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# Children's views on evacuation drills and school preparedness: Mapping experiences and unfolding perspectives

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ABSTRACT

*Introduction and purpose of this study:* Colegio Ingles is the largest and oldest school in the city of Iquique, the capital of Chile's northern Tarapaca Region. In accordance with the School Evacuation Plan, a drill was held in 2013 with the entire student body (n = 1600). The majority of the students had experienced the 2014 Pisagua earthquake.

Considering the school's exposure to natural disasters and the experience of its students, we studied the perspectives of k-12 students relative to their school's evacuation plan for a major disaster, such as an earthquake and a tsunami.

*Materials and methods:* The study applied a qualitative methodology for in-depth exploration and insight into the students' perceptions of the school evacuation plan. The methods applied were: (i) focus groups and (ii) individual mapping exercises. The participants recruited (n = 31), included children between the ages of 11 and 18 years old. The collected information was analyzed through a thematic analysis using NVivo 11 software.

*Results:* The results flagged significant issues that had not been considered during the development of the school evacuation plan, such as the family dimension, which in some cases is contradictory with the school evacuation plan, as well as the need of redefining the safe zones from a multidimensional perspective.

*Conclusions:* More participation from children in the local planning of the school evacuation plan was seen as necessary in order to strengthen their preparedness in case of disaster, integrating their school evacuation plan and their family ones.

## 1. Introduction

### 1.1. School evacuation drills as an example of children's engagement and participation in DRR

Evacuation drills are one of the most common ways to prepare a school community for responding safely to a natural disaster. Some studies on mock drills have concluded that they are a useful tool for reducing evacuation times, which is the focus of most preparedness and evacuation drills [1]. However, despite the effectiveness shown by mock drills for reducing evacuation time, there is scant evidence of their impact on emergency plans and evacuation processes [2,3].

One aspect that has been discussed as potentially affecting the effectiveness of drills and other preparedness efforts has been the degree to which children are capable of being active participants in their planning, implementation and assessment. The UN Convention on the Rights of the Child (UNCRC) asserts children's right to have their views taken into consideration in matters that affect them [4]. Similarly, the Sendai Framework for Disaster Risk Reduction (SFDRR) [5] emphasizes the importance of community participation, and this has led to the development of Child-Centred Disaster Risk Reduction (CC-DRR) to promote children's agency in building individual and community resilience [6,7].

These instruments base their recommendations on the fact that only

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through gaining a better understanding of children's views and experiences in DRR can we effectively design, implement and assess the practices and policies aimed to protect them. However, current research shows that children's voices are still rarely incorporated in disaster planning and research [8–10]. Since most of our knowledge about their experiences before, during and after disaster comes from an adult perspective, Disaster Risk Reduction (DRR) planning may fail to identify children's real needs to the detriment of their safety and wellbeing [11].

For example, a report from Save the Children Australia [8] that found that children's needs were not being properly addressed in disaster plans across this country. It was found that most plans primarily referred to children as part of the wider category of vulnerable groups, without addressing their particular needs. To solve this problem, the report recommended promoting their active engagement in DRR. To achieve this goal, a participatory approach to research with children in DRR offers the opportunity to include children's perspectives as experts in their own lives. In this kind of methodology, children work with adults as co-researchers and share power for decision-making across the different stages of the research process [12,13]. However, there is still scarce evidence on children's experiences and contributions in DRR activities from their own point of view and carried out with participatory methods [6].

### *1.2. Factors related to the effectiveness of drills and emergency evacuations with children in school contexts: previous experience and family dimension*

Emergency evacuations and emergency evacuation drills are planned and executed mainly by organizations that are part of the Civil Defense System, based on criteria not necessarily informed by scientific evidence. Governmental agencies and, in the case of schools, the school administrators, are chiefly responsible for planning, preparing and executing emergency evacuations, and their experience provides valuable data and feedback to researchers. Studies on evacuation drills carried out at schools have contributed to the scientific literature and practices associated to evacuation modeling, its application to school safety and risk reduction in schools, and validating the effectiveness of emergency plans and evacuation drills.

Some studies that have examined school mock drills have concluded that they are, indeed, a useful tool that contributes to successful evacuations in real disaster scenarios [1], that they do not cause anxiety to the children, nor do they negatively affect the latter's perceptions of school safety [14]. Also, that students who follow preplanned instructions contribute to reduced evacuation times [15]. However, drills often do not necessarily lead to an assessment and improvement of the school's procedures [2] and show mixed results as to their effects.

For instance, varying or insufficient levels of knowledge have been detected among the children with respect to vertical evacuation, protective actions or causes of injury, as well as uncertainty regarding how to act in scenarios that are not habitually practiced. This indicates that more active engagement on the part of the families is needed to facilitate the decision to evacuate in time [16,17].

The preceding examples suggest the enormous potential of research for helping schools to enhance the safety, knowledge and protective actions of their students through the practice of emergency drills. However, the number of studies focused on drills is low in comparison to the available literature on the broader theme of disaster education. Many studies in disaster education argue that the real effect of disaster education on behavioral change is still unclear, and that further research is needed to identify significant predictors [3]. Also, in order to be effective, disaster education should take into consideration aspects such as engaging and developing partnerships with families and organizations [18], and the assessment of disaster education programs should focus beyond children's theoretical knowledge and include behavioral change and preparedness aspects, such as practical abilities and protective actions [19].

In this area, the research and initiatives have mostly been focused on schools [16]. In order to be successful, various studies have suggested the need to incorporate disaster education into the educational curriculum, including establishing community collaboration and focusing on teacher training, in addition to assessing school vulnerability [20]. However, there are also important issues that arise during the implementation of disaster education that must be addressed, such as insufficient support for teachers [16,20], scant learning materials [21] and the low educational level of members of low-income and high-risk households [22]. These factors, along with others, may be the underlying cause of the mixed and insufficient findings of studies that have assessed the effects of disaster education on primary and secondary students [3,16,23,24].

For instance, a study by Toyosawa, Karasawa and Fukuwa [25] found that, while disaster education enhanced children's intentions of discussing preparedness with their guardians, who, in turn, augmented their own preparedness actions, the effects on affects and cognition were merely temporary and subsided after three months.

