Disaster prevention strategies, based on an education information system

A.E. Bernhardsdóttir, S. Thorvaldsdóttir & R. Sigbjörnsson
Earthquake Engineering Research Centre (EERC), Selfoss, Iceland

G. Musacchio, R.Nave, S. Falsaperla, F.Sansivero & G. Zonno
Istituto Nazionale di Geofisica e Vulcanologia (INGV), Milano, Napoli, Catania, Italy

M.L. Sousa, A. Carvalho & S. Raposo
Laboratorio Nacional de Engenharia Civil (LNEC), Portugal

M.A. Ferreira & J.C. Nunes
Instituto Superior Tecnico (IST), Portugal

M.J. Jimenez
Agencia Estatal Consejo Superior de Investigaciones Cientificas (CSIC-IGEO), Spain

SUMMARY:
Earthquake damage includes non-structural failure, failure of utility systems and, infrastructure, loss of function and other non-structural damage. Occupants, building owners, insurance companies, building inspectors and others, through their use of the buildings, systems and content, can affect the risk of such negative events. Thus, a prerequisite for more effective disaster risk reduction is increased risk awareness amongst people and in the community and state development planning process, the educational curriculum, and media. As knowledge is clearly connected with understanding risks, the perception of natural hazards and risks in the local environment should be developed with the help of education. This paper presents a comparative study of the current educational curriculum on natural hazards within the school systems in four European countries: Italy, Portugal, Spain and Iceland. None of the countries provides courses dedicated to this topic but include it within other subjects, most often in the natural sciences.

Keywords: risk awareness, education information system, UPStrat-MAFA

1. INTRODUCTION

This paper outlines and summarizes the first phase of on-going activities of Task Group H on “Disaster prevention strategies, based on an education information system” carried out within the framework of the European Project UPStrat-MAFA (Urban Prevention Strategies using MAcroseimic Fields and FAult Sources). The aim of Task Group H is to compare the education information systems in the countries participating in the project. The outcome of the study will be used to build an information dissemination strategy to increase citizens' awareness of how they can reduce disaster risk. The strategy will take into account the demographics in each society by categorizing information on various population groups that are prone to particular kinds of emergencies, such as disabled and elderly people and children. Social, environmental and political dynamics along with economic and security aspects of the emergency context will also be taken into account. This paper introduces the part of the study focusing on the education of children.

Risk awareness and proper perception is a salient prerequisite for disaster risk reduction; a risk must be perceived before it triggers risk reduction efforts. Generally, risk awareness is absent from people’s lives, community and state development planning, the educational curriculum, and in media priorities. To build knowledge one must understand risks, awareness of natural hazards, and risks in the local environment should be developed and correctly received through long-term activities, such as education. This discussion focuses mainly on analysing the current educational curricula on natural hazards within school systems. Research has shown that children have “a valuable and unique ability to conceptualize and analyze risk” (Tanner 2010:343). Their risk perception is built on their own experience of local disasters, combined "with information gained from external information sources, such as the media, school curricula and training sessions" (ibid). The challenge is to provide children with appropriate education, training and information in a way strengthening their ability to participate in disaster risk reduction efforts. A thorough understanding of available information on natural hazards and risk is necessary for any effective intervention in the current hazard education system and awareness programmes. For a clear view on what the shadow zones are concerning the subject, we compare how the topic of natural hazards and risk is addressed within the educational information systems in four countries: Italy, Spain, Portugal, and Iceland. The extent of earthquake and volcano hazard education within compulsory schools will be investigated by using an approach, divided into different steps. The first step provides evaluation of following parameters that generally reveal the content of mandatory education on the subject of natural hazards:

a) Presence in school curricula of subjects dealing with earthquakes and volcanoes
b) The number of hours dedicated to natural and technical sciences
c) The topics addressed involving the natural and technical sciences
d) Comparison of school books with respect to earthquake and volcano hazards

Once data on these parameters have been explored, the following additional parameters will be discussed: e) Interaction between school and the world of science: how and about what.

