possible damage due to earthquakes

Mexico City's history of earthquakes might explain the high levels of belief regarding "potential damage." However, it was surprising to find such high proportions of "moderate" (high possibility of damage, 49%) and "high" (completely certain about damage, 29%) beliefs across **all positions and settings** (see question 13) (schools, students' homes, and their own homes) **regardless of the location** of the school or their home (see Figure 11).

<sup>30</sup> Given the characteristics of these variables and the categories in which the information is classified, it is possible that the p values may be inaccurate because 20% of the cells had an expected count of less than 5.

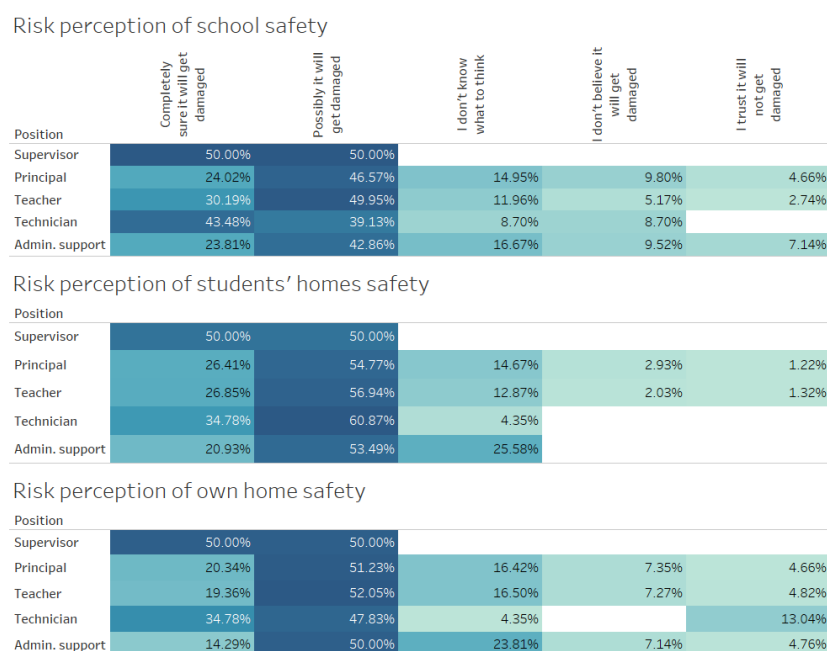


Figure 11: Belief regarding damage across locations.

Slightly higher confidence regarding the seismic behavior of the school was found in principals (particularly those highly involved) compared with teachers, suggesting that belief regarding possible damage is only slightly mediated by factors such as position or location. The relationship between risk perception and who should be responsible for DRR was not statistically significant (see question 5). Nevertheless, the relation between risk perception and involvement was statistically significant ( $\chi^2[20] = 282.346$ ,  $p = 0.0001$ ), showing that people who were more involved with DRR activities had greater confidence in the seismic behavior of the schools. Although this finding is not surprising given that less involvement is expected to increase risk perception due to a lack of knowledge about the phenomenon, it should be noted that this feature is especially important for improving social response during an actual earthquake event (see question 4).

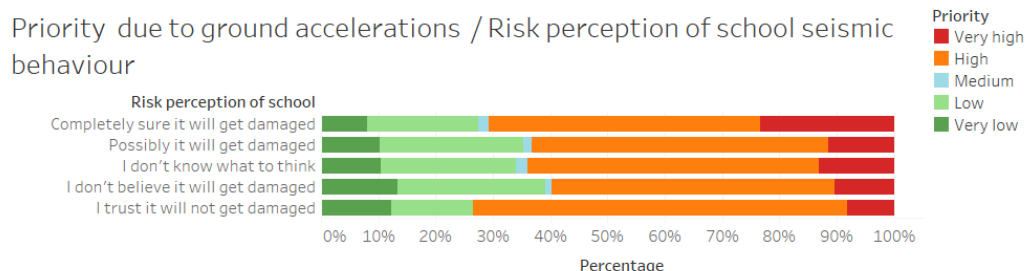


Figure 12: Belief regarding potential damage according to the priority level assigned to the school based on its location.

It could be supposed that poor confidence in the seismic behavior of infrastructure is related to the type of knowledge considered to be most important to teach to students (see question 6). Given that risk perception is very high, it is not surprising that “self-help” was rated the most important type of knowledge, followed by “mutual help,” which stands in contrast to “communitarian help”; this held true across all positions without exception ( $\chi^2[9] = 26.476$ ,  $p = 0.0017$ ) (see question 2). The type of beliefs regarding the safety of infrastructure, both public and private, are likely to affect the preferred type of knowledge to deliver to the school community, leading to a tendency toward self-help rather than community help. This finding may also reflect the fact that Mexican society is more individualist than collectivist.

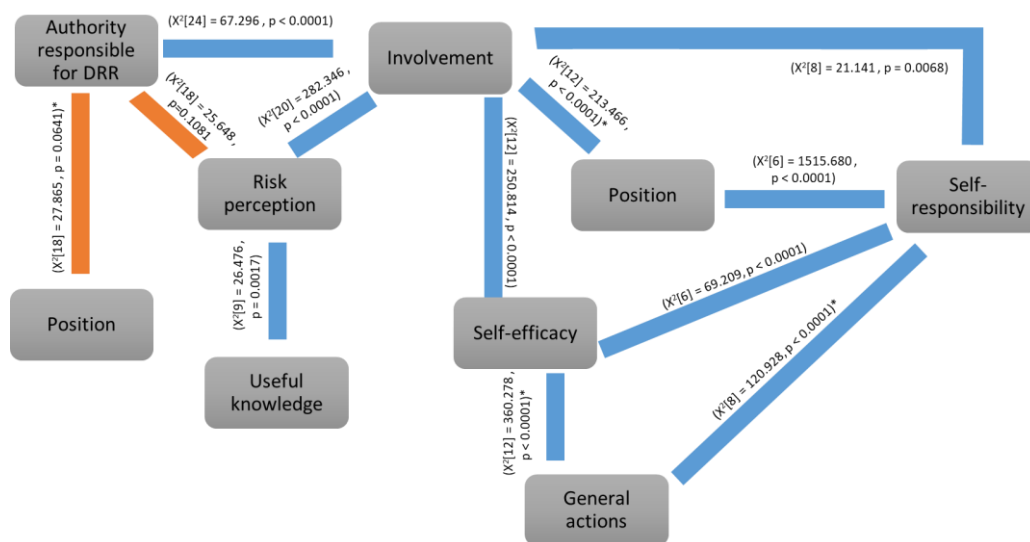
## Useful knowledge / Risk perception of school safety

| Useful knowledge   | Position       | Completely sure it will get damaged | Possibly it will get damaged | I don't know what to think | I don't believe it will get damaged | I trust it will not get damaged |
|--------------------|----------------|-------------------------------------|------------------------------|----------------------------|-------------------------------------|---------------------------------|
| Self help          | Supervisor     | 50.00%                              | 50.00%                       |                            |                                     |                                 |
|                    | Principal      | 25.84%                              | 46.41%                       | 13.40%                     | 9.09%                               | 5.26%                           |
|                    | Teacher        | 28.43%                              | 48.59%                       | 12.50%                     | 6.05%                               | 4.44%                           |
|                    | Technician     | 46.15%                              | 30.77%                       | 15.38%                     | 7.69%                               |                                 |
|                    | Admin. support | 19.05%                              | 47.62%                       | 14.29%                     | 9.52%                               | 9.52%                           |
| Mutual help        | Principal      | 23.49%                              | 45.78%                       | 16.87%                     | 9.04%                               | 4.82%                           |
|                    | Teacher        | 32.22%                              | 51.80%                       | 11.34%                     | 3.35%                               | 1.29%                           |
|                    | Technician     | 28.57%                              | 57.14%                       |                            | 14.29%                              |                                 |
|                    | Admin. support | 31.25%                              | 37.50%                       | 12.50%                     | 12.50%                              | 6.25%                           |
| Communitarian help | Principal      | 15.15%                              | 51.52%                       | 15.15%                     | 18.18%                              |                                 |
|                    | Teacher        | 31.07%                              | 49.51%                       | 11.65%                     | 7.77%                               |                                 |
|                    | Technician     | 66.67%                              | 33.33%                       |                            |                                     |                                 |
|                    | Admin. support | 20.00%                              | 40.00%                       | 40.00%                     |                                     |                                 |

Figure 13: Preferred type of knowledge and risk perception of schools facing earthquakes according to position.