### *1.3. The context of this study: The Pisagua earthquake and Iquique's exposure to natural disasters*

Iquique is the most important city in the Tarapaca Region. It lies above the highly active Nazca – South America subduction zone, where a major earthquake is expected in the near future due to its accumulated seismic energy [26]. The Nazca-South America subduction zone spans the area from Ático, Peru (16°S) to Antofagasta, Chile (24°S, south of Tarapaca Region), and is recognized as being a mature seismic gap in the Western Pacific Basin (See Fig. 1). A seismic gap is a plate boundary segment characterized by a cyclical occurrence of large megathrust earthquakes, long quiescent interseismic periods, and high seismogenic hazard potential for the decades following the seismic event [27,28]. The last major historical event in the gap occurred in 1877, reaching a magnitude of 8.8 $M_w$ [29,30] and associated to a destructive tsunami [31].

The 8.2 $M_w$ Pisagua earthquake was less powerful than expected, causing only a partial rupturing of the gap and generating a moderate-sized tsunami [32,33]. Consequently, the gap's seismogenic and tsunamigenic potential could generate a seismic event of over 8.5 $M_w$ in intensity [34] that would affect all the exposed coastal settlements in northern Chile, including the city of Iquique. Based on the existing data on unreleased seismic energy, a large megathrust earthquake can be expected to take place in southern Peru and northern Chile in the immediate future.

### *1.4. The city of Iquique: general context of population and built environment*

Due to the seismic gap described above in northern Chile, a large earthquake is expected to occur in the near future. On April 1, 2014, the 8.2 Mw Pisagua earthquake took place, causing a moderate-sized tsunami that affected a large area of the city of Iquique and led to the evacuation of 900,000 people along Chile's entire coastal area [35].

Iquique is the capital of the Tarapaca Region and is home to 180,000 inhabitants [36]. Approximately one-third of the total population is made up of k-12 students [36]. Eighty-four (84) out of a total of 143 schools are located in the inundation zone designated by the National Emergency Office (i.e., around 60% of all school facilities) [37]. According to Chilean hazard maps, all coastal areas less than 30 m (98 feet) above sea level should be considered unsafe [38]. Thus, the evacuation plans developed by cities and schools make provision for the evacuation of residents away from these areas to meeting points or safety zones at elevations equal to or higher than 30 m. These plans are managed by the Regional Emergency Office and by the schools themselves. For an illustration of Iquique's inundation zone, see Fig. 2.

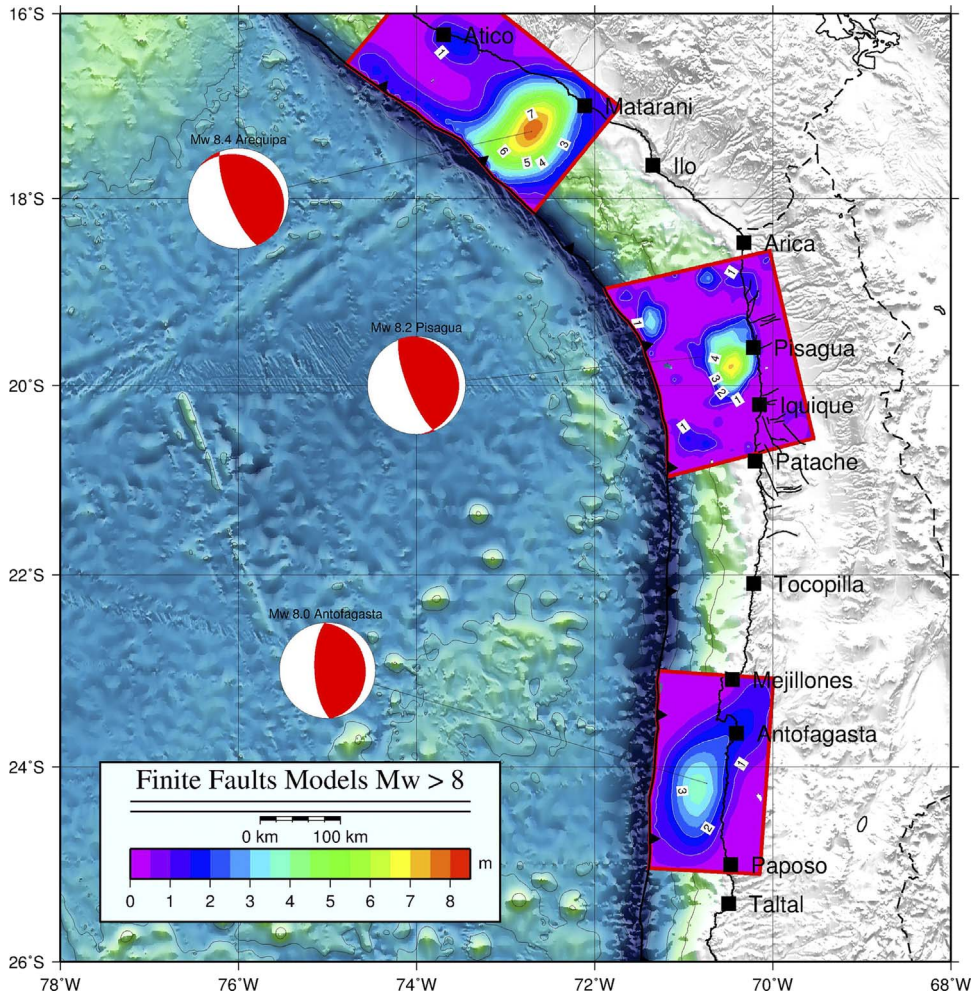


**Fig. 1.** Northern Chile Seismic Gap. Indications of major seismic events (> 8 $M_w$) after 1877. Source: Own.

### *1.5. School evacuation plans in Iquique, Chile*

School evacuation plans in Iquique are managed by two entities, under the supervision of the Regional Emergency Office and the Chilean Ministry of Education. These organisms have designed the *Programa Integral de Seguridad Escolar* (Integrated Program of School Safety, PISE) [39], which provides guidelines for improving safety and information on school evacuation plans and safe zones (located 30 m above sea level). The program covers a wide range and variety of potential emergencies and applies an integrated perspective, including the entire school community of teachers, parents and students. It also considers promoting the engagement of nearby critical facilities to promote safety and wellbeing, such as police, firefighting and health care services.

