

Success, Innovation and Challenge: School Safety and Disaster Education in South America and the Caribbean

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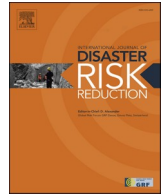
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Success, innovation and challenge: School safety and disaster education in South America and the Caribbean

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ABSTRACT

Authors discuss school safety and disaster education in Brazil, Colombia, Cuba, the Dominican Republic, Jamaica and Puerto Rico. Case studies explore work to increase understanding of natural hazards and disaster preparedness. Puerto Rico offers innovative examples of reflection on memories of Hurricane Maria by primary students and university undergraduates. From Brazil comes description of work in schools to develop curriculum skills and research competencies at high-school level. The Brazilian scheme encourages schools to become producers of knowledge rather than reproducers of centrally disseminated information. Another case study focuses on efforts to protect university buildings in Colombia. The rich landscape of policy, practice and experience in South America and the Caribbean is informed by a model of the three pillars of Comprehensive School Safety: 1. Safe Learning Facilities, 2. School Disaster Management, and 3. Risk Reduction and Resilience Education.

1. Introduction

Ben Wisner.

Students are safer in schools across the Americas and learn more about hazards and preparedness than two decades ago. Schools are getting safer, and school administrations have better safety plans. These are strong generalizations, but with the sort of exceptions and remaining challenges presented by my co-authors and validated by my own observations since I wrote *Let Our Children Teach Us* in 2006, there is support for such optimistic statements [1].

I am proud to have been trusted by my co-author-compañeros/as and friends to edit the following contributions into a snapshot of successes, innovations and challenges in four Caribbean and two South American

territories. These territories were chosen largely on the basis of opportunities offered by professional networking; however, the range offers a reasonable glimpse of the current state of work on several aspects of school safety. There are both large and small countries represented as well as a range of types of government, cultures and languages. Each contribution provides insight into one or more of several aspects of school safety: the physical integrity and security of school buildings and their sites, schools' role in active-learning and community-school relations, and schools' safety planning and emergency preparedness. All the six are signatories of the *Sendai Framework for Disaster Risk Reduction 2015–2030* (SFDRR) and the *Sustainable Development Goals*, and five are signatories to the *Caribbean Safe School Initiative* [2]. Puerto Rico is an unincorporated territory of the United States (Commonwealth of Puerto

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Rico), the latter being a signatory to the SFDRR.

1.1. Successes and innovations

The panorama of success includes a commitment by education authorities to school safety and disaster-related instruction as well as development of institutions and resources to turn these ideals into reality. The concept of safety has been broadened to include natural hazards such as earthquake and hurricane and anthropogenic hazards such as toxic chemical releases near schools, social hazards such as gang violence, and critical events with implications for psycho-social well-being of students and staff such as suicide, mentioned in the Jamaica case study. Awareness of discrimination and inequity is growing. Access to safe educational facilities for children and youth living with disabilities, for girls and for migrants, foreigners, and other marginalized groups is at least a topic of discussion if not yet a universal action agenda item.

Many resources are available for planning and curriculum development, often produced and shared with assistance from national and international non-governmental organizations, bilateral development partners, international and UN organizations. Innovative methods are being used, such as storytelling in Puerto Rico and co-production of knowledge by students and community members in Brazil and Cuba.

Physical safety of locations and structures have benefited from more detailed mapping and engineering studies. National building codes have been revised, as the example from Colombia shows, inspection and maintenance regimes have been put in place, as in Cuba. Precaution now also extends to moving schools, also in the Cuban case study, something that may become more common as sea levels rise. Colombia has shown that ambitious programs of school safety assessment and retrofitting can be financed if political will exists.

1.2. Challenges

The challenges recognized by my co-authors mostly deal with major contextual or structural issues. Changes of political administration can halt, interrupt or delay progress if the new authorities do not prioritize disaster risk reduction in education or retrofitting, situations described by my Brazilian and Colombian colleagues, respectively. The failure of continuity and deep penetration of even well-conceived programs into the administrative structure and into the entire territory is a problem that most document, in both large and small territories (e.g. Brazil and Dominican Republic). Funding for public education and for public investment in disaster risk reduction is problematic in a globalized economy in the face of strong incentives for privatization. This point is made in the case study from Puerto Rico, but it is a story that could be repeated throughout the region, where geopolitics also may complicate investment and funding as in Cuba and Venezuela.

Much has changed since I surveyed the education and disaster scene in 2006, but much is the same. Earlier, I identified four obstacles to progress [1]: 6):

- governance failures;
- poverty traps;
- existence of pockets of poverty;
- specific areas of policy neglect.

I noted that progress comes when movement takes place both from top-down and bottom-up. Governments have put a variety of reasonable institutions into place; however, to make sure they function, it is still necessary, as I wrote in 2006, for “[p]ressure ... to flow from civil society – from teachers’ unions, parents, community leaders and professional associations” (p. 6).

2. School safety and disaster risk education in the Dominican Republic

Lourdes Meyreles.

In 1998, Hurricane Georges affected half of the Dominican Republic, killing more than 200 people, destroying thousands of homes, devastating crops [3]. Schools were damaged and destroyed by wind, flood and mudslides. This catastrophe focused authorities on disaster, and by 2002 there was a law in place organizing a national system for disaster risk management (DRM) [4]. However, it took another decade to give priority to school safety and the optimum use of the education system for the security of Dominican society.

2.1. Hazard and exposure background

The Dominican Republic (DR) shares the Caribbean island of Hispaniola with the Haitian Republic. Islanders are exposed to earthquake hazard and to multiple climate hazards such as hurricanes and drought. These two countries have been high on the list of those most impacted by extreme climate events [5]. A recently developed vulnerability index measured adaptive capacity of households to extreme climate events by analyzing quality of housing, income and exposure to hazards due to location [6]. Thirty percent of Dominican households were highly vulnerable to climate events. The Household Social Survey 2017 corroborates these findings. At the national level, this survey states that 17% of poor households are located near a hazardous zone such as a river, creek or ravine and thus are vulnerable to landslides and floods. In urban areas, 22% of homes were exposed and in rural areas 14% [7].

2.2. DR’s education system

Public education is organized into 18 regions and 122 school districts with 6054 facilities. There are approximately 2.5 million students, of which 73% are in the public sector. Regarding inclusion, children with disabilities and those of Haitian descent or nationality as well as undocumented children still face problems in accessing the education system [8]. One study of northern DR found that access for mobility-challenged students was deficient in 58% of schools in Epailat Province and 49% in Santo Domingo Province [9]. Children attending school in poor urban areas face overcrowding due to lack of schools and classrooms.