### 3.4 Conceptual relationships

The results of this study revealed significant relations between the concepts analyzed<sup>31</sup> (see Figure 14), with different degrees of significance between them, suggesting that some of them can be considered central elements capable of influencing those on the periphery. Therefore, to gain further clarity regarding the possible causal relationships inside the conceptual network, the results were modeled using structural equation modeling (Figure 15), supporting the idea of central concepts in the network ( $\chi^2(10) = 40.49$ ,  $p < 0.0001$ , CFI = 0.95, RMSEA = 0.04, AICc = 36453.78).



Notes:

The color of the line shows if statistical significance between variables was found (blue lines mean it was found; orange lines, it was not found).

\* Given the characteristics of these variables and the categories in which the information is classified, it is possible that the p values may be inaccurate because 20% of the cells have an expected count of less than 5.

Figure 14: Relationships among key concepts.

<sup>31</sup> Position: Fixed by outside factors related to job selection; Responsibility: Deontic belief about a relation in the world; Self-responsibility: Self-perception belief; Involvement: Attitude toward participation; Self-efficacy: Self-perception belief; Useful knowledge: Rational outcome / Preference; Risk perception: Belief about a relation in the world.

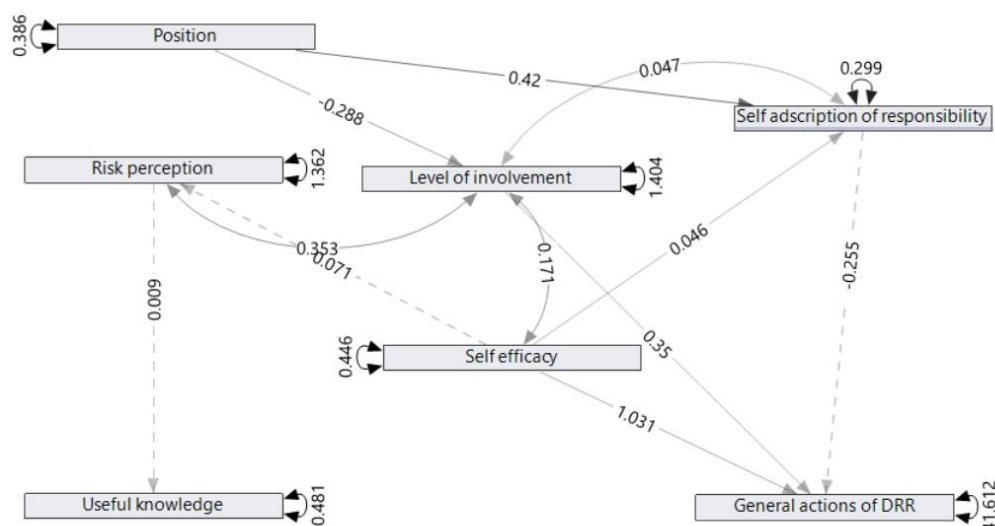


Figure 15: Conceptual network model SEM

According to our results, Mexico City DRRES can greatly benefit by seeking to change how teachers and principals perceive themselves in relation to DRR responsibility while simultaneously promoting activities that enhance their feeling of self-efficacy, mostly by developing experiential opportunities that allow them to connect with others who can share experiences and solutions to similar problems. The importance of developing DRRES that are effective for Mexico City schools becomes clear when reflecting on the city's high exposure to hazards, the poor confidence of the community in hazard-resistant infrastructure (independent of construction codes), and the general attitude-mapping extracted from our earlier results. The design of courses following the mechanics of MOOCs that deliver easy-to-follow knowledge, together with field guides for general knowledge dissemination, might be a good alternative for tackling immediate needs and mandatory elements if it were associated with follow-up mechanisms that guarantee their acknowledgment by the community; only sending invitations by mail does not seem adequate for achieving these aims. For participants with positive attitudes toward learning or a legal responsibility to continue learning about DRR, experience-based workshops with networking opportunities could be the next step. A year-long calendar showing possible activities and a capacity-building roadmap are in line with some of the participant comments. For example, one participant said, "The acquired knowledge was quickly forgotten because there were too few experiences." By maximizing the educational effects produced through the synergy of incorporating various types of activities in integrated DRRES, we are confident that municipal policies such as those described in this study will enhance the disposition, development, and social value of DRR activities in the educational sector.

## 4 Discussion

Implementing a DRR program for schools requires the cooperation of multiple agencies as well as the implementation of a series of different steps. This process includes designing integrated DRRES that embed (are supported by) a mix of agency principles (philosophy); considerations about the social value and acceptability of the actions that should reach the school community; case-based vulnerability conditions; and institutional possibilities due to their legal framework, resources, structure, and possibilities. The results suggest that it is possible to maximize the results through an understanding of transversal concepts and an appropriate selection of activities and dissemination mechanisms.

Concepts such as responsibility are not free from debate, and several positions can be taken. The Sendai Framework for DRR states that "each state has the primary responsibility to prevent and reduce disaster risk, including through international, regional, subregional, transboundary, and bilateral cooperation" and that "disaster risk reduction requires an all-of-society engagement and partnership" (Assembly, 2015a), which can be interpreted as meaning that teachers need not consider themselves as the main people responsible for developing DRR activities<sup>32</sup>. However, this is quite problematic for disseminating DRR knowledge and acting upon risk. A contrary

<sup>32</sup> Due to the existence of DRR specialists.

position is that individuals should be at the center of DRR activities. Nevertheless, some theorists (Benadusi, 2014, Apronti et al., 2015) advise caution regarding this shift in perspective. It is also possible to look for a middle ground where, because of the interaction between society and stakeholders, it is possible to increase soft as well as hard DRR preventive measures in both the short and long runs (Okada and Yamori, 2020). International agencies such as UNICEF and BHA/OFDA evaluate cooperation between sectors as well as the institutionalization of activities as an efficacy indicator; reinforcing a middle position with a focus on the institutionalization of activities (i.e., regulations to be regularly followed and monitored). Our results suggested that the mandatory aspect of activities might be related to the efficiency rate, although non-mandatory activities targeting perceived needs showed similar results. Therefore, a mixed approach might work better.

When recalling Peters' definition of education as a guideline, we can clearly see from the interviews with authorities and field personnel that the main intention is to promote the development of "capacities" in the school population through "preparedness" by focusing on action response through a child-centered response. Accordingly, there was a preference to develop easy-to-understand action-oriented materials focused on problem-solving and accumulating experience by repetition, such as through drills and field activities. Nevertheless, even if the opinions expressed in the interviews and the rationale behind the strategy are aligned with a constructivist approach, the means by which the activities and materials are articulated transmit knowledge in an essentially top-down manner. Knowledge transmission is highly valued in the strategy and is considered to be a necessary step in creating the superstructure to mediate an experience aligned with Miller's approach (see Figure 1). Nevertheless, it is important to note that the most valued activities extracted from the interviews and the survey were those related to field experiences. It is important not to oversimplify the distinction because, in many cases, a mixture of experiences and knowledge transmission can be appreciated. A good example is the course for socioemotional support, which delivered practical knowledge that was quickly adopted and adapted by the teachers and principals to deal with the actual needs of children, thereby enhancing the creation of experiences. Theories such as the ELT emphasize the importance of enhancing understanding by integrating the learning experience into the inner world and then performing experiments again in the real world, which is consistent with the results obtained in the present research.

As a consequence, the "self-efficacy" and "involvement" dimensions seem to be key points where institutional efforts should be focused. A strong belief (confidence) in one's ability to respond to an emergency increases the number of DRR actions performed as well as involvement and belief in self-responsibility in relation to one's immediate community. In this case, children and one's colleagues are a significant element in communitarian DRR approaches.