Although the school's preparedness is covered under the PISE, most preparedness efforts in the school community are limited to drills aimed at meeting specific standards of time and location, summarized as follows: (i) the school community only has 15 min to reach the Safe Zone, and (ii) the Safe Zone is located at an elevation of 30 m above sea level, thus the distance to a safe zone varies depending on the individual's location (See Fig. 3).

Overall, the main measures used to assess the effectiveness of disaster preparation and evacuation drills focus on reducing evacuation times and minimizing fatalities. However, little attention has been given to collecting data on the factors that impact on the decision to evacuate, which should be the next step to achieving better preparedness for natural disasters.

### *1.6. Colegio Ingles as a school community with prior experience in drills and disasters in Iquique, Chile*

Colegio Ingles is the biggest and oldest school in Iquique, located 70 m (229 feet) from the shoreline and currently has a total of 1600 enrollees, with an average of five courses per level, and given its location, natural disaster preparedness is a current concern (See Fig. 3). Thus, preparedness has been mainly focused on the school's participation in drills of tsunami, with main focus on reducing the time to reach the safe zone, located 1,5 km from the school, distance that is evacuated in 18 min, approximately [40].

Nevertheless, the evacuation drills is practiced just for case of a tsunami, but currently there is no evacuation plan for fires or other hazards. Furthermore, the warning for advising the tsunami is not always the same, and during the 2013 drill, the warning did not work and not all students heard the warning, delaying the evacuation start in some grades [41].

To know the perspectives of children on their school evacuation plan, as well as their previous experiences on disasters could impact in the planning of more realistic drills, involving them as active agents that take decision in their own evacuation process and then, that impact in the effectiveness of the school evacuation plan.

In general, the school evacuation plan implemented by Colegio Ingles consists of the following steps: (i) each class gathers and forms a line in the school playground, (ii) once all the students are ready, the evacuation from the school begins, (iii) the evacuation route covers a distance of 1.5 km (0.9 mile) from the grounds of Colegio Ingles to the

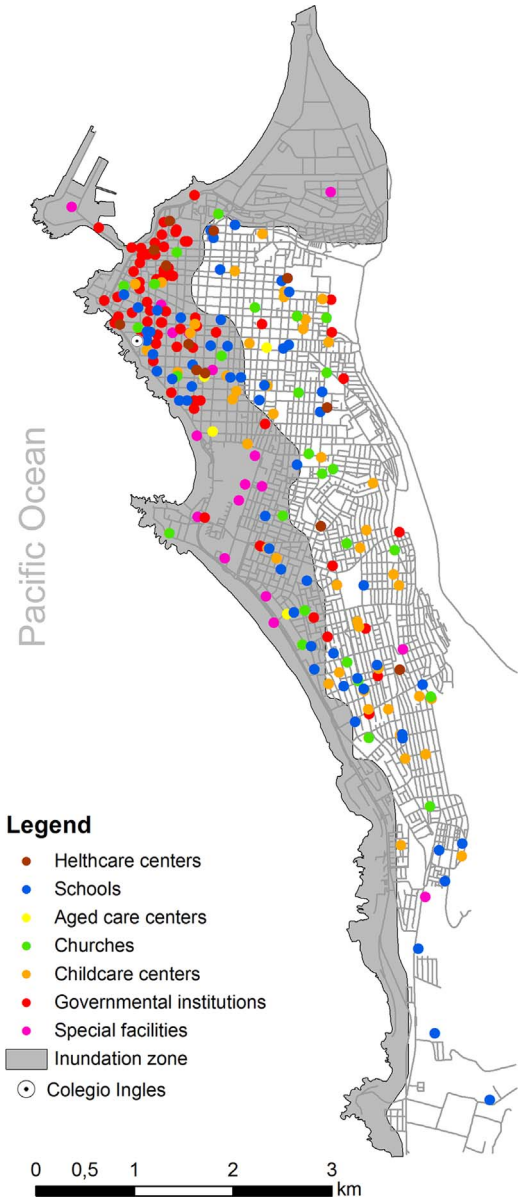


**Fig. 2.** Iquique inundation zone and critical urban infrastructure. Source: Own.

Safe Zone (predefined by the local emergency planners); (iv) when the students have reached the Safe Zone they must help to ensure that the entire class has done so and that no one has been left behind. The Safe Zone is located within two intersecting streets, one narrow street and a second, wider avenue. The narrow street where students should remain is 100 m (328 feet) long and 3.5 m (11 feet) wide. The ratio of people to square meters in the safe zone would therefore be around 5 persons within each square meter.

The preparedness programs of the schools, including Colegio Ingles, focus mainly on the evacuation of teachers, administrative staff and students on the horizontal plane. Despite the school's proximity to the shoreline, vertical evacuation is not a component of the PISE. Between 2013 and 2015, one evacuation drill was carried out at the city level, during which Colegio Ingles clocked 18 min for reaching the Safe Zone [40]. After 2013, two drills were exercised among schools in Iquique: one in 2015 and the other one in 2017 [42].

On April 1, 2014, the Pisagua earthquake (8.2 Mw) took place after school hours, at 8:46 p.m. local time [43,44], and since then the school has carried out in-house evacuation drills within the school premises to improve performance vis à vis the School Evacuation Plan.

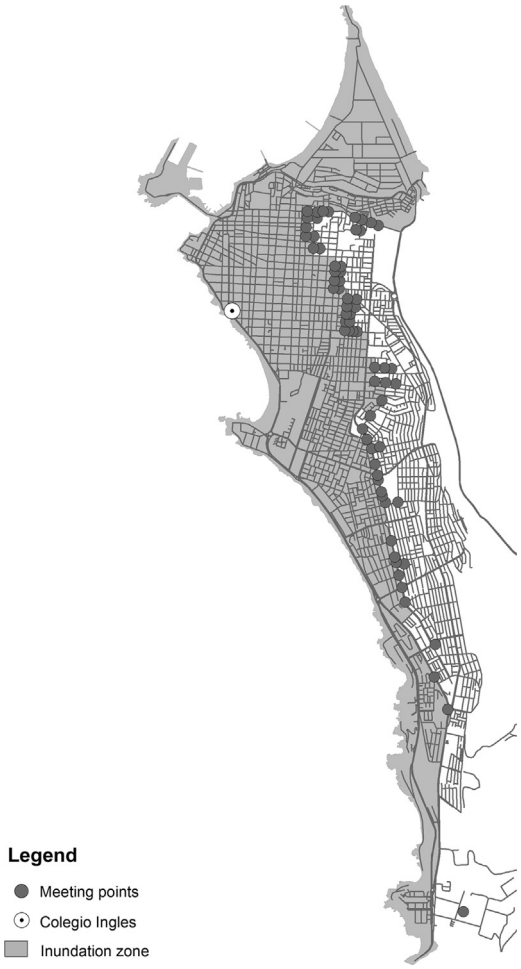


**Fig. 3.** Evacuation routes and meeting points according to the Iquique City Emergency Plan. Source: Own, based on Iquique's Emergency Plan.