A high percentage of schools in the Dominican Republic are exposed



Fig. 1. Earthquake preparedness drill, Dominican Republic. SOURCE: Ministry of Education, Dominican Republic <http://ministeriodeeducacion.gob.do/comunicaciones/publicaciones/con-simulacro-minerd-busca-crear-conciencia-en-estudiantes-y-docentes-ante-posibles-catastrofes>.

to climate-related and seismic hazards. Hurricanes and tropical storms affect 37% of recently surveyed school centers; flooding can affect 30%; thirty-seven percent are exposed to medium or high seismic hazards; 12% are susceptible to fires,² and 6% are exposed to tsunamis [10]. There has been a “build more schools” policy due to demands by civil society and rapid construction of many school centers over the past ten years. The speed of construction is partly responsible for exposure of schools to hazards due to poor quality work and imprudent location decisions.

2.3. Policy and planning for school safety

The Dominican Republic is a signatory to the SFDRR as well as the Sustainable Development Goal (SDG) Global Agenda. The General Law for Education encourages evaluation and management of, and teaching about, natural hazards [10]. Disaster risk management (DRM) is regulated by Law 147-02, which mandates the inclusion of DRM concepts in education at all levels [4]. The National Disaster Risk Reduction (DRR) Plan includes the education sector [11]. The National Seismic Risk Reduction Plan requires the educational sector to prepare infrastructure and build capacity regarding seismic risk [12] (Fig. 1).

The Ministry of Education took a major step in institutionalizing DRR in the educational sector in 2016 by creating the General Office for Environmental and Risk Management responsible for “reducing

Box 1

The Dominican Republic school center safety index

The School Safety Index: Evaluators Guide (in Spanish, *Índice de Seguridad Centro Educativo: Guía del Evaluador*)¹ was launched in 2014 by the Ministry of Education. It was based on a tool developed by WHO/PAHO and then modified for use in Guatemala (giving an interesting glimpse of cross fertilization within the region).

The tool analyzes different variables:

- General information on the school center
- Environment of the school (e.g. geological and climate hazards)
- Social hazards (e.g. violence, delinquency, drug abuse, child labor issues)
- Structural elements (e.g. quality of the construction)
- Non-structural elements (e.g. use of space, electrical installations, gas installations)
- Functional elements (e.g. DRM and emergency plans, sustainability of prevention plans and procedures)

The tool ranks the level of safety of the school center and suggests actions that should be taken. Rankings and actions fall into three categories:

- Low security: Immediate intervention
- Medium security: Short term intervention
- High security: Maintenance

Source: Author.

¹ <http://www.ministeriodeeducacion.gob.do/docs/direccion-general-de-gestion-de-riesgos/cBU0-guia-del-evaluador-indice-de-seguridad-centro-educativo-rd.pdf>.

² Some because of improper storage of propane used for cooking or inadequate fire-fighting equipment, others because of locations exposed to forest fires.

vulnerability levels in the education sector through technical training and intra and inter institutional coordination” [13]. Other important administrative steps have been the creation of an Inclusive Infrastructure Department to eliminate barriers that impede universal access to education and the School Intervention Program for Emergency Situations to facilitate rapid response and adaptation of school buildings as shelters.

2.4. Resources for assisting and assessing disaster education

A study of existing DRM tools was carried out in 2017 [14]. It found that the educational sector was ahead of health and local governments in developing DRM tools. Mostly developed between 2010 and 2014, these tools were directed at curricular development and guides for School DRM and Emergency Plans.³ Of the 22 tools analyzed, 11 dealt with curricular development or teacher training. One tool is the Dominican Republic School Center Safety Index: Evaluator’s Guide [15]; Box 1). Despite its importance, only 48 schools evaluated its use by 2016, in four of the country’s 32 provinces [14].

The implementation of guides for developing curriculum and school DRM plans has had a positive impact. In 2016, sixty-five percent of schools reported they have a School DRM Plan, according to Ministry of Education informants [14].

2.5. Successes and challenges

Successes include a major change in the culture of the Ministry of Education. Traditionally the ministry has thought of school safety as a matter of order, tranquility and the absence of violence. This definition has broadened to include other aspects of safety and security. Where applied, resources for development of school plans and for teaching have produced good results including preparedness drills (Fig. 1). Teachers and school administrators interviewed by Meyreles and her colleagues said a number of things suggesting a perception of positive change: “Schools have a better perception of risk and the role that education plays in promoting a culture of resilience in the education community”; “School communities understand the importance of risk planning”; “Children and adolescents can teach their families what they’ve learned” [14].

Existing challenges for DRR fall in line with those recognized by UNESCO [16]: inadequate investment policies and development practices as well as problems with location and quality of school infrastructure. Tool development has advanced but their use is limited. The tools also lack a gender and inclusive perspective. This applies also to DRM curricular implementation and teacher training activities. Another challenge is structural safety. Seismic activity in 2018 and 2019 left twenty-five schools damaged [17]. Recent hurricanes Irma and Maria affected 109 and 204 public schools, respectively [18]. School exposure to hazards is tightly coupled with gaining access to land for safe school locations, weak institutionalization of the sector, slow bureaucracy, infrastructure issues such as frailty and deterioration, lack of human resources and funds, as well as poor implementation of school DRM plans [8].

3. Jamaica: approaching school safety and student security holistically

Barbara Carby.

In 2004, Hurricane Ivan passed to the south of Jamaica. Although this was not a direct hit, some 334 of 1004 schools were damaged of which two were destroyed, and 301 required repairs. Approximately

³ Eight of these tools may be viewed at <http://www.ministeriodeeducacion.gob.do/sobre-nosotros/areas-institucionales/direccion-general-de-gestion-am-biental-y-de-riesgos/manuales>.

33% of students enrolled in public schools were affected. In the aftermath, some schools sustained indirect damage from use as emergency shelters. In Tropical Storm Nicole (2010), 147 schools were damaged. However natural hazards are only part of the threat faced by students. The education authorities have grown increasingly concerned about security threats to students in schools. Among these are the presence of drugs and weapons, bullying, gang culture and the inappropriate use of information and communication technologies. Anti-social behavior is also a concern in the wider society where violence against children causes deaths and injuries.

The Ministry of Education, Youth and Information (MOEYI), in partnership with the Ministry of National Security (MNS) and the Jamaica Constabulary Force (JCF), have developed a School Safety and Security Programme which includes management of natural and anthropogenic hazards. According to the MOEYI one of the aims of the program is to engender a culture of safety and security in educational institutions. It encourages schools to incorporate safety and security as one of the management functions of the institutions. The idea is to create a safe space in which children can learn [19].