The importance of promoting a belief in self-efficacy and acknowledging that such a belief can be fostered by various experience-based strategies has been previously reported (Hobfoll et al., 2007). In the context of this study, self-efficacy is a belief and, by its very nature, dynamic in the sense that it can change according to the circumstances, including the availability of possible responses. For example, a person might believe that they can respond quickly and effectively during an evacuation procedure but not when a school building has collapsed due to an earthquake. Similarly, a principal faced with a structural problem in a school building might have at their disposal a limited number of possible actions in accordance with agency regulations, such as notifying higher authorities but not being able to take action on their own. Nevertheless, despite the generality of the survey item on self-efficacy, it has been confirmed as a useful indicator of attitudinal drivers for action.

Furthermore, we believe that stronger self-efficacy beliefs are consistent with bottom-up strategies (rather than top-down approaches), which share the idea that by enhancing participatory action, involvement increases, and consequently, a sense of community that acknowledges both self- and mutual responsibility is created. It is worth noting that in the survey and interviews, teachers expressed a desire to play a greater role in the decision-making process for implementing DRR activities at school due to their perceived inability to do so, with many saying they wanted to decide how things were done. Further research is needed to understand the reasons behind the low percentage of school personnel who consider community help as the first option despite most responses focusing on self-help and mutual help. However, in risk prevention, collaboration and the involvement of the community are important for improving responses when faced with an emergency or disaster. A lack of coordination among individual actions can negatively impact the effectiveness of measures implemented in disaster situations; therefore, for risk prevention policy to be effective, it is necessary to improve community work and the involvement of school personnel with the community. It was interesting to observe that middle school principals, who showed higher confidence regarding school seismic behavior and reported higher levels of involvement and self-efficacy, were the only ones who preferred mutual help over self-help, suggesting that a recognition of the capacity of others to respond properly together with the belief in a relatively safe environment might be the necessary conditions for promoting mutual help and a sense of collective belonging.

## 656 5 Conclusions

657 It is widely accepted that working with children is an effective way to realize long-term societal change, and in an  
658 era of unprecedented change, including climate change and an increased frequency of natural disasters worldwide,  
659 it is worthwhile to try to improve the way in which DRR contents are developed and implemented at schools. This  
660 case study of Mexico City will benefit the more than one million children that attend municipal schools as well as  
661 the teachers and authorities responsible for their education in sometimes challenging environments. By improving  
662 our understanding of the interrelationships that emerged in the present analysis, relevant lessons regarding the  
663 relationships between elements such as the responsibility, self-efficacy, involvement, and risk perception of those  
664 developing the activities can be extracted.

665 The present study also contributes to understanding the influence and expected results that experience-based  
666 activities can produce in contrast with information-based approaches, highlighting the importance of the delivery  
667 method and the interactivity that the various pathways can guarantee.

668 In addition to concept mapping, compliance with regulations is a key element to be considered when planning;  
669 however, regulations alone are not enough to foster a DRR culture. Activities such as the DRR workshop, in which  
670 the participatory level of the community increases in relation to other materials, showed a higher number of actions  
671 with a smaller initial participation number, suggesting again that increasing participation in decision-making and  
672 general activities might improve self-efficacy beliefs, which together with the degree of involvement, are a good  
673 predictor for increased actions and, consequently, increased numbers of people benefited.

674 This study highlighted elements relevant to ongoing activities at schools. Future research should focus on  
675 evaluating new activities proposed by the agencies as well as analyzing the opinions of stakeholders over time in  
676 order to determine whether changes across the conceptual network start to emerge as an effect of DRRES.

## 677 6 Acknowledgements

678 We would like to thank the participating agencies for their cooperation and for providing the data we used in our  
679 previous work, particularly Dr. Luis Humberto Fernandez Fuentes, Secretary of the Autoridad Educativa Federal en  
680 la Ciudad de México, Arq. Myriam Urzúa Venegas, Secretary of the Secretaría de Gestión Integral de Riesgos y  
681 Protección Civil, and Dr. Keichi Osato, Director of the Japanese International Cooperation Agency. We also thank Mr.  
682 Jorge Luis Mungia Sanchez, Deputy Director of the DGOSE (AEFCM), and Francisco Javier Nicolas Felix for technical  
683 cooperation (JICA).

## 684 7 Statements and Declarations

685 Data obtained from the survey and interviews that support the findings of this study are available from the  
686 corresponding author upon request.

687 Datasets related to official compliance with the mandatory government requirements of schools are available upon  
688 request from “Unidad de Transparencia” at the following email address: [transparencia@aefcm.gob.mx](mailto:transparencia@aefcm.gob.mx).

689 Information related to the city risk maps can be retrieved through the Mexico City Risk Atlas  
690 <https://www.atlas.cdmx.gob.mx/principal/inicio> or through the official information system:  
691 <https://www.infomexdf.org.mx/InfomexDF/Default.aspx>.

692 The authors have no competing interests to declare that are relevant to the content of this article.

## 693 8 Funding

694 The travel expenses for the interviews were provided by the Japanese International Cooperation Agency through  
695 the SDG Global Leaders program.

## 696 9 Bibliography and Appendix

### 697 Bibliography

698 Apronti, Priscilla T. et al. (2015). “Education for Disaster Risk Reduction (DRR): Linking Theory with Practice in  
699 Ghana’s Basic Schools”. In: *Sustainability* 7.7, pp. 9160–9186. issn: 2071-1050. doi: [10.3390/su7079160](https://doi.org/10.3390/su7079160). url:  
700 <https://www.mdpi.com/2071-1050/7/7/9160>.

701 Assembly, United Nations General (Mar. 2015a). *Sendai Framework for Disaster Risk Reduction 2015-2030*, pp. 1–29.  
702 url: <https://digitallibrary.un.org/record/793460>.

703 – (July 2015b). *Transforming our world: the 2030 Agenda for Sustainable Development*. United Nations General  
704 Assembly, pp. 1–35.

705 Bello, Omar, Alejandro Bustamante, and Paulina Pizarro (2020). *Planning for disaster risk reduction within the*  
706 *framework of the 2030 Agenda for Sustainable Development*. United Nations CEPAL, pp. 1–57. url:  
707 <https://repositorio.cepal.org/server/api/core/bitstreams/ae6fe59f-e288-431b-8edd-7cbe1f760c8d/content>.

708 Benadusi, Mara (2014). “Pedagogies of the unknown: Unpacking ‘culture in disaster risk reduction education.” In:  
709 *Journal of Contingencies and Crisis Management* 22.3, pp. 174–183.

710 Bubeck, Philip, Willem Jan Wouter Botzen, and Jeroen CJH Aerts (2012). “A review of risk perceptions and other  
711 factors that influence flood mitigation behavior”. In: *Risk Analysis: An International Journal* 32.9, pp. 1481–1495.

712 CENAPRED (June 2021). *Impacto socioeconómico de los principales desastres ocurridos en México*. National Center  
713 for Disaster Prevention, pp. 1–20. url: [https://www.gob.mx/cenapred/articulos/conoce-el-impacto-](https://www.gob.mx/cenapred/articulos/conoce-el-impacto-socioeconomico-de-los-principales-desastres-ocurridos-en-mexico-durante-2020)  
714 [socioeconomico-de-los-principales-desastres-ocurridos-en-mexico-durante-2020](https://www.gob.mx/cenapred/articulos/conoce-el-impacto-socioeconomico-de-los-principales-desastres-ocurridos-en-mexico-durante-2020).

715 Garibay Rubio, Carlos Rodrigo (2017). “Educación a Distancia: Nuevo modelo educativo para la formación en  
716 materia de protección civil”. In: *Revista de Administración Pública INAP* LII (2), pp. 103–120. url:  
717 <https://inap.mx/wp-content/uploads/2020/08/rap143.pdf>.

718 – (2018). *Los MOOC como herramientas para la enseñanza y la intervención psicosocial en emergencias*. url:  
719 <https://www.uv.mx/blogs/brechadigital/files/2018/12/hdt6.pdf>.