### *1.7. Purpose of the study*

Most school preparedness programs have focused on evacuation drills, with little or no consideration for the children's and adolescents' knowledge and prior experiences. The consideration of these knowledge and experiences would empower them as active agents of preparedness in the context of the school and in their family context. The addition of this specific knowledge in the school evacuation plan, could impact in a more realistic school evacuation plan, that not only is based in the location of hazardous zone, but that considers the lessons learned from the Pisagua earthquake, impacting in their preparedness in the educational, familiar and community dimension.

The concerns expressed by the World Health Organization in regard to creating safer, healthier cities for children are reflected in the statements of the United Nations on children's preparedness in the event of natural disasters [5,45]. Both of these organizations promote the empowering of children as active agents in the improvement of their own safety and wellbeing. Moreover, the Hyogo Framework for Disaster Risk Reduction highlights the importance of exploring children's perceptions and knowledge of their own evacuation process, for an adequate assessment of their preparedness and the incorporation of their ideas on how to improve disaster preparedness.

## 2. Materials and methods

This was an exploratory study on a sample population of 31 students of Colegio Ingles, Iquique, between the ages of 11 and 18 years old. The methodology applied was qualitative, in order to know the perspectives

of children regarding their school evacuation plan and its safe zone among children with previous experience on school drills and earthquakes. Knowing their perspectives and experiences, the future drills conducted by school could add more realistic scenarios, taking into account the factors that children consider important to take the decision of evacuating, especially those from their previous experiences on Pisagua earthquake, that was a family evacuation out of the school hours, highlighting the family dimension in the evacuation and the role that children have within their families.

The methods applied were: (i) focus groups and (ii) individual narratives of individual mapping about their school evacuation plan.

### 2.1. Data source

#### 2.1.1. Study design

The study was conducted over a three-year period, from 2013 to 2015. The first two years focused on engaging the school community with the project through the creation of a collaborative partnership with the Principal and the School Counselor. During the first two years, engagement focused on presenting the project and its objectives and requesting the school's authorization. Data collection was developed during 2015, following the school's 2013 evacuation drill and subsequent to the 2014 Pisagua earthquake (See Fig. 4).

Two methods were applied to our work with the participating students, as shown in Table 1. The first was a focus group with 6–10 leader students from each academic level. All students belonged to the student's parliament, thus, they were recognized as leaders in their courses. The children knew each other in the instance of parliament, but they did not share the classroom daily, even though they were studying the same levels, but in different sections.

The focus groups were conducted with each one of the grade levels, conducting a total of 4 focus groups: (i) one for 5th grade, (ii) one for 8th grade, (iii) one for 10th grade and (iv) one for 12th grade. The focus groups' main objective was to gain insights into the students' perceptions of their school evacuation plan and its safe zone, as well as their experience of the Pisagua earthquake. In particular, the focus groups would explore the topics described in Table 1.

To facilitate the focus group we encouraged all students to participate as they represented their course. In order to facilitate their participation, the focus group started with a brief presentation of each researcher (2 researchers conducted each focus group) and then the students. We identified each other through credential that contained the participant's name and the course he/she belonged to. At the beginning, the focus group started with the first question described in the table and students were encouraged to participate and respond to this question, voluntarily, but researchers also facilitated the discussion generated inside the group, when not all the students agreed the response, especially in topic (i) related to the school evacuation plan and its safe zone. This allowed researchers to pay attention to the individual perspectives on the school evacuation plan, as well as the recognition of the individual perspectives on safe zones.

**Table 1**
Topics addressed by focus groups.
Source: Own.

| Topic | Questions/guidelines |
|---|---|
| (i) School Evacuation process | Does your school have an evacuation plan? Do you know how it works? Can you describe it? Where is the meeting point/safe zone located? |
| (ii) Previous experience on Pisagua earthquake | Did you evacuate following the Pisagua earthquake? Could you describe the process? |

Due to the emergence of both, individual and collective perspectives on the school evacuation plan, and as a way to validate the information collected in the focus group, the students were encouraged to participate in a second activity, this time individually, consisting of drawing and describing their evacuation route and the safe zone according to their perspective on the school evacuation plan.

#### 2.1.2. Sample selection

The study population sample consisted of 31 students. All the students were leaders of their respective classes, they were active participants of the student parliament and they had experienced the 2013 drill and the 2014 Pisagua earthquake. The selection of participants was carried out in collaboration with the School Principal and School Counselor, in accordance with the following criteria, previously agreed upon with the same school officials: (i) the students should have participated in the 2013 drill and also experienced the 2014 Pisagua earthquake, (ii) the students should not experience high levels of anxiety or distress when speaking of their previous experiences with natural disasters (the School Counselor confirmed the students' compliance with this requirement), (iii) the students should be willing to participate in the study, (iv) students should be able to express their ideas and perspectives (this criterion was added by the School Counselor), and finally, (v) the students should sign a consent form as well as provide signed consent forms from their parents/guardians.

A brief description of the study and of the participants' right to confidentiality, protection of their personal information, and voluntary participation was provided by the research team to the students before initiating the study activities. A summary of the sample characteristics of each academic level is provided below Table 2.

