Awareness-raising of flood risk and building resilience among children in Zagreb, Croatia

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Abstract:

This research aims to evaluate children’s awareness and preparedness toward potential flood risks in Zagreb, Croatia, and to identify key factors in future education for Disaster Risk Reduction (DRR) in the city. In 1964, Zagreb experienced a large flood leading to 17 casualties. There have been no major floods since the national government implemented flood protection, however, the river water levels rise markedly during unexpected heavy rainfall. Although various actions are ongoing in Croatia to raise children’s awareness of natural disasters, very little systematic research can be found on this important topic, especially vulnerability, awareness and preparedness of young generation. Hence, a social survey of children 14–17 years old was conducted in Zagreb. The findings suggest that a fear of extreme weather and preparation status are somewhat co-related. Although 75% of the respondents were aware of the possibility of future floods, preparedness among them was disproportionate to their awareness and there was a gender gap in preparation status. It was concluded that the use of experimental, visual tools would be the best DRR method to educate the children of Zagreb by giving them a clearer understanding of the potential flood risks with information from materials compiled by the Croatian government.

KEYWORDS flood; awareness; children; education for disaster risk reduction; Zagreb

BACKGROUND AND ISSUES

Protection of life and property from the destructive forces of natural disasters is a critical issue the world over. The Millennium Development Goals (MDGs) states, we must “intensify cooperation to reduce the number and effects of natural and man-made disasters” (UN, 2000). The Hyogo Framework for Action (HFA) 2005–2015 (ISDR, 2005) reaffirms, we should “ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation”, (we must) “use knowledge, innovation and education to build a culture of safety and resilience at all levels”, and (we must) “strengthen disaster preparedness for effective response at all levels” which underlines the priority for a call to action. An education plan which raises the public’s awareness of natural disasters, Disaster Risk Reduction (DRR), has been discussed more actively in recent years, with a number of ongoing projects and activities being undertaken globally by various organizations. However, the effects of these projects and activities differ depending on regional, cultural, and societal backgrounds.

A number of studies and projects have been implemented in Europe for DRR and public awareness and preparedness for disasters. Wheater (2006) called for more communication and attention to public awareness while reinforcing and increasing flood protection based on reassessment of flood hazards. The subject of DRR has been discussed by local networking organizations, as they play a large role in what and how information regarding emergency measures for natural disasters is disseminated throughout the community of Zagreb. Harris (1990) paid particular attention to studying how kinship plays a role in the interpretation of emergency information and appropriate response to warning. Moreover, it is important to consider how both the official system of education and unofficial elements can be jointly implemented to improve the safety of those at risk (O’ Sullivan et al., 2012). Since personal experience and empirical evidence are prone to error or late detection, the balance between public and self-assistance, as well as merits of blending official and unofficial action, has been discussed (Parker et al., 1998). Kawada (2008) asserted that assistance related to natural disaster can be divided into three types: ‘official assistance by governments’, ‘assistance by the community’, and ‘self-assistance’. According to Kawada, the ratio of the three is ‘7 : 2 : 1’ before a disaster. However, the ratio changes to ‘1 : 2 : 7’ once a disaster occurs, that is, ‘self-assistance’ becomes most prevalent. In many disaster cases, children are the most vulnerable and tend to be the first casualties (Anderson, 2000; ISDR-Europe et al., 2011; UNICEF and ISDR, 2011; Kar, 2009; UNICEF, 2009). The vulnerability and lack of children’s education regarding natural disasters was also discussed at the World Conference on Disaster Reduction held in January, 2005 in Kobe, Japan, and included in HFA 2005–2015. ISDR (International Strategy for Disaster Reduction) has prioritized the inclusion of DRR in all school curricula by 2015 as well as the development and implementation of firm action plans for safer schools (ISDR, 2009). As courses regarding natural disasters are not commonly taught as part of the natural science curriculum for European schools, Bernardsdottir et al. (2012) called for more curricula or courses dedicated to natural hazards or DRR to be included within school systems through case comparison from four European countries. Tanner (2010) emphasised the uniqueness of the ability of children to conceptualize and analyze risk.