720 Hamm, Cornel M (2003). *Philosophical issues in education: An introduction*. Routledge.

721 Hobfoll, Stevan E. et al. (Dec. 2007). “Five Essential Elements of Immediate and Mid Term Mass Trauma  
722 Intervention: Empirical Evidence”. In: *Psychiatry: Interpersonal and Biological Processes* 70 (4), pp. 283– 315.  
723 issn: 0033-2747. doi: [10.1521/psyc.2007.70.4.283](https://doi.org/10.1521/psyc.2007.70.4.283). url: [http://www.ncbi.nlm.nih.gov/pubmed/](http://www.ncbi.nlm.nih.gov/pubmed/18181708)  
724 [18181708](http://www.ncbi.nlm.nih.gov/pubmed/18181708)<http://guilfordjournals.com/doi/10.1521/psyc.2007.70.4.283>.

725 IASC (2022). *INFORM REPORT 2022, Shared evidence for managing crises and disasters*. InterAgency Standing  
726 Committee, European Commission, pp. 1–30. doi: [10.2760/08333](https://doi.org/10.2760/08333). url: [https://drmhc.jrc.ec.](https://drmhc.jrc.ec.europa.eu/inform-index)  
727 [europa.eu/inform-index](https://drmhc.jrc.ec.europa.eu/inform-index).

728 Kolb, David A (2014). *Experiential learning: Experience as the source of learning and development*. FT press.

729 Matheson, David (2015). *What is education?* Ed. by D. Matheson. url: [https://www.taylorfrancis.com/](https://www.taylorfrancis.com/chapters/edit/10.4324/9780203105450-8/education-david-matheson)  
730 [chapters/edit/10.4324/9780203105450-8/education-david-matheson](https://www.taylorfrancis.com/chapters/edit/10.4324/9780203105450-8/education-david-matheson).

731 Miller, George E (1990). “The assessment of clinical skills/competence/performance”. In: *Academic medicine* 65.9,  
732 S63–7.

733 Nakano, Genta et al. (2020). “Long-term evaluation of proactive attitudes toward disaster education in Nepal”. In:  
734 *International Journal of Disaster Risk Reduction* 50, p. 101866.

735 Okada, Natsumi and Katsuya Yamori (2020). “Action Research on Bosai Map Cycle–Communications and  
736 Interactions Among Stakeholders Involved in Mapmaking Activities–”. In: *Journal of Disaster Research* 15.6, pp.  
737 783–793.

738 Olson, Richard S et al. (2020). “From disaster risk reduction to policy studies: Bridging research communities”. In:  
739 *Natural hazards review* 21.2, p. 04020014.

740 Petal, Marla et al. (2020). “Child-centred risk reduction and school safety: An evidence-based practice framework  
741 and roadmap”. In: *International Journal of Disaster Risk Reduction* 49, p. 101633. issn: 2212-4209. doi:  
742 <https://doi.org/10.1016/j.ijdr.2020.101633>. url: [https://www.sciencedirect.com/science/](https://www.sciencedirect.com/science/article/pii/S2212420919305692)  
743 [article/pii/S2212420919305692](https://www.sciencedirect.com/science/article/pii/S2212420919305692).

744 Peters, Richard Stanley (2015). *Ethics and education (Routledge revivals)*. Routledge.

745 Takenouchi, Kensuke and Katsuya Yamori (Dec. 2020). “Synergistic Integration of Detailed Meteorological and  
746 Community Information for Evacuation from Weather-Related Disasters: Proposal of a “Disaster Response  
747 Switch””. In: *International Journal of Disaster Risk Science* 11 (6), pp. 762–775. issn: 21926395. doi: [10.](https://doi.org/10.1007/S13753-020-00317-3)  
748 [1007/S13753-020-00317-3](https://doi.org/10.1007/S13753-020-00317-3). url: [https://link.springer.com/article/10.1007/s13753-](https://link.springer.com/article/10.1007/s13753-020-00317-3)  
749 [020-00317-3](https://link.springer.com/article/10.1007/s13753-020-00317-3).

750 Tatebe, Jennifer and Carol Mutch (2015). “Perspectives on education, children and young people in disaster risk  
751 reduction”. In: *International Journal of Disaster Risk Reduction* 14, pp. 108–114.

752 Tight, M (1996). *Key Concepts in Adult Education and Training*. London & New York: Routledge Falmer.

753 Watson, Charlene; Alice Caravani; et al. (Mar. 2015). *Finance for reducing disaster risk: 10 things to know*. Overseas  
754 Development Institute. url: <https://odi.cdn.ngo/media/documents/9480.pdf>.