A comprehensive set of policy guidelines related to safety and security has been developed:

- Security and Safety Policy Guidelines;
- Field Trip Policy Guidelines;
- Safety Guidelines for Contact Sport;
- Guidelines for Management of Hazardous Materials and Equipment and the Disposal of Hazardous Waste;
- Guidelines for Developing a Critical Incident Management Plan for a Safe School Environment.

The last-mentioned includes guidelines for developing plans for a variety of natural and anthropogenic hazards and emergencies including flooding, earthquakes, hurricanes, suicide, unauthorized entry to school premises, and unauthorized removal of students. In addition, there is a template for a School Emergency Preparedness and Response Plan. The template includes guidelines for developing emergency plans as well as establishing a calendar of events such as drills and exercises (Fig. 2).

A number of initiatives have been developed which are aligned to the Safety and Security Program and which aim to reduce indiscipline and promote harmony in schools. In 2015, a School Wide Positive Behavior Intervention and Support Program was created which sought to address social behavioral and emotional difficulties before the situation becomes critical [19–21].

The physical safety of school buildings is also taken into account. MOEYI signed a contract with the University of Technology in Jamaica to carry out inspections of school structures. The inspections are part of a wider programme to integrate disaster risk management into design, planning and management of school infrastructure. The programme will assess risk, structural and infrastructural needs of 971 public schools. Results will be used to inform prioritization of infrastructure investment in schools [67].

The legal framework for these initiatives is the 2015 Safe Schools Act. A Safety and Security Unit within the MOEYI coordinates school safety and security. The JCF has also established a Safe Schools Program under which there are designated School Resource Officers who support schools with their safety and security. Schools are expected to establish Safety and Security Committees as part of the school governance structure.

The approach used by MOEYI is holistic. It involves partnerships such as with the JCF in training school safety personnel who visit schools to speak with students and staff as part of a pro-active approach. The emergency plan template calls for the participation of students in development of school disaster preparedness plans. All guidelines emphasize importance of involving partners in planning. These include the local disaster office, police, health services, community organizations and parent-teacher associations. Furthermore, the MOEYI

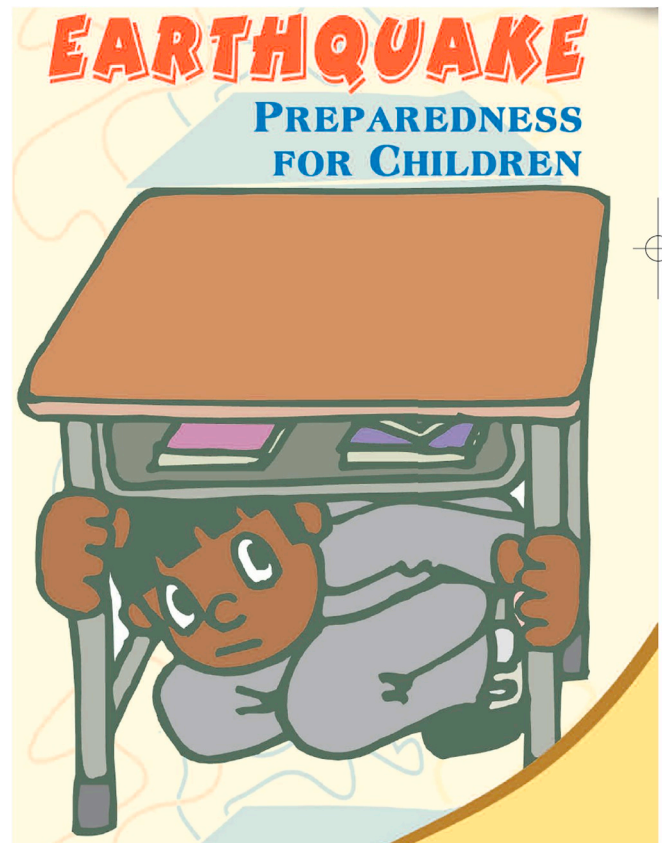


Fig. 2. Jamaican government brochure “Earthquake Preparedness for Kids”. SOURCE: http://www.odpem.org.jm/Portals/0/PDFs/Earthquake_Children_Brochure.pdf.

emphasizes the importance of integrating the safety and security programs into school management and administration. Schools are required to include safety and security in their annual reports.

3.1. Successes and challenges in Jamaica

Though well-conceived, the School Safety and Security Program has not been carried out without challenges. At this writing, there is no monitoring and evaluation framework available for assessing the programme. The MOEYI states that more than 85% of schools reported having established Safety and Security Committees, but it is uncertain about their current state of progress. The ministry is now in the process of collecting data. No data is therefore currently available on compliance nor on the status of schools under the inspection programme which would indicate the structural integrity of buildings and compliance with the building code. Nevertheless, discussions with the MOEYI indicate that it considers the programme to be successful in the following areas:

- establishing of minimum standards;
- provision of guidelines for meeting minimum standards;
- encouraging planning for emergencies;
- ensuring better student safety;
- allowing schools to spend more time on teaching and learning and less on disciplinary matters;
- sensitising children to safety issues, who can then influence parents and the wider community.

4. Disaster education and safety of schools in Cuba

Enrique Castellanos.

In Cuba education is free and universal for all levels up to the PhD.

The government considers education to be a high priority. In 2019, education received the 23.7% of the national budget [22]. Beginning in the 1960s, the government established a national program to eliminate illiteracy and then continued to promote increasing the minimum educational level. Nowadays the compulsory minimum level is 9th grade, hence education is mandatory up to 15 years of age.

Over the decades, this system has had a positive impact on disaster reduction. As a result of Cuba's high level of educational attainment, people can understand natural phenomena, can read newspapers and have the ability to process instructions on how to reduce vulnerability. Such broad deep preparation of the population for hurricanes in particular is both necessary and difficult in a situation where the schools themselves are often severely affected by storms. In 2008, Hurricanes Fay, Gustav, Ike and Paloma hit the country in different areas [23], more than 4300 schools were affected, and educational activities were interrupted [24].

4.1. Disaster education

In Cuba, education and educational infrastructure are seen as important elements of disaster reduction [24]. Disaster reduction is included in the National Educational System (NES) which has a place in the integrated national system of disaster management.

The NES carries out this role by:

- teaching main characteristics of different hazards and how to protect oneself and others;
- providing understanding of the importance of civil defense for the preservation of life, the economy and the environment;
- developing knowledge of the impacts of natural hazards such as tropical storms, tornadoes, lightning, coastal and riverine flooding, earthquakes, rural fires and droughts;
- teaching about diseases affecting human beings, plants and animals, and prevention measures.

Civil defense teaching programs also encourage students to analyze in detail local natural conditions that might expose people to a natural hazard such as a town located close to a floodplain or in a high seismic risk zone. The instruction uses many pedagogical tools and methods including games and competitions. In one case, a high mountain school had a rain gauge and radio which they use to call down the river valley to report periodically the rain level as a contribution to flood hazard warning.