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AWARENESS-RAISING OF FLOOD RISK

Historical flood in Croatia

Nestled between the Sava River and Medvednica Mountain is Croatia’s capital city of Zagreb. The Sava flows from neighbouring Slovenia to the Danube River (Figure 1), with Zagreb located on the plains along the northern shore of the river (Figure 2). The city has suffered a number of major floods in the last hundred years. For instance, ten large floods caused by overflow of the Sava River have been recorded from 1923 to 1998 (ISRBC, 2009). The city has also suffered many floods caused by overflow of streams from Medvednica Mountain, such as events occurring in 1898, 1936, and 1989 (Trninic, 2001; Oskorus and Bosnjak, 2006). The flood of 1964 brought the most severe damage, resulting in 17 casualties and the central part of Zagreb being flooded with as much as 1 meter of water. Soon after the flood of 1964, the Croatian government commenced construction of a drainage canal—the Sava-Odra Canal—to discharge excess water to fields in order to prevent flooding within the city (ISRBC, 2009). There have been no large-scale floods within the city since these anti-flood operations were introduced in January 1979 (Trninic, 2001).

Raising-awareness among children in Croatia

Precipitation in Zagreb has become unusually high during the past several years, according to Croatian Meteorological and Hydrological Service (DHMZ) observations. Precipitation in September of 2009, 2010, and 2011 was especially high (Supplement Figure S1). Due to unexpected heavy rainfall in September 2010, the water level of the Sava River reached 654 cm, triggering evacuation alarms set by Croatian Waters (Supplement Figure S2). However, many adults and children were nonetheless observed at the Sava River during this period of dangerously high water levels (Supplement Figure S3).

EM-DAT (2013), Emergency Events Database by Centre for Research on the Epidemiology of Disasters (CRED), considers floods as a major part of disaster events (Supplement Table SI). UNICEF and UNISDR (2011) reported that there were 6 flood events which affected 3,160 people from 1980 to 2010 in Croatia. The national government has taken steps for DRR since establishment of the Croatian Platform for Disaster Reduction in September 2009. The Platform has organized an annual conference during which the National Protection and Rescue Directory (NPRD) plays a focal part. The conference focuses on key disaster awareness-promoting activities concerning national institutional and legislative framework and building a strong sense of ownership of the state government through collaboration with international/local governments (HFA 2005–2015). The Platform also introduces various educational measures regarding DRR for Croatian children, including revision of school programs to promote DRR as a more focal part of standard curricula. For young children, NPRD implemented a painting competition about DRR. A unique, practical program for about 95,000 young children in 1st and 2nd grade from 871 primary schools and 623 kindergartens with was conducted by the Agency for Education and Development and Ministry for Science, Education and Sport (UNICEF and UNISDR, 2011).

Although there have been attempts to incorporate DRR into education, it has been presented ad hoc or in one-time events which have only failed to achieve full implementation, due in large part to overwhelming regular academic subject work of both teachers and students (ISDR-Europe et al., 2011; NPRD, 2011; UNICEF and ISDR, 2011). Another report, Sub-Basin Level Flood Action Plan, by the International Commission for the Protection of the Danube River (ICPDR, 2009), targeted “raising-awareness and preparedness of the general public” as one of the priorities for Croatians. Information should be provided to the general public regardless of interest, age, gender, or ethnic groups so that young generations can build self-assistance skills and develop proactive programs and practices to reduce risks of flooding. In the past, details describing activities related to DRR in Croatia have been distributed, however, it is unclear to what extent those activities contribute to raising awareness of natural disasters among children. There is a real need for systematic research on this point. This research aims to clarify the status of awareness regarding flood risk among children in Zagreb, and seeks implementation of key factors which are necessary to raise awareness of flood risks in Zagreb.
METHOD