2. NATURAL HAZARDS EDUCATION WITHIN SCHOOL SYSTEMS

An introduction of the four countries' compulsory school systems is necessary before evaluating the education in the natural science, by considering the number of hours provided on the subject.

2.1. Italy

In Italy at present, 10 years of compulsory education is required (up to 16 years of age). It includes the first cycle of education (5 years of primary school followed by 3 years of lower secondary school) and the first two years of the second cycle of education. The last two years of compulsory education can be completed in either upper secondary school (high school) or in the three-year vocational training courses run by the Regions.

Within a single cycle, primary school and lower secondary school are two different educational levels, each with its own characteristics. Primary school is subdivided, only for didactic purposes, into a first year linked to pre-school, and two two-year periods, within a major teacher system. Specialised teachers might include music, foreign language and religion. Primary school, through the exploitation of the pupils' personal diversities, including disabilities, fosters personality development, acquisition of basic knowledge and development of skills. Furthermore, it aims to at placing the basics for using scientific methodologies to study the natural world, its phenomena and laws, and to exploit social and orientation skills in space and time as well as teach the fundamental principles of civil coexistence. Topics on earth sciences might be briefly introduced at the beginning of first two-year period (age 7) when discussing topography within the topic of geography, basic knowledge, such as reading a map and understanding the meaning of colours in representing hills, mountains and rivers. At age 9 (grade 4) students start learning about volcanoes. At this stage they might study the formation of mountains without discussing earthquakes. In fact, instruction on volcanoes is provided simply because they are a specific type of mountain. However, it is worth noting that schools might choose to discuss a particular subject in laboratories more deeply. This practice, although not widespread in the country, could sometimes be the only way that pupils learn about subjects, such as earth sciences, volcanoes and earthquakes that teachers might not be able to teach.

Within compulsory education, secondary school teachers are specialists on their subjects. In lower secondary school, earth science topics are taught in the first and third year and only in the latter year is this matter of science education. Although several formats of material, including online, books, videos, and CDs, are used for teaching, outside experts are seldom used to run special projects. Teachers may not necessarily be up-to-date on all subjects as they might have a degree in biology or in natural science but not in geology.

The amount of time officially allocated to a particular subject does not always accurately reflect the actual time students spend on it. Two hours at most are generally devoted to natural sciences throughout the first cycle of compulsory school (up to age 13). However, only 1 to 2 hours the first year of lower secondary schooling, or one month at the end of it as a whole are spent on earth science. This official amount of time does not take into account special projects when pupils might delve deeply into the subject.

2.2. Portugal

In Portugal, education is mandatory for children between the ages of 6 and 17. Compulsory school comprises 12 levels, being organized in 3 cycles of basic education, plus a fourth cycle called secondary school, in which students choose an area of expertise. The 1st cycle of basic education (1st CEB), includes the four years of the primary school and is attended by children, aged 6 to 9, in a single-teacher system. An earth science theme is included in «Estudo do Meio» that is a broad subject, comprising several subjects like Science, Geography and History, and as well as rules of daily life, the environment, etc. The 2nd cycle of basic education (2nd CEB), comprising levels 5 and 6, is attended by children, aged 10-11. In this cycle volcanoes and earthquakes are not topics in classes, unless very superficially, although children attend around 2.5 hours of Science per week. The 3rd cycle of basic education (3rd CEB), includes grades 7 to 9, attended by children, aged 12-14. The topics of earthquakes and volcanoes are addressed as part of Geography. Finally, secondary school comprises grades 10 to 12 and beers attended by 15- to 17-year-old students. Only students choosing the Sciences curriculum deal with the earth sciences theme as part of Biology and Geology.