### 2.2. Data collection

Data collection was conducted in 2015 for one week during the initial stage. The following stages were considered: (i) introduction of

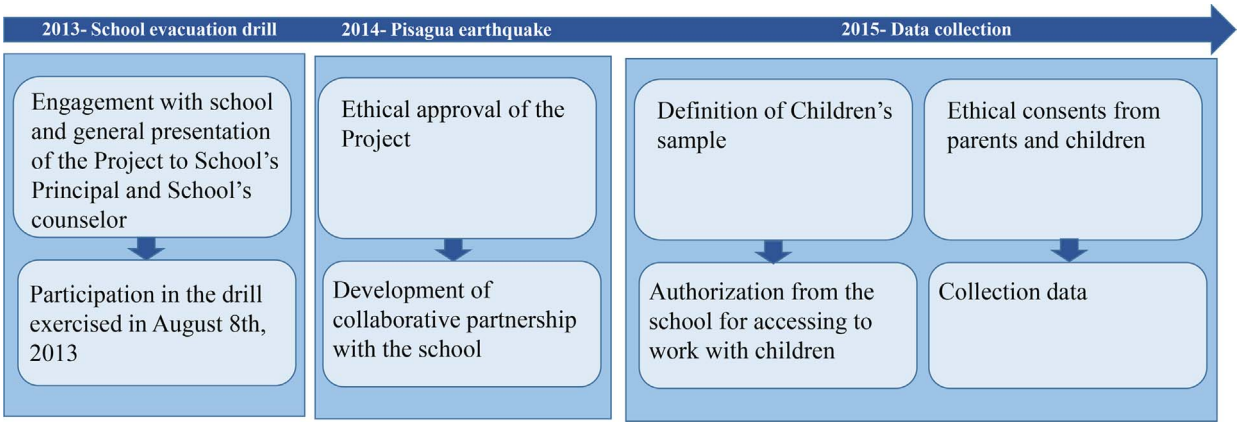


**Fig. 4.** Summary of research methodology pathways. Source: Own.

**Table 2**
Sample description.
Source: Own.

| Academic level | Number of participants | Female | Male |
|---|---|---|---|
| Fifth grade | 9 | 4 | 5 |
| Eight grade | 7 | 6 | 1 |
| Tenth grade | 9 | 5 | 4 |
| Twelfth grade | 6 | 3 | 3 |

the research team to the students, the School Principal and School Counselor; (ii) revision and approval of the study's ethical issues, consent forms and methodology, by the Principal and School Counselor; (iii) focus groups and schematic mapping with the study participants.

On average, the activities lasted for a total of 90 min per class, with one level participating per focus group (4 in total): (i) fifth grade (aged 10–11), (ii) eighth grade (aged 13–14), (iii) tenth grade (aged 15–16) and (iv) twelfth grade (aged 17–18). Data collection was carried out during school hours, previously authorized by the school's counselor, as well as authorized by their parents/guardians. As the focus group started with the presentation of researchers and participants, researchers invited to participate voluntarily, encouraging to the participation of everyone. This method was especially important when students disagreed among their individual perspectives. At the end of the focus group the collective perspective allowed them to agree regarding some specific topics, realizing the collective but also the individual perspectives on the topic, especially in case of topic (i) as mentioned in Table 1. Focus groups and mapping narratives were audio recorded.

### 2.3. Data analysis

All stages involved audio recording (previously authorized by all participants and their parents/guardians), and the data from focus group was analyzed using NVivo 11 software. A thematic analysis [46] was carried out following the original categories contained in the questions and instructions provided and used during the focus groups and mapping, as shown in Table 1. New emergent categories that had not been previously considered in the study but were mentioned by participants were likewise analyzed, such as the importance of the family dimension in the decision to evacuate following the school evacuation plan.

The information provided by the focus group was validated by the individual interviews collected individually after the focus group. In these instances, they were encouraged individually to describe their school evacuation plan, and its safe zone.

In a second instance of validation, in 2016, the analyzed information was shared with the students, in order to know if they wanted to add other perspectives to the original ones. In these instances, the information was validated again and they agreed the analysis. Some of this analysis is briefly cited in the book created by the research team, in collaboration with the students from the school [47].

In order to ensure the quality of information, as well as the analyses of the data, transcripts were made by the researchers who did the focus groups, and then the categorization; especially the emergent categories were discussed with the members who participated in the data collection (2 researchers). One researcher made the analysis, and then the other checked it separately.

Transcripts were read before doing the codes books, using the reference of the topics addressed with the objectives and questions of focus group. After that, codes were read again, in order to keep the saturation of information provided by the data [46].

Emergent topics, especially family dimension, corresponded to another category, but is was mainly related to the identification of the safe zone, so it was considered as an important issue, given its impact in the student's decision of evacuate and their further decision of follow the school evacuation plan. For this reason, it was included as a main topic that impact on the planning of integrative school evacuation plan that considers the children's perspectives and previous experiences.

### 2.4. Ethical issues

This research study was approved by two Ethics Committees in Chile: CONICYT and the School of Engineering (Fondecyt Grant Project 1141187) of *Pontificia Universidad Católica de Chile*. To accomplish the study objectives, informed consent forms signed by the participants included: (i) formal authorization from the school to conduct the study; (ii) informed consent form for parents/guardians of the students who participated in the study, describing the study objectives and activities, the students' right to voluntarily participate, a statement expressing that students and families would receive no material gain from their participation, and the main researcher's contact information; (iii) a consent form signed by the students. The consent form included a brief description of the project and project activities, a description of their rights as participants (voluntary participation, confidentiality and privacy), and the option of informing the researchers of their wish to withdraw from participating if they did not feel comfortable with the activities. It should be noted that no signs or reports of high levels of anxiety or distress were observed during any of the activities.

## 3. Results and discussion

### 3.1. Results

Despite of the topics shown in Table 1, that conducted the focus group, there were identified three major topics that appeared in the four levels of courses (5th–12th grades). Two main topics resulted as the most important of the data collection, because they offered different discussion through the levels of courses: (i) description of the school safe zone according to the children's perspectives, (ii) identification of the location of the safe zone, according to what is stated by the school evacuation plan and, an emergent topic that appeared when they talked about their experience in Pisagua earthquake, (iii) the role of family dimension in taking the decision to follow the school evacuation plan.

A brief summary of the speaks found in each of the three aforementioned topics, as well as the category given by the analysis is provided below:

#### 3.1.1. Identification of the Safe Zone: individual and school perspectives

Regarding the topic (i) about school evacuation process stated in Table 3, the identification of safe zones varies from 5th grades to 12th graders, essentially regarding the description they did about the safe zone. They identified different elements that allow pedestrian to follow and reach the safe zone at individual level.