This study focuses on children and their awareness toward flood disaster risks, as well as education materials for DRR, in Zagreb. The study follows the definition of children as being less than eighteen years of age, as stated in Article 1, Convention on the Rights of the Child by UNICEF (1989). The study consists of material collection, semi-structured interviews, and a sociological survey (questionnaire). Material collection and interviews were undertaken at the Office of Emergency Management (OEM) of the municipal government of Zagreb City. The authors of this study visited the OEM to obtain information and materials regarding DRR in Zagreb. Interviews of OEM officials were carried out in order to determine how and when materials were disseminated, and to how many citizens. Sociological surveys were conducted in September 2011 in Zagreb to determine children’s awareness of natural hazards, especially floods. The target group was children aged 14–17 years old from a primary and a secondary school located near the area affected by the flood of 1989. The total number of answers collected was 208 (Table I). Before distributing the questionnaire, the authors first consulted with school teachers to confirm which respondents were competent to answer the questionnaire based on their vocabulary. Through pre-discussion with teachers, it was determined that children higher than the 8th grade of primary school (the last grade of primary school in Croatia; 14-year-old students) should have already learned local history, basic world geography, and geology in relation to natural disasters. Based on advice by school principals and teachers as well as textbook observation, the authors decided to conduct the survey to children 14–17 years old. The survey included three sections: Section 1 on historical floods and natural disaster experience; Section 2 on extreme weather and the river; and Section 3 on learning and information for preparation. In the survey, “preparation” was defined as having the following items at home: emergency food (canned food, freeze-dried food etc.), water, a flashlight, a small radio, batteries, towels, clothes and underwear, a rain coat, a rubber boat, ropes, a dynamo-electric generator, and a memo-pad and pens.

RESULTS

Material collection and interview

During the material collection, a brochure aiming to raise citizens’ awareness of floods (Supplement Figure S4) that had been disseminated by OEM was found. The brochure described four steps to take before and after a flood occurs: Step 1) determine what accidents may happen and be wary of the weakened state of structures following a flood, Step 2) make your own plan for how to escape the flood, Step 3) make a list of all necessary personal data for each family member, and Step 4) exercise and maintain the plan. This guide instructs readers in what preventive measures one should take and how to avoid potential hazards during evacuation. Also, a badge with a QR-code that enables readers to obtain the brochure via mobile phone (Supplement Figure S5) was collected. This badge was OEM’s attempt to attract children’s attention so that they would learn what to do and follow directions by themselves in an emergency. The authors tested the QR-code, however it eventually became not a flood brochure, but an earthquake preparedness brochure.

Interviews with OEM revealed that printed materials for raising awareness of the risks of emergencies, including floods, were mainly targeted at adult citizens. OEM had produced a brochure series on four different disasters/risks, namely: earthquakes, floods, chemical material spills, and radioactive material leaks. Those brochures were distributed to 300,000 households in the city by post in 2009. According to OEM, the disasters most residents of Zagreb are primarily concerned with are earthquakes and floods, as earthquakes are feared to cause failure of river dykes. Regarding this brochure on preparation for flood, it is presumed that OEM expected adult family members to give directions to children as per Step 3 of the brochure. It became apparent that materials related to the QR-code are in development, as OEM was only established in 2008. Given that children can access the brochures through QR-codes, the following issues came to light for future consideration: recognition of brochures and the badge-logo, terminology and illustrations that allow children to understand the brochure contents, and mobile phone line accessibility and capacity. Disaster may strike at any time, and may quite possibly happen when children are alone. Hence, education for DRR and basic disaster preparation must be instructed in a language that children can understand. Such measures may encourage children to undertake autonomous learning on how to prepare and how to protect themselves when they are on their own.

Questionnaire/Survey

The major findings from the distributed questionnaire were: 1) the large flood of 1964 is known to only 47% of respondents, even 50 years after it occurred, and most sourced information about the flood of ’64 from ‘family’ rather than ‘school’, 2) responses regarding future flood risk and preparation status were not proportional, 3) fear of extreme weather (or respect of nature) may affect attitudes toward preparation, and 4) gender gaps in preparation status were observed (Supplement Table SII).

Almost half of the respondents surveyed knew about the large flood in 1964, and considering their mean ages and the number of years since the flood occurred, 47% could be considered a high percentage. An interesting finding was that 62% answered ‘family’ as the source of information on the historical flood, which was three times higher than those who answered ‘the media’ (21%) and twelve times higher than those who learned of the event ‘at school’ (5%). Actually, information on the large flood event is provided during local history classes during primary education and students must learn about it at school, nevertheless, many of them recognize ‘family’ members as their learning sources.