These programs are taught in grades three (about 8 years old), five (10 years old), eight (13 years old) and eleven (16 years old), in the second year of technical training courses (electronics, metallurgy, agriculture, etc.) for 16-18 years-olds, and in the last semester training of artisans (carpenters, plumbers, etc.). Teachers in the pedagogical universities receive preparation in civil defense. Day care centers carry out practical exercises, games and environmental activities with children. At every level, civil defense teaching is integrated with the other subjects such as Spanish, mathematics, physics, natural sciences, history and so on, depending on the level.

4.2. Schools as shelters and school safety

Schools serve as the main temporary shelter for people due to their stronger construction. People shelter there before the hazard strikes and during the first days of the recovery period. Therefore, schools are built for this purpose, and they are prepared to store supplies, have independent power plants, and can accommodate health services provision. The government is aware of the tension between shelter provision and educational continuity, and it attempts to limit the time schools are used as shelters to a minimum whilst also providing for continuing education in various ways. For example, after the series of four hurricanes in 2008, undamaged private houses were used as teaching facilities, thus allowing continuation of educational activities for about 17,000 students within a few days of the storms. Families in these private houses received a medal



Fig. 3. Aerial photos of school complex at Guanabo, 2002 and 2019. SOURCE: Google Earth.

from the Council of State afterwards, recognizing their support of education. In addition to continuity in education, there is concern for the full psycho-social wellbeing of students who have experienced a disaster. In 2018, UNESCO and UNICEF supported publishing a manual to guide post-disaster socio-emotional support at schools [25].

Directors of schools are responsible for civil defense. They carry out disaster reduction planning and develop activities during the year for disaster preparedness such as drills with teachers and students. The Ministry of Education carries out construction and maintenance work at schools according to an annual plan. This includes re-locating schools if risk assessment concludes that a location is unsafe. That was the case of the school close to the sea at Guanabo, a town 25 km east of Havana. Fig. 3 shows how the school complex has been invaded by sea level rise and coastal erosion.

4.3. Successes and challenges

Cuban authorities have been investing in education and the National Civil Protection System for about 60 years. Society has received the benefits of this investment, witness the small number of casualties when disasters strikes [26]. The National Education System has been successful in building stronger schools which provide protection not only for students and teachers but also for the local population when there is a need. Cuban education follows six principles [27]. Among these are several that facilitate the integration of DRR into education. Universal, free and equitable access to education has already been mentioned. This produced the high level of adult literacy and understanding that partly explains the response of residents to warnings and preparedness activities. The principle of combining theoretical and practical learning (study and work) provides the philosophical basis for grounded instruction in civil protection and hazards. The principle of democratic participation of all society in education explains why disaster education puts students in contact with community members. Finally, the principle of co-education and diversity means that the considerable potential of girls and young women as leaders is fully realized in DRR activities during education and afterwards.

Reducing physical vulnerability remains a challenge for Cuban schools. Although there is much maintenance and repair work carried out, the number of schools affected by each extreme meteorological event is high. The economic, financial and commercial blockade by the US government constrains the ability of Cuba in the construction sector, thus affecting the rate of school repair, new school construction and retrofitting, as well as creating a backlog of home reconstruction after storms [23]. The embargo also affects education in Cuba because of the ban on import of teaching material. For example, Braille typing machines for schools for children with impaired vision cannot be imported [28].

5. Hurricane Maria in Puerto Rico

5.1. Storytelling as social memory, reflection and healing

Tania López-Marrero with Ben Wisner.

On September 20, 2017, Hurricane Maria made landfall in Puerto Rico as a powerful category-4—almost category-5—hurricane with winds of 155 mph. Nearly 90 years had passed since the island had been hit by a hurricane with winds of such magnitude (a category-5 hurricane in 1928 known locally as San Felipe II). After Hurricane San Felipe II, Hurricane Maria is the second most intense hurricane to affect the island. Hurricane Maria's trajectory, from southeast to northwest, caused massive destruction on the island. Winds, floods, and landslides led to the collapse of telecommunications, roads and buildings; to the breakdown of basic services such as water and electricity for months (more than a year, in some communities); to agricultural losses; and to changes in the landscape. Nearly 3000 people died as a direct and indirect consequence of the hurricane [29].

Here follow two examples of storytelling to capture social memory of an extreme event and to help provide students with insight, healing and closure, or at least to encourage these processes. Storytelling is a well-established technique for helping children re-establish normalcy and give meaning to events such as the hurricane [30,31].

5.1.1. Storytelling by university undergraduates

On August of 2017, a group of undergraduate students from the University of Puerto Rico at Mayagüez and the first author began to work on a project about natural hazards and disasters in Puerto Rico: *Proyecto 1867: Desastres y memoria en Puerto Rico* (www.proyecto1867.com). The project was developed within the framework "social memory", a concept that refers to the accumulated experiences and lessons learned from disasters [32–34]. At the time, almost 20 years had passed since the island had experienced a direct hit by an intense hurricane (Hurricane Georges in 1998), and we were close to the commemoration of the century of an earthquake and tsunami that greatly impacted the western coast of the island in 1918. The low frequency of extreme natural events and associated lack of experience are two factors that can increase people's vulnerability to hazards [35, 36]. Within this context, the project had the following goals: to document past disasters, identify lessons learned from their occurrence, increase awareness about hazards exposure, and promote a dialogue about the importance of hazard and disaster awareness and preparedness. We emphasized that, although Puerto Rico had not had an intense hurricane, earthquake or tsunami for a long time, we were not exempt from them due to the island's geographic location and its geologic situation.

Hurricane Maria made landfall in Puerto Rico about two months after beginning the project. It was one of those extreme events we used to refer to while conceptualizing the project but that none of us had ever experienced. After Maria's passage, a new element was added to the project: the students would document their experiences related to the hurricane and, with this, contribute to the social memory of the event. They became actors and producers of information and knowledge. This resulted in the publication of *Un cambio categoría 4: Memorias del*

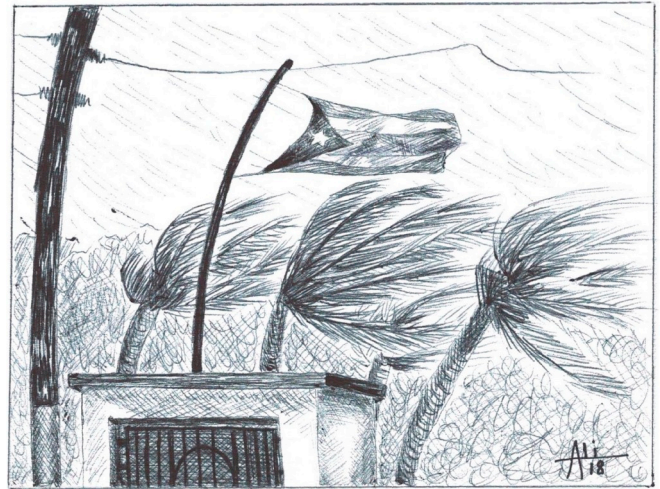


Fig. 4. "Resistiendo el huracán" (Resisting the hurricane). SOURCE: López-Marrero et al. (2018: 37)

huracán María [37],⁴ a book that contains the experiences and memories of 15 students before, during and after the hurricane (Fig. 4).