But, even though the safe zone is delimited under a geographical criteria, thus safe zone should be located outside the hazardous zone (30 m above the sea level), the identification of safe zone involves other elements of territory, that make it recognizable at pedestrian level, as suggested by the speaks:

"*In the safe zone there is a green house*" (Female, 5th grade)
"*There is a burnt truck in front of the safe zone*" (Male, 12th grade)

Thus, the green house and the burnt truck are recognizable in the safe zone, not related to the safety of the zone as an attribute itself, but as two elements that make it recognizable.

In addition, in the context of an evacuation, children did recognize the evacuation of the school and the elements that are going to make the school recognizable within the safe area, as suggested by a student of 8th grade:

"*We recognize the safe zone because the school's inspector always has the*

**Table 3**
Summary of topics and speaks.
Source: Own.

| Topic/Question | Category | Speaks |
|---|---|---|
| (i) Does your school have an evacuation plan? Do you know how it works? Can you describe it? Where is the meeting point/safe zone located? | Identification of safe zones from an individual perspective | "*In the safe zone there is a green house*" (Female, 5th grade)<br>"*We recognize the safe zone because the school's inspector always has the school's flag and he stays in the safe zone with the flag*" (Female, 8th grade)<br>"*People are not going to follow the evacuation route of the school. I think people are going to continue their evacuation, walking up as much as they can*" (Female, 8th grade)<br>"*I reach the safe zone that is located in Arturo Perez Canto intersected with Jose Joaquin Perez and then I meet with my sister (she courses 11th grade) and my other cousins (they are younger than me). And then we meet my others cousins (we are a lot here at school), we evacuate to my house, because we all live in the same block*" (Male, 12th grade)<br>"*There is a burnt truck in front of the safe zone*" (Male, 12th grade) |
| | School safety zone: collective perspectives on the location of safe zone | "*We evacuate following Jose Joaquin Perez street. Then we go straight until Arturo Perez Canto street*" (Male, 12th grade)<br>"*We reach 12 de Febrero street*" (Female, 10th grade)<br>"*After the evacuation route we meet our green flag at the safe zone located in Tomas Bonilla with Jose Joaquin Perez*" (Male, 8th grade) |
| (ii) Emergent topic following the question about the evacuation after Pisagua earthquake (previous experience on drills and earthquake): Did you evacuate following the Pisagua earthquake? Could you describe the process? | The role of family dimension in the identification of safe zone | "*I feel afraid because of my cousins. Two of them study here at the school. I also feel afraid for my brother and my cousins who are little (they study in pre-kinder and the building is close)*" (Female, 5th grade)<br>"*I think people are going to run according to their own evacuation route. Because here there are people who have family. For example, My little brother is in kinder. Firstly, I would go to pick up him and then I would evacuate*" (Male, 8th grade)<br>"*Student A: In my case, I have two younger brothers and one older brother (we are 4 brothers) and my mom told as that in case of an emergency, my older brother is going to pick up one of my younger brother, and I', going to pick up my other younger brother. The problem is that we all are studying at different grades: one is in kinder, the other in 2nd grade, other one in 11th grade and me in 8th grade*" (Female, 8th grade)<br>*Researcher: And does this protocol follow the school evacuation plan?*<br>*Student B: The school protocol says that the students are going to follow their class. But I'm not going to follow my class. I'm going to pick up my brother, after that, we are going to evacuate to the Air Force. Student B has a younger brother who studies in the same level that my brother* (Female, 8th grade)<br>*Researcher: Does anyone else have brothers here in the school?*<br>*Student C: I have an older brother and one cousin"* (Male, 8th grade)<br>*"Researcher: How do you identify the safe zone of the school?*<br>*Student D: I'm not going to reach a safe zone, I'm going to evacuate to my home* (Male, 10th grade)<br>*Researcher: Do you feel safe at your home?*<br>*Student D: Yes*<br>*Researcher: And what about the safe zone of the school evacuation plan?*<br>*Student D: No*<br>*Researcher: Why?*<br>*Student D: Because I won't have connection with my family, so I won't know how they are"* (Male, 10th grade) |

*school's flag and he stays in the safe zone with the flag*" (Female, 8th grade)

The interaction among children and their surrounding space in the safe zone, point out the importance of considering the safe zone as a space where this interaction happens, even though there is no consensus regarding the safety provided by this predefined safe zone in the school evacuation plan:

"*People are not going to follow the evacuation route of the school. I think people are going to continue their evacuation, walking up as much as they can*" (Female, 8th grade)

The definition of the safe zone exercised previously with drills, is not necessarily recognized as a safe zone, and emerge the question about what a safe zone is, as well as which dimensions it involves.

### *3.1.2. School safety zone: location of the safe zone from a collective perspective*

In the topic (i) shown in the Table 3, children also identified the location of the safe zone, location that is expressed in the school evacuation plan, and exercised in the drills (two drills were exercised by children previous to the data collection of this study). This location was agreed by all students who participated in each focus group per level, but not in case of 5th graders, that just described the safe zone, because they were not sure of the street's name of the safe zone.

Overall, children from 8th to 12th grades, identified three different safe zones, and only one was correct. The right one, was agreed in 12th grade. The other two safe zones are located 300 and 400 m under the safe zone in case of a tsunami.

The three safe zones identified by children were:

"*We evacuate following Jose Joaquin Perez street. Then we go straight until Arturo Perez Canto street*" (Male, 12th grade)

This is the correct safe zone, updated to the drill of 2013 [37].

"*We reach 12 de Febrero street*" (Female, 10th grade)

This safe zone is located 400 m under the safe zone.

"*After the evacuation route we meet our green flag at the safe zone located in Tomas Bonilla with Jose Joaquin Perez*" (Male, 8th grade)

This safe zone is located 300 m under the safe zone and this street does not correspond to the school evacuation plan.

Despite of the different locations of the safe zones in the narratives among children, is important to warn about the importance of considering the safe zones as areas in which children take decisions. Thus, the safe zone is not only the intersection between two streets, but an area in which children have agency to decide if they are going to continue evacuating or not.