755     **Annex A and tables: A1, A2, A3 and A4 in complementary files.**

756

Table A1: Table of questions and remarks

| No.  | Question                                       | Result                                                                                                                                                                                  |
|------|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| N/A  | School name                                    | Personnel from 714 different schools                                                                                                                                                    |
| N/A  | Gender                                         | Female (1323, 73%), Male (465, 26%)                                                                                                                                                     |
| N/A  | School Level                                   | Kindergarten (252, 14%), Elementary school (1087, 60%), Middle school (449, 25%)                                                                                                        |
| N/A  | Schedule                                       | Morning (714, 39%), Afternoon (350, 19%), Extended period (481, 26%), Full time (243, 13%)                                                                                              |
| N/A  | Position                                       | Teacher (1210, 67%), Principal (472, 26%), Supervisor (5, 0.2%), Support (86, 4%), No response (15)                                                                                     |
| 1    | Most important type of knowledge to teach      | Self-help (899, 50%), Mutual help (689, 38%), Community (184, 10%), No response (16)                                                                                                    |
| 2    | Preparedness responsibility                    | Teachers (471, 26%), School Authorities (728, 40%), Civil protection authorities (449, 25%), Students (74, 4%), Family (40, 2%), No response (26)                                       |
| 3    | Number of general DRR actions performed        | 0 (24, 1%), 1–10 (1344, 75%), 11–20 (302, 16%), 21–30 (62, 3%), >31 (56, 3%)                                                                                                            |
| 3.1  | School year of start of performance            | 2018–19 (864, 48%), 2019–20 (241, 13%), 2020–21 (135, 7%), 2021–22 (525, 29%)                                                                                                           |
| 3.2  | People benefited                               | Total 408,299 (mean 261, median 167)                                                                                                                                                    |
| 4    | Main types of actions                          | Response (892, 49%), Prevention (467, 27%), Prevision (224, 12%), Recovery (93, 5%), Mitigation (51, 2%), No response (41)                                                              |
| 5    | What elements trigger a faster response        | Protocols (1092, 61%), Alert messages (217, 12%), Environmental cues (211, 11%), Seeing other people respond (150, 8%), Emotions (70, 3%), Agency messages (17, 0.9%), No response (31) |
| 6    | Main type of drill                             | Earthquake (1,742, 97%), Fire (3, 2%), Social unrest (2, 0.1%), Flood (1, 0.05%), No response (40)                                                                                      |
| 7    | Performance of collaborative drills            | Yes (243, 13%), No (965, 53%), Not possible (527, 29%), No response (53)                                                                                                                |
| 8    | Evacuation outside school grounds              | Has not happened (671, 37%), Has happened (64, 3%), A plan exists (518, 28%), No plan exists (502, 28%)                                                                                 |
| 9    | Trust in self-response in emergencies          | Highly confident (931, 52%), Appropriate response (742, 41%), Not much confidence (59, 3%), No confidence at all (17, 0.9%), No response (39)                                           |
| 10   | Recognition of the DRR workshop held in 2019   | Yes (923, 51%), No (839, 46%), No response (26)                                                                                                                                         |
| 11   | Workshop usefulness                            | Yes (883, 96%), No (40, 4%)                                                                                                                                                             |
| 12   | Starting period of use (DRR workshop)          | 2018–19 (283, 31%), 2019–20 (272, 29%), 2020–21 (106, 11%), 2021–22 (262, 28%)                                                                                                          |
| 12.1 | Number of actions performed                    | 0 (19, 2%), 1–10 (762, 83%), 11–20 (104, 11%), 21–30 (19, 2%), >31 (19, 2%)                                                                                                             |
| 12.2 | People benefited                               | Total 209,650 (mean 255, median 162)                                                                                                                                                    |
| 13   | Recognition of the socioemotional course       | Yes (922, 51%), No (827, 46%), No response (39)                                                                                                                                         |
| 14   | Course usefulness                              | Yes (855, 92%), No (67, 7%)                                                                                                                                                             |
| 15   | Number of actions derived                      | 0 (38, 4%), 1–10 (784, 85%), 11–20 (69, 7%), 21–30 (15, 2%), >31 (16, 2%)                                                                                                               |
| 15.1 | Starting period of use (socioemotional course) | 2018–19 (160, 17%), 2019–20 (213, 23%), 2020–21 (183, 20%), 2021–22 (322, 35%), No response (44)                                                                                        |
| 15.2 | People benefited                               | Total 174,286 (mean 223, median 120)                                                                                                                                                    |
| 16   | Recognition of PIPCE course                    | Yes (794, 44%), No (940, 53%), No response (54)                                                                                                                                         |
| 17   | Course usefulness                              | Yes (762, 96%), No (32, 4%)                                                                                                                                                             |
| 18   | Number of actions derived                      | 0 (24, 3%), 1–10 (667, 84%), 11–20 (68, 9%), 21–30 (16, 2%), >31 (19, 2%)                                                                                                               |
| 18.1 | Starting period of use (PIPCE course)          | 2018–19 (178, 22%), 2019–20 (167, 21%), 2020–21 (111, 14%), 2021–22 (312, 39%), No response (44)                                                                                        |
| 18.2 | People benefited                               | Total 184,578 (mean 260, median 178)                                                                                                                                                    |
| 19   | Recognition of DRR activity guides             | Yes (371, 21%), No (1,364, 76%), No response (53)                                                                                                                                       |
| 20   | Guide usefulness                               | Yes (348, 94%), No (23, 6%)                                                                                                                                                             |
| 21   | Number of actions derived                      | 0 (15, 4%), 1–10 (310, 84%), 11–20 (34, 9%), 21–30 (9, 2%), >31 (3, 1%)                                                                                                                 |
| 21.1 | Starting period of use (activity guide)        | 2019–20 (70, 19%), 2020–21 (69, 19%), 2021–22 (165, 44%), No response or inappropriate time reference (67)                                                                              |
| 21.2 | People benefited                               | Total 79,199 (mean 250, median 160)                                                                                                                                                     |
| 22   | Safe return to schools' guides                 | Yes (647, 36%), No (1090, 61%), No response (51)                                                                                                                                        |
| 23   | Guide usefulness                               | Yes (617, 95%), No (30, 5%)                                                                                                                                                             |
| 24   | Number of actions derived                      | 0 (15, 2%), 1–10 (448, 69%), 11–20 (71, 11%), 21–30 (28, 4%), >31 (45, 70%)                                                                                                             |
| 24.1 | Starting period of use (safe return guide)     | 2019–20 (75, 12%), 2020–21 (170, 26%), 2021–22 (351, 54%), No response or inappropriate time reference (51)                                                                             |
| 24.2 | People benefited                               | Total 128,365 (mean 229, median 140)                                                                                                                                                    |
| 25   | "The Teachings of Ollin" comic book            | Yes (478, 27%), No (1257, 70%), No response (53)                                                                                                                                        |
| 26   | Comic book usefulness                          | Yes (408, 85%), No (44, 15%)                                                                                                                                                            |
| 27   | Number of actions derived                      | 0 (29, 6%), 1–10 (409, 86%), 11–20 (27, 6%), 21–30 (8, 2%), >31 (5, 2%)                                                                                                                 |
| 27.1 | Starting period of use (comic book)            | 2020–21 (62, 13%), 2021–22 (318, 67%), No response or inappropriate time reference (98)                                                                                                 |
| 27.2 | People benefited                               | Total 87,824 (mean 228, median 123)                                                                                                                                                     |
| 28   | Willingness to use in class                    | Yes (1,138, 63%), No (78, 4%), No response (572)                                                                                                                                        |

Table A2: Table of questions and remarks

| No.  | Question                                           | Result                                                                                                                                                                                                                                                             |
|------|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 29   | What to do after COVID-19 workshop                 | Yes (187, 10%), No (1546, 86%), No response (55)                                                                                                                                                                                                                   |
| 30   | Workshop usefulness                                | Yes (167, 89%), No (20, 11%)                                                                                                                                                                                                                                       |
| 31   | Number of actions derived                          | 0 (13, 7%), 1–10 (121, 65%), 11–20 (24, 129%), 21–30 (11, 6%), >31 (18, 10%)                                                                                                                                                                                       |
| 31.1 | Starting period of use (After COVID-19 workshop)   | 2019–20 (21, 11%), 2020–21 (58, 31%), 2021–22 (82, 44%), No response or inappropriate time reference (26)                                                                                                                                                          |
| 31.2 | People benefited                                   | Total 32,788 (mean 214, median 126)                                                                                                                                                                                                                                |
| 32   | Expectancy of earthquake damages at school         | Certain of damage (420, 23%), It is possible (719, 40%), Unsure (191, 11%), I doubt it (97, 5%), I am certain there will be no damage (49, 3%), No response (311, 17%)                                                                                             |
| 33   | Expectancy of earthquake damage at students' homes | Certain of damage (393, 22%), It is possible (831, 46%), Unsure (200, 11%), I doubt it (32, 2%), I am certain there will be no damage (18, 1%), No response (313, 18%)                                                                                             |
| 34   | Expectancy of earthquake damage at one's own home  | Certain of damage (393, 22%), It is possible (755, 42%), Unsure (241, 13%), I doubt it (106, 6%), I am certain there will be no damage (71, 4%), No response (326, 18%)                                                                                            |
| 35   | Awareness of regulation changes                    | Yes (706, 39%), No (996, 56%), No response (84, 5%)                                                                                                                                                                                                                |
| 36   | The regulations were useful for you                | Yes (624, 88%), No (47, 7%), No response (35, 5%)                                                                                                                                                                                                                  |
| 37   | Recognition of PIPCE guide                         | Yes (660, 37%), No (1069, 60%), No response (57)                                                                                                                                                                                                                   |
| 38   | Guide usefulness                                   | Yes (617, 93%), No (43, 7%)                                                                                                                                                                                                                                        |
| 39   | Number of actions derived                          | 0 (26, 4%), 1–10 (517, 78%), 11–20 (85, 13%), 21–30 (22, 3%), >31 (10, 2%)                                                                                                                                                                                         |
| 39.1 | Starting period of use (PIPCE guide)               | 2020–21 (90, 14%), 2021–22 (446, 68%), No response or inappropriate time reference (124)                                                                                                                                                                           |
| 39.2 | People benefited                                   | Total 157,482 (mean 276, median 209)                                                                                                                                                                                                                               |
| 40   | Awareness of PIPCE                                 | I know school has PIPCE (1301, 72%), Does not have PIPCE (57, 3%), I do not know (278, 16%), No response (150, 8%)                                                                                                                                                 |
| 41   | The school community has response tools            | Very quick and efficient (309, 17%), Appropriate and timely (718, 40%), sufficient (432, 24%), deficient and slow (74, 4%), no tools (98, 5%), no response (155, 9%)                                                                                               |
| 42   | Coping styles                                      | Active (1485, 83%), Passive (11, 6%), No response 192, 11%)                                                                                                                                                                                                        |
| 43   | Degree of involvement in DRR                       | High (574, 35%), Moderate (629, 35%), Bare minimum (377, 21%), I try not to get involved (21, 1%), I do not care (5, 0.2%), No response (182, 10%)                                                                                                                 |
| 44   | Availability of psychosocial support               | Yes (1274, 71%), No 433, 24%), No response (81, 5%)                                                                                                                                                                                                                |
| 45   | Involvement of parents in psychosocial response    | Yes (1108, 62%), No 527, 29%), No response (153, 9%)                                                                                                                                                                                                               |
| 46   | Family response plan (actions)                     | 0 (162, 9%), 1—10 (1506, 84%), 11–20 (76, 4%), 21–30 (25, 1%), >31 (12, 1%)                                                                                                                                                                                        |
| 46.1 | Starting period of use (family response plan)      | 2018–19 (496, 28%), 2019–20 (244, 14%), 2020–21 (190, 11%), 2021–22 (672, 38%), No response or inappropriate time reference (186, 10%)                                                                                                                             |
| 46.2 | People benefited                                   | Total 289,700 (mean 220, median 120)                                                                                                                                                                                                                               |
| 47   | Common risks at school                             | Earthquake (1,415, 79%), Infectious diseases (121, 6%), Flooding (40, 2%), Fire (26, 1%), Others (33, 2%), No response (151, 8%)                                                                                                                                   |
| 48   | Recognition of the Mexico City Risk Atlas          | Yes (611, 34%), No (1,113, 62%), No response (62, 3%)                                                                                                                                                                                                              |
| 49   | Usage of risk atlas for school preparedness        | Yes (433, 71%), No (178, 29%)                                                                                                                                                                                                                                      |
| 50   | Starting period of use (risk atlas)                | 2018–19 (113, 18%), 2019–20 (63, 10%), 2020–21 (56, 9%), 2021—22 (295, 48%), No response (84, 14%)                                                                                                                                                                 |
| 50.1 | Benefited people                                   | Total 126,858 (mean 270, median 200)                                                                                                                                                                                                                               |
| 51   | Best learning resource                             | Games (608, 34%), Experiments (280, 16%), Videos (243, 14%), Simulations (210, 12%), Field trips (172, 10%), Stories (93, 5%), Comics (81, 5%), No response (101, 6%)                                                                                              |
| 52   | Memorable activities to share                      | Related to drills (67), Infographics and talks (36), Videos on preparedness (22), Practices (29), Experience sharing (14), Risk maps (10), Infrastructure improvement (3)                                                                                          |
| 53   | Comments                                           | Desire training and visits from experts (109), Report problems with material distribution or desire printed materials (100), Report problems with infrastructure (17), Too much class work to perform DRR activities (13), Believes it is too much information (3) |