Writing their memories resulted in a process of learning and reflection at different levels. Despite feelings of sadness, anxiety and despair, they recognized positive aspects: unity among family and friends, acts of solidarity and mutual help, community self-management. The experience suffered by the students also promoted their reflection on the wider historical, social and political context that triggered the disaster. They also reacted to how the local and federal government handled the situation after the hurricane. They were critical of the slogan adopted by the Puerto Rican government "*Puerto Rico se levanta*" (Puerto Rico rises up) by stating that "*Puerto Rico siempre estuvo de pie*" (Puerto Rico was never laying down). This reflects peoples' resilience and perseverance, not just vulnerability.

Each writing includes a drawing that exemplifies a key point students wanted to transmit to the reader. (Drawings by Isabel A. Escalera García.)

The book, *Un cambio categoría 4*, shows how the concept of social memory is put into practice: what was learned as a result from the hurricane, new experiences, new knowledge and better understanding of the physical and social environment wherein people live and in which a hazard may become a disaster. It also is a reference point for future generations and a source of information to assist and promote preparedness for intense hurricanes that future cyclonic seasons influenced by climate change may bring.

5.1.2. Storytelling by fifth & sixth graders

Children are one of most vulnerable groups in the aftermath of a disaster. Damage, loss and disruption to their daily activities are just some factors that result in feelings of anxiety, confusion, sadness, fear, and sense of insecurity [38]. They are, moreover, among the groups that are least heard after disaster occurrence. Their concerns and experience with the disaster, and their coping mechanisms (or lack of them) are oftentimes overlooked in the surrounding chaos and preoccupation of parents or guardians with response to the event.

The passage of Hurricane Maria over Puerto Rico had a strong impact on the island's 350,000 school students, whose education was disrupted by the storm for weeks, in some cases even months. In addition, some 60,000 were further disrupted by the government's decision to cut the education budget as part of the response the Puerto Rico's large debt,

⁴ Available for download at: <https://www.proyecto1867.com/un-cambio-categoria-4.html>.



Fig. 5. Students from Las Mareas and their *Kamishibai* stories.
SOURCE: Fernando Silva (InCiCo).

resulting in the closure of 263 of its 856 schools [39,40]. All students faced post-disaster uncertainty as well as the disruption of a reorganization involving reassignment of students and teachers to other schools.

In an effort to help the students cope, a group of local non-governmental organizations partnered with a primary public school to work with children in their recovery process after the hurricane. They used *kamishibai* (also known as *teatro de papel*), a story-telling technique originating in Japan in which the narrator uses illustrations as he or she narrates the story.⁵ The activity took place with 5th and 6th grade students in *Las Mareas*—a community in the southern municipality of Salinas, Puerto Rico, in the zone of hurricane landfall. The purpose was to provide an opportunity for children to creatively express themselves in the aftermath of the hurricane⁶ (Fig. 5) (also see Fig. 6).

Through the process of developing the illustrations and script for their story, students were able to express their emotions and experiences during and after the event: their fear of the sound of wind and rain, their concerns whether their houses would resist the force of winds, their anxiety watching the entrance of sea water into their community, the anxiety caused by evacuation and the fear of losing a family member or a loved one. They also expressed the sadness of losing their means of recreation (as was the case of a boy that expressed deep sadness for losing part of his baseball equipment and seeing his dream of becoming a professional player vanish). Many of them were also able to express their relief with a “happy ending” to their stories: knowing that their home was not destroyed, that their parents were safe, witnessing family and community action for recovery after the hurricane, and that “a good soul gave that boy a new ball and bat”.

Oral, visual, and written activities have been cited as important participatory tools for disaster risk reduction, and particularly for working with children [41]. *Kamishibai* proved to be an effective tool not only to allow children to express their concerns and feelings but to allow documentation of their experience and thus create part of the social memory of Hurricane Maria. Moreover, the activity allowed children to share their thoughts with each other. It promoted children’s involvement, confidence (through public speaking, for example), and creativity

⁵ The author would like to thank Fernando Silva of *Instituto de Ciencias para la Conservación de Puerto Rico* (InCiCo) for providing information about the project *Kamishibai en Las Mareas*. The activity was conducted by Tere Marichal with the collaboration of InCiCo and Jacqueline Vázquez a *Las Mareas* community leader. On *kamishibai*, also see “Kamishibai for Kids” <http://www.kamishibai.com/index.html>.

⁶ See the video *Kamishibai en Las Mareas*, available at: <https://vimeo.com/265133581>

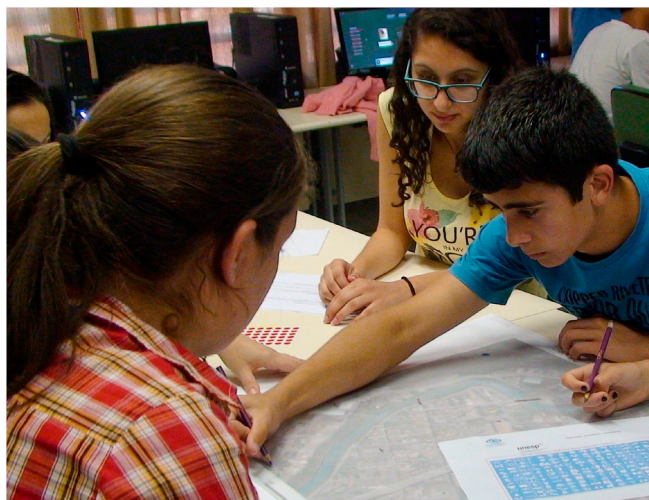


Fig. 6. Students working on flood hazard mapping.
SOURCE: Authors.

in difficult times. For adults, it was also a learning process that allowed awareness of children’s needs, feelings, and experiences.