2.3. Spain

Education in Spain is compulsory and free from 6 to 16 years of age, supported by the Government in each Region. Compulsory school is divided into two phases: Primary School (*Educación Primaria*) structured as three 2-year cycles: First Cycle (6 to 8 years of age), Second Cycle (8 to 10 years of age) and a Third Cycle (10 to 12 years of age). Compulsory Secondary Education (*Educación Secundaria Obligatoria*) is four years of schooling for students 12 to 16 years of age.

During the six years of primary school, children attend the course “Knowledge of the natural and social environment”. The aim of this course, on one hand, is to provide children with some basic knowledge of natural sciences by providing them some firsthand experiences through interacting with the physical world around them. On the other hand, this class tends to connect physical aspects with social actions connected to them (such as health and consumption, based on physical aspects, but evolving into social issues). During Secondary Education, there is a common list of classes for the first 3 years (children, aged 12 to 15), two classes related to earth sciences: “Natural Sciences” and “Social Sciences, Geography and History” After that, during the last year of secondary compulsory school, children continue taking the course on “Social Sciences, Geography and History”, but they can also take other courses that are electives (not compulsory), from which they can choose the course “Biology and Geology” .

2.4. Iceland

Compulsory education in Iceland is organized in a single-structure system, i.e., primary and lower secondary education are parts of the same school level and are generally taught in the same school. The law on compulsory education stipulates that education shall be mandatory for children between the ages of six and sixteen. The grades in the compulsory school are from 1 to 10, but these grades are split into three levels: lower level (grades 1-4), middle level (grades 5-7), and higher level (grades 8-10).

The Icelandic Minister of Education, Science and Culture issues a National Curriculum Guide for Compulsory Schools. Each school develops its own curriculum guide, based on the national guide. In the curriculum (in force since 1999), no courses are specifically dedicated to natural hazards or natural disasters, but these subjects are discussed within courses on geology, geography, physics, and history. A special course on life skills provides subjects not covered within traditional education but is supposed to enhance the students' versatility. It is provided to all grades to some degree but time for this topic is specifically scheduled for students in grades 4-10. One of the course goals is to increase the students' awareness of various dangers in the environment and teach them how to respond during natural disasters. In autumn 2012 the compulsory schools will have a new curriculum guide to follow. The expected outcomes of learning are outlined, but each school defines the way in which these outcomes are reached. A timetable is provided on how many minutes should be devoted to lessons in different courses. The allocated time is summarized for each level of compulsory education. For instance, the first 4 grades, combined, are to provide 7 hours per week of classes on natural sciences, grades 5-7, 5.7 hours per week and grade 8-10 receive 6 hours per week. The principal of each school decides how the hours of teaching will be divided between the grades. This arrangement supports the emphasis on decentralization of compulsory schools in Iceland (and the policy of school autonomy) that has been dominant since 1995 when the governance of schools was transferred from the State to the municipalities. Included in natural sciences, under the new curriculum are subjects, such as natural history, physics, chemistry, earth sciences, biomedicine, and nature education. Life-skill education is now included in the social studies along with geology and history (among other subjects), but as mentioned earlier, these three courses also provide a brief discussion of natural disasters.

3. TEXTBOOKS ON NATURAL HAZARDS

In order to evaluate the educational materials on earthquake and volcano hazards in the three countries, textbooks on the subject are evaluated, based on the coverage of topics introduced in Table 1. The Spanish analysis will be defined in the next step of the project because information gathering on school materials demands more time in Spain than in the other countries.

Table 1. Topics of natural hazards to be evaluated

Tectonics-related	**Earthquake-related**	**Volcano-related**
Plate tectonics	What is an earthquake	What is a volcano
Faults	Where does it occur	Description
Earth interior and dynamics	Epi- and Hypocentre	Volcano types
	How to measure an earthquake	Eruption types
	Seismic zones	National volcanoes
	Historical earthquakes	
	Safety and prevention measures	

The evaluation of the educational materials is graded as follows:
'A' if all the listed topics are presented
'B' if half or more of the topics (but not all) are presented
'C' if less than half the topics is presented

3.1. Italy

In Italy compulsory textbooks are chosen by the teachers according to general criteria issued by the Ministry of Education, which remain the same for 3 to 5 years. Some books provide CDs and on-line materials especially at the beginning of lower secondary school (age 10). In primary school 9 books were tested and in lower secondary 4 textbooks. The general picture throughout the country is that educational training on the topics of interest looks scanty. However, it is worth noting that interviewed pupils living in areas of high risk might be trained to evacuate their school in case of earthquake, even more than once per year. Hence, local awareness of seismic hazard seems to balance the lack of information from books.