Table I. Questionnaire survey targeted groups

| Targeted groups               | Male | Female | Total |
|------------------------------|------|--------|-------|
| Primary School (6th–8th grade)| 46   | 40     | 86    |
| Secondary School (1st–4th grade) | 47   | 75     | 122   |
| Total                        | 93   | 115    | 208   |
Following earthquakes, floods are one of the major disasters respondents were concerned with. In contrast to high knowledge of the large flood, respondents' own disaster experience was low at 15%, and those with flood experience was only 6%. The most important finding was that 75% of the respondents thought that a flood may likely take place in Zagreb within the next 10 years, while only 30% of them have made any preparation at home (Figure 3). Table II shows detailed figures and percentiles. A large number (40%) of the respondents have experienced fear of extreme weather, compared to 60% with no fear. This ratio is related to preparation status; 37% of those with fear of extreme weather had made some kind of preparation at home, compared to barely 28% of respondents with no fear of extreme weather. Those who had witnessed the brutal nature of flood scenes, even through the media, seemed more aware of extreme weather; 64% of those who had experienced and/or seen a flood felt some fear of extreme weather such as heavy storms, compared to 31% who have never experienced/seen floods. The majority of respondents (62%) did not know where to evacuate in cases of flood emergencies. Some children were also observed waiting for directions by their parents and/or elder siblings, which suggests that they imagine floods happening when they are with their families. It is most likely that they do not imagine flood emergencies taking place when they are alone, for example, on their way home from school.

**Gender gap**

A tendency towards less preparation was observed among female respondents, as shown in Figure 4. The preparation status of child respondents as a whole was 30%, however, only 25% of these respondents were female compared to 37% male. A similar trend was observed in responses on preparation status and fear of extreme weather. On the whole, 40% had felt fear of extreme weather in last few years. Out of the remaining 60%, the ratio of male students who had prepared at home was 33%, whereas only 23% of female students had made preparations. Within the group of respondents who had felt fear of extreme weather (40%), the ratio of male students who had prepared at home was nearly half (46%), whilst that of female students was barely 28%. This implies not only that female students may be more vulnerable than male students during a large flood, but that female students inevitably depend more on others for their evacuation.

**DISCUSSION**

Based on experience of floods and extreme weather, it could be assumed that extreme weather and floods risks were completely absent from the minds of the children who responded, because they have neither had any such experience nor learned of the consequences brought about by extreme weather. More than 60% of the respondents who had seen a flood scene via some type of media, as well as those who had actual experience, felt fear of extreme weather. This clearly suggests that visual experiences, such as video and pictures, can give similar recognition to children as actual events. Regarding the historical flood disaster, the respondents were rather well-informed by their families. This type of information should be expanded on and exploited since children’s perception of risks are formed through emotional attachment and group experiences viewing images of contemporary and past disaster hardship, and does not distort the experience of ‘real-life risks’ (Joffe, 2003).

Visual materials may function in a similar way to actual
experience in giving tangible images of flood disaster emergencies, especially when scenes are of the viewers’ local area. DRR materials currently provided by the national and municipality government are thoroughly composed with respect to practical information, however, they do not illustrate the probable damage caused by nature in such a way as to nurture respect for, or awe of, nature.

It may be useful to produce computational virtual tools including maps, photos, videos or other visualization tools to help children build their own imagery of floods and increase awareness of the potential danger associated with them. Virtual tools, including images and videos, would be especially effective to elicit participatory and action-oriented practices, which has been emphasized as important in various studies based on international experiences (e.g., Mitchell et al., 2009; Plush, 2009, 2013). However satisfactory plans for experienced-based educational equipments may be, to OEM, the financial burden of undertaking construction of such facilities remains to be determined. Virtual experimental tools and materials followed by implementation of new educational measures to address inaccurate information or lack of participation might help facilitate clearer education. Thus, awareness-raising activities related to social class and level of education could eventually be realized, as indicated by Burningham et al. (2008). As for the effect of visual materials, a concise representation of the data, user-friendly terminology, and a pleasant layout with simple functions are required; images and/or cartoon-like impressions usually help both children and adults to relate easily to the subject matter (Mach, 2009). Use of visual materials can be helpful regarding three aspects: 1) overcoming any lack of flood experience by showing actual images of disasters and their consequences, 2) providing teachers with tangible ideas on what and how to instruct evacuation procedures, and 3) enabling students to understand the consequences of their actions. Visual tool/video materials should lead to action-oriented practice in Zagreb where official assistance, e.g., brochures and badges, have just started to be produced. Thus, information from official assistance should be widely accepted by both teachers and students. In this way, education and activities for DRR in schools can go beyond school borders and bridge learning at school with learning from family at home, as pointed out by Shaw et al. (2014). When children play a role as a catalyst, bringing their own learning to their family, there will be further interaction on preparation for future floods in Zagreb from learning at school to all households.