5.1.3. Successes and challenges

The usefulness of storytelling has been well established in the literature and has been successfully used in Puerto Rico following Hurricane Maria. More recent initiatives have also documented peoples’ experience with the hurricane as a way for allowing their voice to be heard and, at the same time, to create repositories of histories and memories of the hurricane.⁷

A catastrophic event may become what De Vries [42] refers to as a “permanent marker,” a point of reference to which people will refer and to which they will compare other events or disasters. These permanent markers can contribute to a disaster-based social memory and can help to assess how people understand past events, where information comes from, and how it influences preparedness and planning in the face of future events. In schools, and elsewhere in Puerto Rico, Hurricane Maria will probably become a permanent marker regarding hurricane-related hazards and disaster preparedness and response. However, some researchers think the knowledge acquired in past disasters can be a “double-edged sword” for public preparedness if future disasters exceed the magnitudes experienced of past ones [43]. Emphasizing extreme events can also negatively influence people’s preparedness if they distract attention from intense events (such as tropical storms and less intense hurricanes) and non-land-falling cyclones [44]. These “minor” cyclones or the ones passing at a distance from a territory can—and have—caused significant damage and losses in Puerto Rico.

The closure of a quarter of the schools and moves by the government to allow school vouchers and charter schools may threaten the entire public education system. Some have argued that disasters such as Maria and other shocks offer ideological opponents of public services including public education a chance to step into the resulting uncertainty and instability with proposals that privatize services [45–47]. Whatever the case, budget and staff cuts due to austerity, along with stipulated rigid curricula of the Department of Education, will make more difficult to promote safer conditions in schools and to institutionalize storytelling of this kind into the education system. At the university level, innovative approaches to undergraduate teaching might also suffer under similar situations of budgets cuts and teaching constraints.

⁷ See, for example, *Listening to Puerto Rico*, at: <http://listeningtopuertorico.org/>.

6. Brazil: between student enthusiasm and politicians' apathy

Viviana Aguilar Muñoz, Victor Marchezini, Débora Olivato, Rachel Trajber.

6.1. Introduction

In January 2011, more than 1000 deaths were reported in the mountainous region of Rio de Janeiro during flash floods and mudslides, the worst disaster of Brazilian history. In response, in August 2011, the Brazilian government launched the National Plan for Risk Management and Disaster Response (2012–2015), which divided the responsibility among several ministries including the National Civil Protection agency (Ministry of National Integration), the National Monitoring and Early Warning Center - Cemaden (Ministry of Science, Technology, Innovation and Communication), the Geological Service - CPRM (Ministry of Mines and Energy) and Ministry of Cities. At that point, there was no mention of the Ministry of Education.

Some months later, the Brazilian government enacted the Law of the National Policy for Protection and Civil Defense. Among other provisions, it establishes national guidelines for disaster education, stating in article 29: "The curricula of primary and secondary education should include the principles of civil protection ... and environmental education in an integrated way..." [48]. Likewise, the National Curricular Guidelines for Environmental Education recommend "the revision of fragmented school practices ... and the establishment of relationships between climate change and the current model of production, consumption and social organization, aiming at the prevention of environmental disasters and to the protection of communities" [49].

Based on these recommendations, in 2014 the National Monitoring and Early Warning Center (Cemaden) began a project called "Cemaden Education: Network of Schools and Communities for Disaster Risk Prevention".

6.2. Risk reduction and resilience education

The Cemaden Education project develops curriculum skills and research competencies at schools located in cities with areas exposed to natural hazards. A goal is also to contribute to creating disaster awareness in the context of environmental education. The project is centered on three sets of activities:

- Citizen Science – research methods for local data collection, analysis and sharing of results. The approach encourages schools to become producers of knowledge. Through hands-on participatory learning activities, the project encourages young people to "learn by doing".
- Information Sharing – through a collaborative system (crowdsourcing) among participating schools via the project website (<http://educacao.cemaden.gov.br>) and a phone app.
- Commissions for Disaster Prevention and Life Protection – *Com-VidaAção* (see Box 2 below) promote the idea of participatory management led by students and involving the school, its community, civil defense and other social groups for local interventions and disaster risk prevention.

Table 1 summarizes the activities that students' research groups developed in two schools located in the Paraíba Valley (São Paulo state) in collaboration with community members. For example, in Cunha town, the high school divided its more than 900 students into research groups. One involved evaluation of school building infrastructure. After students learned the methodology, they decided to evaluate other school buildings and a kindergarten in their town. They produced a report and gave it to the municipality. Another project identified flood-prone and deforested areas. After studying the risks, students decided to act. They contacted the local NGO "Serra Acima" which has a tree nursery, and they started to do reforestation activities in the areas they previously mapped. Another group learned to measure rainfall and the threshold (mm per hour) above which a landslide is more likely. Seeing their

Box 2

Mobilization and Involvement of different actors: Com-VidaAção and campaign

Com-VidaAção - Commission for Disaster Prevention and Protection of Life.

These Com-VidaAção Commissions are groups that involve representatives of the school (students, teachers, employees, managers), community, civil defense among other social actors for the participatory management of transformative interventions in the community (e.g. small local risk prevention projects). The outcomes and innovations generated by knowledge that is produced allow the communities where schools are situated to take more informed actions and co-develop systems for disaster risk reduction.

The **#LearnToPrevent Campaign** celebrates International Disaster Reduction Day, held every 13 October and aims to encourage school communities to reflect on disaster risk and reduce their exposure. The National Campaign is coordinated by Cemaden and stimulates schools to join efforts with partners such as the local office of civil defense, universities and NGOs to build and strengthen the protection of their communities through ERRD - Education in Disaster Risk Reduction.

The National Campaign has been held three times, in 2016, 2017 and 2018, and the number of participants has steadily increased. The first campaign had the theme "Education in Disaster Risk Prevention", and received 53 projects from schools in five states, and 36 municipalities (<http://educacao.cemaden.gov.br/aparteparaprevenir2016>). The theme of the second campaign was "Education in Risk Prevention of Socio-Environmental Disasters", and involved schools and civil defense units that prepared and sent 67 projects from 14 states and 50 municipalities (<http://educacao.cemaden.gov.br/aparteparaprevenir2017>). The third round had the theme "Water [2much + or 2little -] = Disaster?" (*Água [D+ ou D-] = Desastre?*), and added the participation of universities to schools and civil defense units. Cemaden received 86 projects from 20 states and 65 municipalities (<http://educacao.cemaden.gov.br/aparteparaprevenir2018>).

Source: Authors.

measurement exceed this quantity, they phoned a warning to an elementary school known to be on a steep slope.

The 2016 academic year culminated in a seminar on "Dialogues: Citizenship and Socio-environmental DRR." During the seminar, the students had an opportunity to show the results of their research to teachers and external experts from local NGOs and Cemaden. Cemaden researchers simultaneously observed and analyzed the relations between experts and the students, the building of knowledge and the social representations of young people; while also observing some of the obstacles and aids to students' involvement in early warning system [51].