In primary school pupils generally learn more about volcanoes than earthquakes. Volcanoes are included in textbooks beginning from grade 3 (age 8) even though there are only 1 to 2 pages. Volcanoes and volcanic eruptions are described to identify national volcanoes. Volcanoes are generally introduced when discussing the formation of mountains or hills, while earthquakes are not, as if they did not belong to the same process.

Only in lower secondary school, that is at age 11, do children start to learn about earthquakes as one of the natural phenomena causing disasters, together with floods and landslides, which is discussed as part of Geography, together with volcanoes (Bersezio, 2005; De Marchi, Ferrara and Dottori, 2010). Less than one page is used for this topic, where earthquakes are briefly described. Hypo- and epicentre are defined and the Mercalli Intensity Scale is described, whereas just a few words are spent to explain the concept of magnitude. In the newest textbooks seismographs are briefly described. Moreover, both seismic and volcanic hazard maps are shown although they refer to old versions. There is no mention of the faulting process in plate tectonics. At age 13 (grade 8, lower secondary school) earthquakes and volcanoes become a matter of science education. A textbook (Negrino and Rondano, 2011) discusses the Earth's surface changes caused by endogen forces. Earthquakes are introduced before discussing plate tectonics and the Earth's interior. Although 6 pages are devoted to the general topic, there are some suggestions are made for experiments to arrange extremely simple shaking scenarios for buildings, as well as on what to do in case of an earthquake. The following topics are described: what is an earthquake; definition of epi- and hypocentre, seismometers (although sentences like this can be found: "An earthquake can be studied using seismometers.."), P-, S- and surface waves with some indication of velocities and motion, Tsunami, Mercalli Intensity versus Magnitude. The importance of prevention is briefly discussed as well as the impossibility of forecasting earthquakes. From a comparison between the distribution of earthquakes and volcanoes worldwide, the author suggests that they must have a similar origin. Moreover, it is suggested that "Italy is a seismic zone" as there have been more than 150 events of Mercalli intensity higher than IX in the last 2000 years. A list of some of the strongest earthquakes in the last 20 years is shown, ending with the 2010 Haiti 7.0 M Earthquake.

Table 2. Evaluation of textbooks in Italy: first cycle of compulsory school (age 6-13)

Grade	Framework		N° pgs.	Topics					Labs		
	Natural disasters	Earth Science		Volcano-related	Earthquake-related	Hazard maps		Tectonics-related	Behaviour		
							date			adequate	
1											
2		x[1]	1	C							
3		x[1]	1	C							Volcano
4		x[1]	2	B							
5		x[1]	2	B	B						
6	x		2								
7											
8	x	x	10	B	B	x	NO	B	x		various

Notes: 1: In grades 3 and 4 the topics are discussed as part of geographical environments when explaining shape, age and mountain formation. In some cases activity concerning volcano eruptions is included, with instructions on how to simulate lava flow. In grade 5, there are only a few words on volcanoes regarding regions where they are in the country.

3.2. Portugal

In Portuguese compulsory school, the books are chosen by the teachers in charge of each subject's department, according to criteria defined by the Education Ministry. The books' editors provide the schools teachers with several books to analyse. Once chosen, they are used for the next six years. The criteria defined by the Education Ministry discriminate between several dozen factors, properly weighed, such as, scientific accuracy, price, the availability of exercise books, graphic design, etc. Some books include extra material like CDs, and some schools provide online material.