As happened in the disaster of Japan 2011 [48], the evacuation started by children who did not awaited for an official warn kept them alive, as the magnitude of event was higher than the expected. Thus, the safe zone is an area in which children are supposed to be safe, depending on the event they are facing, their previous experience and preparedness to disaster at a school level. Thus, again, considering children perspectives on evacuation drills and safe zones, as well as their previous experiences are important to improve the performance of children in further events, through the empowerment of themselves regarding their agency in taking decisions in their evacuation process.

### 3.1.3. The role of family dimension in the school evacuation plan

This emergent topic appeared in the narratives of children in both instances: the focus groups and individually when researchers asked them about their experience in Pisagua earthquake (2nd topic on Table 3).

Even though the family topic was discussed in all focus groups, in case of 8th–10th graders, they even stated the existence of a parallel family evacuation plan, mainly discussed it.

Among 5th graders, they did not identified a parallel family evacuation plan, but they did express their concern about their loved ones in case of a major earthquake, especially related to those loved ones that studied at school.

In case of 12th graders, they did not express the existence of a parallel family evacuation plan. Moreover, 12th graders were the only students that identified the correct safe zone according to the school evacuation plan, and 12th graders also have a school authorization that allow them to continue evacuating after reaching the school safe zone, in case that their homes are located outside the hazardous area (30 m above the sea level).

Summarizing, even though the student's previous knowledge on their school evacuation plan, previously exercised in drills, they identified family dimension as a crucial dimension when taking the decision of evacuating, especially when they had loved ones in the school. An hypothesis that could explain this, is that the Pisagua earthquake, the most recent real scenario of evacuation for children, was a family evacuation, due to the time of the earthquake (8.46 p.m.).

Added to the previous results, the local government has launched a family program with guidelines to prepare families to evacuate in case of a major event [49], what does not necessarily mean that both, family and school evacuation plans speak and integrate each other, as suggested in the following quotes:

"*I feel afraid because of my cousins. Two of them study here at the school. I also feel afraid for my brother and my cousins who are little (they study in pre-kinder and the building is close)*" (Female, 5th grade).

This quote expresses the concern of a fifth grader related tot their family, especially in case of younger brothers and cousins, but, as happened with other 5th graders that stated they concern about their family, they did not express a parallel family plan. As an emergent topic, the research team conducted the discussion, but as the focus group flew, the main discussion was about this concern about family, but not speaking about a parallel family evacuation plan.

In case of 8th graders, they discussed about the concern of family, but they also expressed that they had a parallel family evacuation plan that is not included in the school evacuation plan:

"*Student A: In my case, I have two younger brothers and one older brother (we are 4 brothers) and my mom told as that in case of an emergency, my older brother is going to pick up one of my younger brother, and I', going to pick up my other younger brother. The problem is that we all are studying at different grades: one is in kinder, the other in 2nd grade, other one in 11th grade and me in 8th grade.* (Female, 8th grade)
*Researcher: And does this protocol follow the school evacuation plan?*
*Student B: The school protocol says that the students are going to follow their class. But I'm not going to follow my class. I'm going to pick up my brother, after that, we are going to evacuate to the Air Force. Student A has a younger brother who studies in the same level that my brother* (Female, 8th grade)
*Researcher: Does anyone else have brothers here in the school?*
*Student C: I have an older brother and one cousin*" (Male, 8th grade)

As suggested by student A and Student B, they do have a parallel family evacuation plan, conducted by a previous experience on evacuation with their own families. In the first case of Student A, the family evacuation plan change the first step of the school evacuation plan, being the student responsible of picking up her younger brother, while her oldest brother is going to pick up other younger brother. In doing so, the school evacuation plan would result highly impacted, as these students are not going to follow the school instructions.

As suggested by Student B, her family is going to meet in the Air Force that is located at a contrary direction compared with the safe zone of school evacuation plan. This parallel family evacuation plan would impact in the entire evacuation process, especially when reaching the safe zone.

Thus, family dimension is not only important to take the decision of evacuating as suggested by previous literature review [17,50], but it is important to take the decision of where to evacuate, and that a safe zone is not only a place geographically located outside the hazard zone, but involves other dimensions, such as the familiar one. At this point we face safe zone defined from a geographical dimension, faced to the safe zone defined at human scale, in which places and people interact and children take decisions according/opposite to their school evacuation plan, in order to get and feel safe after a disaster.

In the same line, one student did not identify the safe zone defined by the school evacuation plan, as stated in the following quote:

"*Researcher: How do you identify the safe zone of the school?*
*Student D: I'm not going to reach a safe zone, I'm going to evacuate to my home*
*Researcher: Do you feel safe at home?*
*Student D: Yes*
*Researcher: And what about the safe zone of the school evacuation plan?*
*Student D: No*
*Researcher: Why?*
*Student D: Because I won't have connection with my family, so I won't know how they are*" (Male, 10th grade).

As stated by this quote, the narrative of this student expresses his thoughts on the school safe zone after evacuation: the safe zone is not such thing and he does not identify it, even though he knows where it is located according to the school evacuation plan. As stated at the end of the quote, a safe zone should provide a connection with the family, at least to know how they are.

Summarizing, family dimension have an important role that could potentially impact on the children's decision of evacuating and which plan to follow. These results suggest the challenge of generate more integrative school evacuation plans, regarding the family dimension: children with brothers, especially younger brothers express their willing to evacuate with them and not following their courses immediately, disturbing the school evacuation. Secondly, an interesting issue emerges regarding the concept of a safe zone. In the school evacuation plan the safe one is defined 30 m above the sea level, where the green house is and the flag of the school, but also where the current 1600 students should reach a density of 5 students by square meters to fit in.

As a result of this research and its dissemination to the school community, the school required an authorization to the local emergency management to change the safe zone (2017), relocating it one block before Arturo Perez Canto, a zone in which the current 1600 students fit in the space. Thus, the relationship among the participation of children, the school and the local authorities on emergency, is important to improve the preparedness and effectiveness of evacuation plans and in this specific case, to redefine what a safe zone is and where it is located.

## 4. Discussion

### 4.1. Contrasting findings with theory and previous research

Two main topics were mostly discussed by students and ask for research questions that need to be responded in future research: (i) the importance of family dimension and (ii) the dimensions involved in the concept of a safe zone in case of an evacuation due to a major event.