Table A3 Results of interviews with school personnel; each activity corresponds with Table 2, e.g., A2 = DRR workshop

| Inst | Posit.    | Level | A.2 | A.3 | A.4 | A.5 | A.6 | A.7 | A.8 | A.9 | A.10 | A.11 | Triggers for DRR                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Common Problem                                                                                                                                                                                           | Important remarks                                                                                                                                                                                                                                                                                                                                              | Proposals                                                                                                                                                                                            |
|------|-----------|-------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AEF  | Sup.      | Kind. | 6   | 10  | 11  | 0   | 2   | 1   | 0   | 2   | 7    | 1    | Attitude of the leader / transmits security// Appropriate and timely information aligned with regulations// Motivation and certainty// Collectively developed and agreed upon actions// Common sense                                                                                                                                                                                                                                                                                       | How to operationalize the information in the manuals// How to access materials in difficult times// Bureaucratic overload// Problems receiving information updates// Problems documenting the experience | The experience of moving between 5 different school building for 4 years, due to structural damage caused by a big earthquake, changing the whole community perspective about the importance of DRR are well as the difficulties following standard procedures in such an unusual situation (the school kids were sent to different schools according to grade | Creation of experience-sharing materials// Creation of a special team to provide counseling and other services when faced with DRR problems// Development of better information transmitting systems |
| AEF  | Princ.    | Kind. | 1   | 3   | 2   | 0   | 1   | 1   | 0   | 1   | 1    | 1    | Leadership, passion for moving forward, sense of pertinence, and facilitation of discourse                                                                                                                                                                                                                                                                                                                                                                                                 | Bureaucratic overload// Problems related to transmission of instructions and information updates                                                                                                         | Children safety should be prioritized. Buddy system among school personnel// Learning to keep calm// The kindergarten serves poor and indigenous children, so there is a compromise in order to make children happy// Sense of pertinence and responsibility for the children                                                                                  |                                                                                                                                                                                                      |
| AEF  | Princ./T. | E.S.  | 2   | 4   | 4   | 0   | 0   | 0   | 0   | 2   | 0    | 0    | Bells and alarms to issue alerts about drills or emergencies// Frequency of drills// Feedback after drills// Promote habits                                                                                                                                                                                                                                                                                                                                                                | Few DRR activities                                                                                                                                                                                       | DRR centered mainly around drills// PIPCE remains as a normative document only                                                                                                                                                                                                                                                                                 | Comics and in-person courses are better, in his opinion, because of the experience, but should always be during regular work hours                                                                   |
| AEF  | Princ.    | E.S.  | 0   | 0   | 8   | 5   | 0   | 4   | 0   | 2   | 1    | 0    | Training through evacuation drills, working with time registers during the evacuations, and assessment of teachers// Feeling of responsibility and commitment to family and society// Experiential learning is key for responses// Being sensible about risks                                                                                                                                                                                                                              | We are not experts, but we sign the documentation anyway// Authorities' lack of knowledge about DRR                                                                                                      | Differences in criteria for operative procedures usually create friction with the community// I made the decision after analyzing the experiences of other people after the 2017 earthquake// Sarmex alarms in classrooms tend to fail and no one provides support//Security agencies' participation is a key element in schools like ours.                    | Training that includes social problems such as gun violence near the schools// Develop a small course of how to easily fix Sarmex alarms                                                             |
| AEF  | Princ.    | E.S.  | 5   | 4   | 6   | 0   | 0   | 0   | 0   | 2   | 2    | 1    | Develop and promote a culture of prevention starting with ourselves and then with our teachers and students// Prepare using drills// Feedback after the experience// Previous experience with disasters changes attitudes, making it easier to include in everyday life// Commitment of the personnel is a key element// Attitude is central for rapid response                                                                                                                            | The small number of experiential activities leads to knowledge that is quickly forgotten// Get involved in activities as an authority figure, leading by example and lowering resistance                 | In-person classes are more comfortable but online courses provide time flexibility, which is convenient for us; having both modalities is better, it was really helpful during the pandemic// We visit each classroom, providing information about DRR response protocols                                                                                      | Social issues such as informal markets are important when considering safety, so facilitating easier coordination with public agencies would be helpful                                              |
| AEF  | Staff     | M.S.  | 4   | 3   | 3   | 1   | 0   | 1   | 0   | 8   | 3    | 1    | The culture of DRR might be improved by involving all community little by little// Courses and training increase awareness, which leads to increased participation by making something mandatory into something useful// Knowledge and proximity to DRR facilitate subsequent participation// Mandatory things tend to make people feel negatively about them// Previous experience can have a strong effect on attitudes, including one's own experiences and those of people close to us | Principals are normative oriented, while teachers are oriented toward teaching techniques                                                                                                                | It takes time to get people involved in DRR, but emergency experiences can be a good opportunity to improve rapidly; a culture of DRR enhancement improves drills and involvement, particularly by including teachers and kids                                                                                                                                 |                                                                                                                                                                                                      |
| AEF  | Sup.      | M.S.  | 2   | 3   | 1   | 1   | 1   | 0   | 0   | 4   | 0    | 1    | Students explain by themselves their roles and responsibilities during drills to other children, increasing their interest in the                                                                                                                                                                                                                                                                                                                                                          | Teachers do not have time or do not want to read the materials                                                                                                                                           | Emotional support on the first month after resuming in-person classes had been very useful and important, so I have encouraged several of the schools I supervise to take the                                                                                                                                                                                  | Hire a technical counselor to make teachers review the materials in a supervised manner, giving them the                                                                                             |

| Inst | Posit. | Level | A.2 | A.3 | A.4 | A.5 | A.6 | A.7 | A.8 | A.9 | A.10 | A.11 | Triggers for DRR                                                                                                                                                                                                                                                                                          | Common Problem | Important remarks                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Proposals                                                                                                     |
|------|--------|-------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
|      |        |       |     |     |     |     |     |     |     |     |      |      | subject// Rewards such as extra points in class can greatly increase initial motivation// Leadership is a key factor for implementing activities at school, choosing the right personnel is crucial, affinity is necessary// Awareness is the first step in involvement// Direct observation in the field |                | socioemotional support course [[The intended meaning is unclear. Does this mean they worked at several schools and have reduced the number of schools they work at in order to take the course?]] //We tend to share experiences from other schools in order to overcome fears about implementing the program// Peer-to-peer learning is much better for addressing DRR// Direct observation of nature in controlled environments produces much better results than in-class training | opportunity to use the materials in a creative way// It is important t use an integrated approach toward DRR. |

Abbreviations: Inst., institution; Posit., position; A.2, activity 2; DRR, disaster risk reduction; Sup., supervisor; Princ., principal; T., teacher; Kind., kindergarten; E.S., elementary school; M.S., middle school; Sarmex., seismic alert.