Last but not least, gender gaps in preparation status cannot be ignored. Fewer female respondents think they are adequately equipped for flood risks than male respondents. What follows is a discussion from two aspects: favor of academic subjects and gender relations in society.

Disaster-related issues are taught in natural science subject classes in primary and secondary schools in Croatia. Academic achievement rate in mathematics and science subjects is about 70% in Croatia, and is almost the same in both male and female students (World Bank, 2011). Today, the ratio of female researchers with a tertiary level education in Croatia is higher than that of the European average (Deloitte, 2013). This is a stark contrast to the traditional stereotype of female students who avoid mathematics and science. Thus, subject matter likely has nothing to do with the low rate of preparation in female students. Nevertheless, there still seems to be an embedded gender bias in managerial positions across society (World Bank, 2011). Female students may have unconsciously taken such social structure as an implication that women are not in the position of leading or autonomous decision-making in society, but rather that their role lies in following directions given. Hence, they become rather passive or dependent when faced with preparation for emergencies. Raising awareness among female students could be reinforced through school and family level practices. The relationship between preparation for DRR and the evident lack of preparation among females may need to be examined further in the future.

CONCLUSIONS

The government of Croatia has built a modern infrastructure system, which has succeeded in protecting the city and its citizens from floods since the large flood of 1964. Social survey results can be summarized as follows: 1) DRR materials provided by national and municipality government are informative on what to do in case of a disaster, but there needs to be more effective use of this information and it’s dissemination; 2) even 50 years after the flood, 47% of surveyed respondents knew of the occurrence of the large flood in 1964, and most identified the information source regarding the event as ‘family’ rather than ‘school’; 3) fear of extreme weather (or respect for nature) may affect attitudes toward preparation for future natural hazard disasters; 4) although 75% of respondents had concerns regarding future flood risk, preparation status was not proportional; and 5) there is a gender gap in preparation status.

This research suggests that the perception of extreme weather and a lack of tangible flood disaster images affected the level of preparation for floods among children that responded to the survey. Use of virtual experimental tools should help increase understanding of flood cases more thoroughly. It can be assumed that both physical and visual experiences stimulate awareness and preparedness for floods, as asserted by Gruber (2005). Although Zagreb has been protected from floods since river dykes and retention dams were built, floods are currently perceived as a disaster caused by strong earthquakes and subsequent river dyke failure (Basta et al., 2011). The key for raising awareness of flood disasters in Zagreb is a holistic approach with visual experimental tools that help children create tangible imagery of flood disasters, thereby becoming more aware of the risks of extreme rainfall and increasing levels of river water. Materials distributed by governments could be more effectively used together with such visual tools. In other words, visual experimental tools such as videos should play a main educational role so that DRR learning in school has the opportunity to go beyond school borders into the community, with quality information based on official assistance. The aim is not to scare younger generations, but to have them recognize the existence of very real dangers and be prepared so that they can react rationally without panicking; thus the approaches described will eventually lead to resilience and sustainable development of the city.
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SUPPLEMENTS

Figure S1. Monthly Accumulated Precipitation from 2009 to 2011 (black line)
Figure S2. Daily Water Level Monitoring of the Sava River by Croatian Waters
Figure S3. People at the Sava River with water increased, Zagreb, September 2010
Figure S4. Brochure “4 Steps for Safety” on flood emergency by Office of Emergency Management (OEM), City of Zagreb [A4 size (folded twice)]
Figure S5. QR-code budge produced by OEM
Table S1. Top 10 Natural disasters in Croatia for the period 1900 to 2013 (sorted by numbers of total affected people)
Table SII. Major results of questionnaire

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