6.3. Safe learning facilities

Advances in creating safe facilities are still incipient in Brazil. However, it is worth mentioning the Proinfância initiative's architecture standards project of the National Foundation for the Development of Education (FNDE) under which projects should consider socio-environmental criteria such as thermal comfort, acoustic comfort, tree planting and lawns for slope containment or soil moisture control and the construction of lightning protection systems. Proinfância also requires the development of a climate change assessment [65]. However, the FNDE's program does not concern itself with the structural integrity of schools or their siting in relation to possible impacts from natural hazards.

A spatial analysis of cross referenced data from the 2012 National Geological Survey (CPRM) and the National Institute of Educational Studies (INEP) revealed exposure of schools to floods and landslides in the 957 municipalities monitored by Cemaden (17% of 5570

Table 1
Summary of Activities Two Schools Located in the Parafba Valley (São Paulo state).

| Thematic research Activities | Oral history and disasters | Watershed mapping | School buildings risk analysis | Monitoring rain gauges |
|---|--|---|---|--|
| Main discipline Science activities and data collection | History/Language Interviews in urban and rural risk areas | Geography/Arts Participatory risk mapping (Google Earth, model making, fieldwork observation) | Maths/Language Derivation of formula for risk assessment (graphing data on structural vulnerability against flood & landslide hazard) & using spreadsheet models | Physics/Maths Meteorological monitoring with semi-automatic and homemade rain gauges |
| Transformation, outcomes and innovations | Students gathered community solutions to flooding, landslides Changed perception of, and solidarity with, poorer residents Changed perception about how to learn in schools after students' involvement with action research | Tree nursery creation (riverside protection) Agroforestry with NGO Asked Cemaden to undertake specific data collection on rural areas (deforested zones, types of soil) | Research findings presented to the City Council Information sent to the mayor for political action | Landslide warning issued by high school students to elementary school children Testing/comparing accuracy of rain gauge models (semi-automatic rain gauge of Cemaden and handmade rain gauges out of plastic bottles) |

SOURCE: Trajber et al. [50].

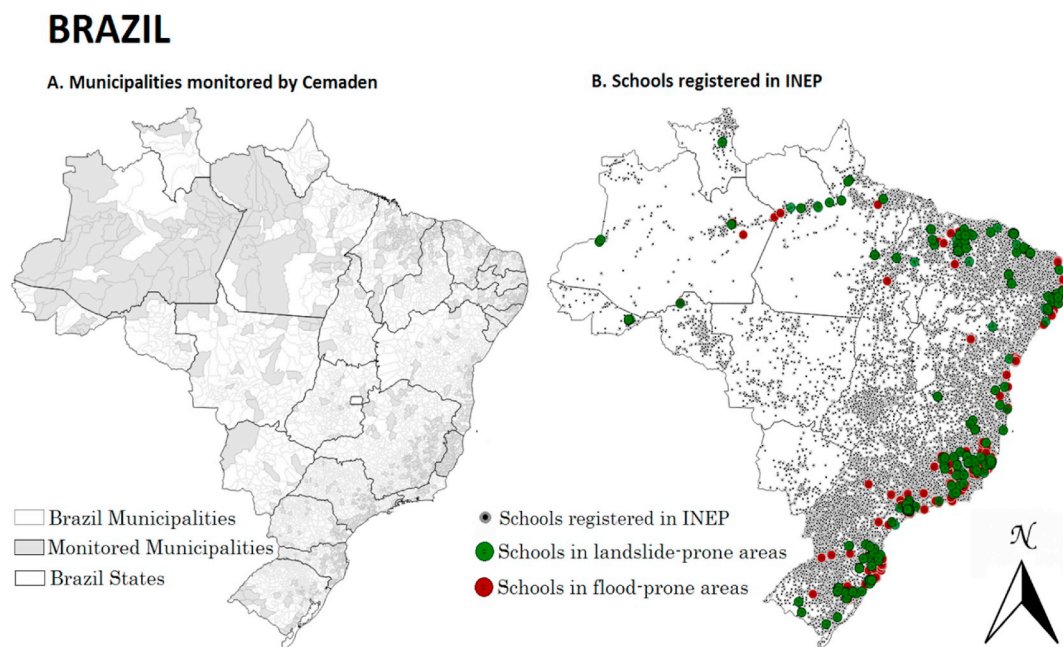


Fig. 7. Municipalities monitored by Cemaden & schools registered in INEP
SOURCE: Marchezini, Muñoz and Trajber [52].

municipalities in Brazil) [52]. The study identified 1714 public and private schools in landslide-prone areas and 729 in riverine flooding zones (Fig. 7). Further research is necessary to raise awareness about schools' exposure to natural hazards (coastal floods, storm surges, etc.) and to technological hazards (dam failure, for instance). Moreover, improvements and updates in hazard mapping are necessary since land use changes are rapid in Brazil.

6.4. Successes and challenges in Brazil

Cemaden Education has been recognized as an inspiring practice by the United Nations Framework Convention on Climate Change (UNFCCC). Cemaden Education has shown the viability of integrating applied study of natural hazards and civil protection into the school curriculum [1,53]. However, a setback occurred when Brazil passed a new law in 2017 that reorganized primary and secondary education and introduced a basic common national curriculum. Innovations brought by Cemaden Education were thus revoked, including the integration of the principles of disaster risk reduction and civil defense into environmental education.

Engagement in these initiatives by government educational authorities in Brazil has been patchy and intermittent. At the federal level, the Ministry of Education included the theme disaster risk reduction in a sustainable schools/environmental education program in 2014. However, federal involvement lapsed after that until new contacts with Cemaden were established in 2019, when the Minister of Science, Technology, Innovations, and Communications created a new directorship of Science Education that decided to sponsor the Cemaden Education project. At the state level, Cemaden has been collaborating a great deal with the São Paulo and Acre State Secretaries of Education and Civil Defence in several actions including co-organization of seminars on education and disaster risk reduction; creation and launch of the first Campaign #learntoprevent in 2016 (with São Paulo). Cemaden has also contributed themes and competencies to the state curriculum. At the city level, the municipality of São José dos Campos invited Cemaden Education to organize five monthly workshops (4 h with concepts and hands-on activities) for 160 geography and science school teachers in 2018.

The main challenges and barriers to mainstreaming Education for Disaster Risk Reduction in Brazil are due to the political instability in the country since the beginning of the project, in 2014.

7. Colombia: twenty years of seismic retrofitting and rehabilitation of schools

Omar Dario Cardona.