Table A4 Results of interviews with authorities

| Inst.  | Position                                   | Triggers for DRR                                                                                                                                                                                                                                | Expectancy                                                                                                                                                                                                                                                                                                                                              | Important remarks                                                                                                                                                                                                                                                                                                                                                                                                                                            | Key factors for success                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Where to work                                                                                                                                                                                                                                                                                                                                                                                       | Future cooperation with other                                                                                                                                                                                                                                                                                                |
|--------|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AEF    | General director / Institutional Authority | Well-known protocols related to DRR elements (risk recognition, preparedness, etc.)                                                                                                                                                             | The strategy should be viewed as a way to incorporate elements into daily life// Participation and socialization at schools allowed kids to re-engage in normal life// In-person approach is considered by the community to be the best option for implementing the program, but adaptation due to the pandemic was both a challenge and an opportunity | The materials were constructed to be quick and easy to implement on the school grounds because they could be adapted by the teachers// Schools were represented both during the pandemic and after, one of the safest places for children to be// Including the opinions of everyone is necessary for achieving common goals such as those of DRR// Changes in regulations caused a change in how DRR measures were viewed, from administrative to pragmatic | Start with an in-person workshop, making clear the objective to develop a children centered DRR program// Materials should be available to the community all year long// Mental flexibility and the ability to imagine multiple disaster scenarios leads to better decision-making// The materials should help teachers and children to solve real problems// Socioemotional training was fundamental for the smooth resumption of in-person activities for both teachers and students// The sense of responsibility should be shouldered by everyone         | Work on better protocols// Preserve and update the present materials for later inclusion in the formal curriculum// Create mechanisms to target the root causes of common hazards around schools (e.g., problems with gas pipes, unstable structures, poor construction)// Adapt the regulations to improve the actual actions of children during emergency response based on habits and repetition | Create a calendar of DRR activities before the start of the school year// Improve protocols for school principals to coordinate with response agencies, establishing clear routes to follow// Publish a regular bulletin that delivers useful information to schools// Develop an app for schools to use during emergencies. |
| AEF    | Deputy director / Institutional authority  | Shared responsibility for risk reduction                                                                                                                                                                                                        | Regulations should be harmonized with full understanding of real-world capabilities and limitations in order to close implementation gaps                                                                                                                                                                                                               | We were in a moment of social change due to the pandemic, which led to the shift to online learning// There are DRR contents that are best taught in a practical way (e.g., first aid)// We are still in the process of recovering the school population that was scattered during the pandemic// Investment in structural reinforcement and maintenance is a priority, which needs to be followed by supervision throughout the entire process              | Diversification of responsibilities and the use of various information and communications technologies is important to reach the entire community// The management of online instruction needs to be improved// Practice is necessary to gain confidence in the process// Continuity is necessary for the success of a strategy// Socioemotional tools were needed for the resumption of in-person activities after the pandemic// Institutional commitment between agencies is necessary for quick implementation and for operational adaptation when needed | Online instruction should be continued to improve its effectiveness because the need for this modality will likely remain in some capacity// The change in regulations remains to be fully grasped by schools, so its full implementation is still ongoing// Continue to improve inter-agency communication channels                                                                                | The “Responsible official de protección civil institucional” (the official responsible for civil protection) position needs to be developed further// Educational offers should be of two types: permanent ones and ones that respond to the needs of the moment or innovations, with official recognition of the PIPCE      |
| SGIRPC | General director / Institutional Authority | Improved identification of local risks by the community// Knowledge of risks// Monitoring the phenomenon// Appropriate ways to convey the message// Response capacity                                                                           | A participatory risk atlas, if appropriately disseminated, would be a great tool for risk awareness                                                                                                                                                                                                                                                     | We first need to know the risk according to location, so establishing priority based on cartography was necessary// On-site evaluations and development of awareness leads to increased motivation// Communities have the right to know about risk information in order to create a sense of shared responsibility                                                                                                                                           | Prioritization facilitated better decision-making// We believe that the creation of an informatics platform to update the PIPCE and ensure compliance with regulations related to DRR eased the bureaucratic workload associated with the emergency response plans// Historical memory// Democratization of knowledge                                                                                                                                                                                                                                         | Improve digital systems that allow follow-up of DRR measures at schools// Ease the bureaucratic burden in relation to DRR at schools in an integrated way with all the agencies involved// To develop a service platform for DRR at the local level, it is necessary to establish proper intergovernmental regulations for state and local governments                                              | Specific inter-agency and inter-government regulations are needed to establish a service platform                                                                                                                                                                                                                            |
| SGIRPC | Legal advisor                              | Understanding the regulations enhances the adoption of actions and consequently the implementation of DRR activities// Prioritization of a practical approach for DRR rather than a knowledgeable one// Training (repetition/habits) is the key | Start with teaching what to do in emergency situations before explaining why// Regulations should respond to the social reality and propose desirable behaviors                                                                                                                                                                                         | The normative regulations for DRR were first established in 1996, so the regulations have been evolving, changing from civil protection (mainly reactive) to risk management (mainly preventive)// The creation of a legal authority (ROPC) who works as an auxiliary of the state government to increase government capabilities for supervising private schools                                                                                            | The normative spirit of the 2018 regulations was centered mainly around governance and was created in cooperation with the educational-sector authorities// Training aligned with regulations governing the appropriate DRR actors facilitates understanding of the legal framework and consequently the correct implementation on the ground                                                                                                                                                                                                                 | Improvement of specially designed regulations for schools with the aim of establishing more operative DRR principles// Create normative changes that enable the transition from reaction to prevention                                                                                                                                                                                              | Follow-up of infrastructure evaluation program for private schools by the Institute for Infrastructure Safety                                                                                                                                                                                                                |
| JICA   | Director of JICA Mexico                    | A strong self-efficacy belief in DRR response within individuals is needed first in order to promote good practices throughout the community by setting good                                                                                    | Delivery of a booklet that teachers can use to systematize their DRR approach throughout the school year// Public health and DRR should                                                                                                                                                                                                                 | Changes in mentality through knowledge and implementation can help to improve DRR response// Focusing on self-help, mutual help, and public help are pillars needed                                                                                                                                                                                                                                                                                          | The quick transmission of knowledge among countries during the pandemic highlighted areas to focus on for DRR// Awareness is key to enhancing preventive measures//                                                                                                                                                                                                                                                                                                                                                                                           | Increase the involvement of children in the design of DRR activities targeting their own communities as well as the ways in which they can deliver mutual help                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                              |

| Inst. | Position | Triggers for DRR                      | Expectancy                             | Important remarks                                        | Key factors for success                                                                                                                                                                                                                     | Where to work                                                                                                                                   | Future cooperation with other |
|-------|----------|---------------------------------------|----------------------------------------|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
|       |          | examples accompanied by professionals | be approached in a more integrated way | for moving from a reaction paradigm to one of prevention | Targeting children's education is much more effective than working with adults for improving preventive and response measures// The sharing of experiences among members of the community is a central objective for improving DRR measures | in the event of an emergency// A participatory risk atlas, used outside the schools, would greatly increase awareness and community involvement |                               |

Abbreviations: Inst., institution; Posit., position; A.2, activity 2; DRR, disaster risk reduction; Sup., supervisor; Princ., principal; T., teacher; Kind., kindergarten; E.S., elementary school; M.S., middle school.