Firstly, students stated that family was an important dimension to be considered for initiating their evacuation and following their school evacuation plan. In some cases, the family evacuation plan goes on the contrary direction of what is stated by the school evacuation plan, but the only common thing is that both family and school look for the safety and survival of children.

The results of this study add to the evidence of the family as an essential dimension for taking the decision to evacuate and as an important factor to consider during decision making in emergency evacuations, as Quarantelli suggests [17,50]. There are several empirical studies that have established family as a key dimension during emergency evacuations [17,50–52], but few studies have explored its importance from the perspective of children and adolescents [16,25,53,54], considering them as active agents in both environments: (i) their school, as a students, but also (ii) within their own families, in which they have a specific role depending on the family structure (i.e. to pick up a younger brother).

Thus, the family dimension cannot be missed in the school evacuation plan, as children and adolescents are active agents that take decisions in their evacuation process as students, but also as members of their families. To develop more integrative evacuation plans at school level, strengthening the dissemination to all the school community: children, teachers and parents, would benefit the whole evacuation process as a family and as a school, including the perspectives of children, but also, as active agents, as key actors in the process of evacuation. Empowering them regarding their role in the school evacuation plan could impact in the recognition of themselves as promoters of a culture of disasters but also as promoters of wellbeing and safety in case of a natural disaster, at family, school and community levels [5].

Regarding the second topic, safe zones in case of a tsunami in Chile are planned from a geographical point of view, thus, outside the inundation zone in case of a tsunami (30 m above the sea level). But, as happened in other cases, the safe zones do not only depend of the physical dimension of hazards, as this physical dimension can change depending on the magnitude of the event, but also there are other dimensions to take into account for providing safety among children.

A safe zone, as suggested by these results, is a multidimensional concept in which geographical dimension and family dimension are integrated. As stated by Quarantelli [17,50], the family could be one of the most important reasons to take the decision of evacuating. Thus, to get access to information regarding the loved ones is an important issue to consider when defining and locating safe zones.

To put in dialogue the family dimension and the physical one is important to create a more realistic planning of safe zones in case of a major event. Thus, to know the perspectives of children regarding their school evacuation process, with especial focus on their previous experiences on disasters, is important to create meaningful safe zones for children, their families and then for their communities, especially at local level. The challenge is to create safe zones that are not only recognizable, but that brings safety to children and their families.

### 4.2. Study strengths

This is the first study in the Region that addresses school evacuation processes from the perspective of children and adolescents, a group with particular vulnerabilities in the context of natural disasters, but that at the same time perceives itself as a promoter of its own safety and wellbeing.

Moreover, our sample selection included children who had lived through at least one real disaster and emergency evacuation event: the Pisagua earthquake, and a school evacuation drill in 2013. This enabled our research to uncover insights into the importance of the children's past experiences vis-à-vis their ability to critically evaluate school's evacuation plans as an alternative for disaster preparedness.

### 4.3. Study weaknesses

The study's sample size and sample selection constitute one of its limitations. For the purposes of this research, the sample was selected based on specific criteria, including certain elements that are difficult to generalize among different schools. For instance, all the children were leaders in their school (a criterion specifically requested by the school staff, and which therefore had to be respected), and all had prior experience with earthquakes and drills.

Nevertheless, their perceptions as key actors in the context of their school, families and communities, in case of real natural disasters and preparedness, allowed this research to conclude that their perspectives and experiences were, in fact, consistent with what previous theories and scientific evidence suggest. This is the case especially in regard to the issues of the effectiveness of drills for helping to predict what will happen in a real-life scenario, and the importance of the family dimension for decision-making processes during emergency evacuations, which are both involved in the initiation of the evacuation as well as in compliance with the established protocols.

### 4.4. Policy implications

This research indicated some dimensions that are currently not taken into account in the Chilean school evacuation plans, such as the importance of the family for evacuating, and of the past experiences of children and adolescents with natural disasters. The integration of these dimensions, which are consistent with the evidence from previous studies, should be an important input for strengthening school evacuation plans. This would benefit communities that have already experienced disasters as well as others at risk of doing so.

Firstly, there is a challenge in the recognition and empowerment of

children and adolescents as key actors in the preparedness in case of natural disasters, that play a role in the school (as students that follow a protocol), but also in families (as sons and brothers who have a responsibility with their loved ones) and communities, three important elements that promote preparedness and resilience in case of a disaster [5].

Thus, local authorities on emergency as well as urban planning could integrate these perspectives in order to facilitate the preparedness and the creation of effective an integrative school and family. To add a meaningful safe zone, beyond its physical dimension is urgent to engage children and their families with the school evacuation plan, and then to improve the effectiveness of preparedness in their communities.

### 4.5. Future research

Future research is needed to add evidence on how to promote the empowerment of children regarding their school evacuation plan, as well as, to explore more in depth how to integrate the family dimension with the school evacuation plan.

More research is needed to explore the effectiveness of participatory methods with children that allow the inclusion of their perspective sand their multiple role in the definition of more effective evacuation process, as well as more meaningful safe zones, that effectively provides safety and wellbeing among the students. This could impact in the definition of emergency plans and safe zones from local authorities of emergency management and urban planning, as this study achieved with Colegio Ingles.

## 5. Conclusions

Family emerged as a crucial dimension for taking the decision to follow school protocols and instructions, with strong influence brought to bear by the experience of the Pisagua earthquake. Staying close to their loved ones is essential for children and adolescents in order to get safe in these extreme scenarios.

As well, the emergence of family as an important dimension to follow the school evacuation plan, pointed out the need of redefining what a safe zone is in case of a disaster, suggesting that a safe zone should not be only defined under geographical criteria, but involving the family dimension and previous experiences of children, recognizing them as active agents in preparedness, within their schools but also in their families.

Thus, safe zone could be understood as an area in which children get access to their families, and also are located outside a hazardous zone. These elements are important to open the debate on how research is defining the safe zone and how this definition could impact in concrete actions on local emergency planning, as shown in the results of this study.

The inclusion of children as protagonists of their own safety and wellbeing could promote their empowerment in front of natural disasters or other emergencies. This includes incorporating their experience and knowledge of natural disasters and of their territory, including evacuation routes. To value these crucial experiences would allow researchers and policy makers, especially those who work at local level, such as emergency planners and urban planners, to develop more participative school evacuation plans, with the active participation of the entire school community, involving: children, teachers and parents.

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