The 25th of January of 2019 was the 20th anniversary of the earthquake in Colombia's World Heritage coffee-growing area. Commemorative acts reminded residents that in Armenia, one of the most affected cities, twenty-two schools were destroyed (74% of the schools in Armenia and Pereira suffered damage). The education losses were approximately US\$137 million. The event occurred during the school vacation, so 9335

students who might have been in the schools were not harmed. What would have been the consequences if the students had been inside of these schools during the earthquake, leading to mass casualties? [54]. This question and its answer confirmed the need for enforcement of school retrofitting according to the updated 1998 national seismic resistant building code (NSR-98). The 1999 earthquake raised awareness that schools in all cities exposed to seismic risk required protection, including schools in Bogotá, the capital of the country.

As a positive heritage of the Nevado del Ruiz volcanic eruption and Armero disaster in 1985, the National System for Disaster Risk



Fig. 8. (A) Seismic retrofitting of University of Caldas and National University buildings.(B) More views of seismic retrofitting of University of Caldas and National University buildings.

Source: Author.

Management of Colombia was created in 1988. This inter-institutional and multi-sectoral organization provided the framework for encouraging seismic reinforcement of essential buildings and lifelines [55]. One of the most important requirements of the NSR-98 building code was seismic vulnerability evaluation and rehabilitation of essential buildings. The seismic code also provided a period of time for doing so; initially the period was six years, but in 2001, this time period was extended by up to twelve years. Should this evaluation of essential buildings and lifelines not proceed with more urgency?

At that time, the Education Secretariat of Bogotá contracted a study to identify the structural conditions of the public schools. There were 710 schools, and most of them were constructed in 1960s without taking into account earthquake resistant requirements. This study showed that 434 of these schools had high seismic vulnerability, three were exposed to flooding and twenty were likely prone to landslides. In 2004, with the encouragement of the World Bank, Bogotá's administration promoted an initiative to reduce the seismic vulnerability of the public schools with its own financial resources, and this was approved by the city council. From the 434 vulnerable schools, the most critical 201 were prioritized and were retrofitted. The city made an investment of US\$ 464.2 million to improve, rehabilitate, retrofit and build new schools, and to promote risk management [56]. This initiative was the product of the cooperation of a wide range of urban and socio-economic development actors and stakeholders. The investment by the city administration was guided not only by the mayor's desire to rehabilitate beams, columns and foundations but to give to the children a generally better school environment and educational quality [54,55,57–60]. In 2012, the National System for Disaster Risk Management of Colombia was updated, and in 2014 a new National Plan for Disaster Risk Management was issued. This new National Plan promotes the retrofiting all the schools in the country [61]. Other cities of the country are prioritizing schools and also hospitals, bridges, fire stations, governmental key buildings. **Box 3** discusses one such effort.

7.1. Successes and challenges

Thirty years ago, seismic retrofitting of schools, universities, and essential buildings was considered an impossible, unaffordable task, but taking a comprehensive, developmental approach, including the quality of education, some political leaders became convinced. In the last twenty years the seismic retrofitting of schools has been promoted in several cities, but not with the same outcomes as in Bogotá during 2004–2008. In other places, seismic retrofitting of schools has proven to be a slow process, and in some cases, particularly in small towns, there is no progress at all. There is a huge stock of public buildings in need of strengthening for which the funds and political commitment are not yet available. "It is necessary to be more radical in requesting effectiveness and commitment. If we reinforce one school but we need to intervene in 10,000, the achievement is nothing... The problem grows faster than the velocity of the solutions: this is the main failure of our social commitment as academics and professionals" (Cardona, quoted by Spense [66]: 74).

8. Conclusion

Ben Wisner, Tania López Marrero, Barbara Carby, Omar Cardono Dario, Victor Marchezini, Enrique Castellanos and Lourdes Meyreles.

On the basis of our limited yet revealing review of six experiences, we are able to highlight issues of likely relevance elsewhere in the region and the world. Firstly, many tools for assessment of school safety, planning and disaster-relevant teaching are available, but their use is limited. Indeed, with exceptions, implementation is generally weak,

Box 3

Seismic reinforcement of university buildings in Manizales, Colombia

In Colombia, the seismic reinforcement of buildings has been an effort made over several decades. One of the cities where this gradual process has been important is Manizales located in the center west of the country in the Andean zone. In Manizales, many buildings have been reinforced in the last thirty years. Hospitals, headquarters of public entities, private buildings, religious temples and the buildings of university campuses in recent years, especially the public universities. The National University of Colombia and the University of Caldas were the first universities in Manizales that carried out studies of seismic risk of their campuses and later carried out reinforcement, building by building. **Fig. 8A & B** illustrate a building and some of its reinforcements.

Bogotá's example goes national and international

In 2010 the national seismic resistant building code of Colombia was again updated. Schools were promoted from "key" to "essential" buildings, the same status as hospitals, for which seismic resistance requirements are higher. In part, this change reflected the fact that in emergency situations, schools may be considered as alternative facilities for shelter, supply centers, temporary emergency clinics, among other functions. Risk reduction in schools could thus be considered as the reduction of negative effects in the educational sector and also an opportunity to increase response capacity, especially when the school engages in training of teachers and pupils for emergency situations and risk management.

Building on the experience and lessons learned from the World Bank's safe school project in Bogotá, and more recently in countries such as Philippines and Turkey,⁸ the Global Program for Safer Schools (GPSS) was launched in 2012 to boost large-scale investments for the safety and resilience of new and existing school infrastructure. The GPSS is funded by the Global Facility for Disaster Reduction and Recovery (GFDRR) and is focused on public school infrastructure in low and medium income countries [62].

including enforcement of standards and regulations. These are problems of political will and politicians' priorities, as well as inadequate national budgets as some countries struggle with high debt burdens.

Secondly, despite improvements, poorly-built schools and schools in hazardous locations still exist, as there are no systematic retrofitting programmes in most countries reviewed. This is a particular problem in smaller conurbations. Population growth among the school-aged and exacerbation of meteorological hazards due to climate change will continue to challenge authorities to invest more in order to get ahead of a rising wave of increasing risk. Particularly concerning seismic safety, investments have to compete for priority with climate-related risk and common perception that disaster risk reduction can be equated with adaptation to climate change [63].

Thirdly, whilst funding programs such as the Global Program for Safer Schools are welcome, additional new models of funding school safety and insurance schemes are urgently required. A related, fourth observation is that worldwide and in the Americas, wealth and income inequality are increasing. This is breaking down human solidarity within societies and has already led to the growth of gated residential communities for the rich and low investment in low-income neighborhoods. Such polarization can also be seen in pressure to privatize education and cuts to public education budgets [64].

⁸ <https://www.worldbank.org/en/topic/disasterriskmanagement/brief/global-program-for-safer-schools>.

Conflicts of interest

None.

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