## A Activity description

**Disaster risk reduction workshop:** This activity involved 10 hours of in-person training comprising 12 50-minute modules aimed at developing educational tools that teachers could use with their students, including videos, guides, activities, manuals, PowerPoint presentations, and descriptive charts, all of which can be found at the following URL:

[https://drive.google.com/drive/folders/1XsT-5EpncdNmXqwibUNXWTpPC-i\\_559S](https://drive.google.com/drive/folders/1XsT-5EpncdNmXqwibUNXWTpPC-i_559S)).

**Module 1:** Didactic strategies and seasonal considerations

**Objective:** To provide teachers with tools to develop lessons on civil protection and comprehensive risk management, with full consideration of seasonal changes.

**Module 2:** Democratic values

**Objective:** To encourage the promotion of humanitarian values, democratic ideals, and fundamental respect for human rights in the context of civil protection culture, with a focus on primary education as a key component in fostering proactive attitudes toward DRR.

**Module 3:** Community first aid

**Objective:** To ascertain what actions need to be taken to provide first aid in the community setting.

**Module 4:** Socio-emotional support

**Objective:** To train teachers to provide basic socio-emotional support to children and adolescents in the aftermath of a natural disaster.

**Module 5:** Emergency backpacks for children

**Objective:** To train teachers to help children make a personalized emergency backpack that is appropriate for their particular environment and circumstances.

**Module 6:** Family plan for disaster risk reduction

**Objective:** To provide a friendly home guide that helps families develop response plans at home in a systematic manner.

**Module 7:** Evacuation basics

**Objective:** To teach school personnel the basic principles of recognizing when and how to carry out effective evacuations.

**Module 8:** What to do in the event of an earthquake

**Objective:** To teach school personnel the actions to implement before, during, and after an earthquake as well as develop strategies for teaching these measures to children and adolescents.

**Module 9:** What to do in the event of a flood

**Objective:** To teach school personnel the actions to implement before, during, and after a flood as well as develop strategies for teaching these measures to children and adolescents.

**Module 10:** Fire prevention

**Objective:** To teach school personnel the basic measures for preventing fires at home and school as well as develop strategies for teaching these measures to children and adolescents.

**Module 11:** Strategies for strengthening comprehensive risk management in schools

**Objective:** To explore the available materials on comprehensive risk management so that teachers can strengthen this process in their schools with the participation of children and adolescents.

**Module 12:** WASH

**Objective:** To raise awareness in the educational community about the importance of water resources, to promote their care and preservation, to contribute to sustainable development, and to recognize the economic, social, and environmental value of the Valley of Mexico.

- **Risk management and socioemotional support at schools:** The course was developed as a 10-hour massive open online course to provide general knowledge about comprehensive risk management in schools as well as tools for teachers to provide socio-emotional support to students in the aftermath of an emergency or disaster situation, with a special emphasis placed on the importance of the teacher's role as an agent of well-being because they can transmit valuable information that encourages the adoption of self-protection measures.

Throughout the modules, the national and international regulatory frameworks are discussed with the aim of placing humanitarian actions in the educational sector in the context of school situations. Subsequently, the concept and characteristics of comprehensive risk management are explored, highlighting the importance of schools as social hubs in emergency situations. In addition, the promotion of self-care and the creation of safe spaces for children and adolescents in emergency situations are considered. Finally, teachers are trained to provide socio-emotional support to children and adolescents in the classroom setting while also providing self-help techniques for their own benefit ([https://mexicox.gob.mx/courses/course-v1:SGIRPC+GDRY21084X+2021\\_08/about](https://mexicox.gob.mx/courses/course-v1:SGIRPC+GDRY21084X+2021_08/about)).

**Syllabus:** Regulatory framework / Education and risk management / Risk mitigation in schools / Socio-emotional support / The COVID-19 pandemic

- **Preparation of internal civil protection programs for basic education in schools:** This course was developed as a 20-hour massive open online course to train school personnel to create disaster-response plans in the event of an emergency in accordance with normative regulations, with the aim of promoting risk management measures in the educational community. The course also seeks to create awareness in the community as well as promote the involvement of each member by fostering an understanding of the need to develop and implement disaster response plans (i.e., PIPCE).

The course focuses on the characteristics of the Civil Protection Internal Committee, which prepares disaster response plans and keeps them up to date, thereby promoting a culture of civil protection ([https://mexicox.gob.mx/courses/course-v1:SGIRPC+EDPI21031X+2021\\_03/about](https://mexicox.gob.mx/courses/course-v1:SGIRPC+EDPI21031X+2021_03/about)).

**Syllabus:** Introduction / Internal school civil protection program / Risk identification and analysis / Risk reduction plan I / Risk reduction plan II: Safety measures / Contingency planning / Operational continuity planning

- **Activity guides for DRR:** The guides aim to help teachers create classroom activities that teach children and adolescents about issues related to comprehensive risk management and civil protection while promoting the development of habits as well as collaboration between teachers and students that leads to the creation of effective DRR strategies ([https://www2.aefcm.gob.mx/gbm/variantes/gestion-integral-riesgos/archivos/Guia-Actividades\\_VF\\_31-08-20.pdf](https://www2.aefcm.gob.mx/gbm/variantes/gestion-integral-riesgos/archivos/Guia-Actividades_VF_31-08-20.pdf)).

**Contents:** Didactic strategies / Socioemotional support / Family DRR plans / DRR at schools / Emergency backpacks / Geologic risks / Hydro-meteorological risks / Technological and chemical risks / Health-related risks / Social risks / First aid

- **Seminar for a safe return to schools:** An online seminar was organized to facilitate exchange among public health experts, education authorities, and school communities, with the aim of promoting hygiene measures in response to the COVID-19 pandemic, thereby fostering safe and healthy school environments for student's return to school (<https://www.proteccioncivil.cdmx.gob.mx/storage/app/uploads/public/60a/d35/d51/60ad35d51b067003413071.pdf>).

**Contents:** Introduction / Route-map for a safe return / Checklists / How to involve students in the school's response to a public health emergency / Descriptive charts / Bibliography and other resources

- **The Teachings of Ollin, comprehensive risk management, and mental health:** A comic book entitled “Las Enseñanzas de Ollin” (The Teachings of Ollin) follows the Gonzalez family as they search for possible risks and effects of emergencies in their daily lives, with the aim of promoting mental health and healthy lifestyles (<https://www.proteccioncivil.cdmx.gob.mx/storage/app/media/ollin-el-chapulin/comic-interactivo-ollinf5pdig.pdf>).

**Contents:** Spheres of comprehensive risk management / How we react to emergencies / What we can do to feel better / How to look after children during emergencies / Mental health during the COVID-19 pandemic / Problems identified close to the end of the school year

- **What schools should do after a public health emergency: Lessons from the Japanese experience in implementing risk and disaster education:** The activity was a 2-hour-long online seminar on educational settings organized by Japanese experts from Hyogo University.

**Contents:** The COVID-19 pandemic in Japan / Effects on children’s mental health / What can be done to help children to feel better

- **Guide and formats for creating a civil protection internal program at school:** This guide helps schools to create emergency response plans using the official formats required by law ([https://www.aefcm.gob.mx/normateca/disposiciones\\_normativas/UAF/archivos-2021/2021-06-01/GEPIPCE.pdf](https://www.aefcm.gob.mx/normateca/disposiciones_normativas/UAF/archivos-2021/2021-06-01/GEPIPCE.pdf)).

**Contents:** What is the PIPCE? / Legal framework / How to use the 22 official formats / Risk analysis and response plans

- **Family response plan guide:** This manual helps families to create home-centered emergency response plans (<https://www.proteccioncivil.cdmx.gob.mx/storage/app/media/Plan-Familiar-web-ok-2022.pdf>).

**Contents:** Family characteristics / Risk detection / Where to take shelter / Drills / Assigning responsibilities to each family member

- **Mexico City Risk Atlas:** This tool allows people to identify local risks using georeferencing and other types of information. (<https://www.atlas.cdmx.gob.mx/principal/inicio>).

**Modules:** Risk indicators for minimal statistical areas / Risk and exposition analysis / Emergency records / Chemical emergencies / Gender indicators / Markets / Phenomenological follow-up.