Six books for the 1st CEB, four books of levels 5 and 6 of the 2nd CEB and one book for level 7 of the 3rd CEB were analysed and compared (Table 3). It was found that the earthquake theme is not addressed in the 1st CEB, except in the last year (grade 4 – age 9) in which books (Vieira da Silva et al., 2010; Rocha et al., 2006; Rodrigues et al., 2009) present two pages explaining why earthquakes occur and introduce safety rules in case of an earthquake. The major earthquake of 1 November 1755 is also mentioned, with a brief description of the destruction of Lisbon. The 1998 earthquake affecting Faial Island in the Azores Archipelago is also described (Vieira da Silva et al., 2010; Rodrigues et al., 2009). Volcanoes are not mentioned during primary school. The scientific accuracy of one of the books analysed is questionable, as it states that earthquakes are caused by cracks and by explosions in the Earth's interior.

In the 2nd CEB (grades 5 and 6, ages 10-11) the issue is addressed superficially in History and Geography of Portugal. In grade 5, earthquakes and volcanoes are mentioned when discussing the characteristics of the volcanic Azores Islands. There is a schematic of a volcano (Costa and Marques, 2007). In level 6, the topic is addressed when referring the Portuguese King, D. José I. Reference is made to the earthquake in 1755. The destruction of Lisbon is described, along with the strategy of Marques de Pombal to re-build the city (Costa and Marques, 2011).

Earthquakes and volcanoes are included in science education (as part of geography subject) only when children reach age 13 in the 3rd CEB (grades 7 to 9, ages 12 to 14). So far, only one book for grade 7 was analyzed (Rodrigues and Coelho, 2009), in which the origin of earthquakes and plate tectonics are addressed; maps of intensities are presented, and differences between magnitude and intensity are discussed. Concepts like hazard and vulnerability are also mentioned, and, the former is illustrated by a maximum macroseismic intensity map for the whole country.

Table 3. Evaluation of textbooks in Portugal (ages 6-13)

	Framework		**No. of pgs.**	**Topics**				**Labs**
Grade	Natural disasters	Earth Science		Volcano-related	Earthquake -related	Hazard maps	Tectonics-related	Behaviours
						Updated		Adequate
1								
2								
3								
4	**x**		**2**		**C**			
5	**x**		**2**	**C**	**C**			
6	**x**		**3**		**C**			
7			**3**		**B**			

3.4. Iceland

Icelandic textbooks on natural sciences and natural disasters for students in compulsory schools are provided by the National Centre for Educational Material. In addition to textbooks the centre provides various formats of material, including online, books, videos, and CDs. Discussions of natural disasters can be found in textbooks used in courses on geography, physics, geology, and history.
In a textbook on geography (Hróarson, 2007), one chapter (6 pages out of 96) is dedicated to

discussing of Earth’s interior. Plate tectonics and the types of forces acting on the plates are described. The hot spots on the surface above the mantle plumes are described as being more volcanic than other parts of the Earth, and there is an explanation of how one of these spots can be found in Iceland. Special attention is given to Icelandic geology, how the country is only part of the Mid-Atlantic Ridge (not mentioning the Azores Islands) above sea-level, and how it is continuously spreading to the east and west as magma wells up through the rifts along the ridge. In chapters dedicated to different parts of the country, the most serious natural disasters that have affected the lives and/or livelihoods of Icelanders are mentioned. Hence this information is presented primarily from an historical and social point of view.

A three-book series on physics, chemistry, and geology (Grímsson, 2001, 2002) is also offered to students in grades 5-7. In book 1, 13 pages out of 64 are dedicated to the topic of the Earth (its interior and plate tectonics), with special focus on Iceland. The different types of rock formation in Iceland are mentioned, and how rock density determines how much force from plate movements the crust can withstand. The book states that scientists have developed an approach to predicting earthquakes by measuring pressure release, and how the strength of earthquakes can be measured by using the Richter scale (magnitude scale). Volcano types and forms are introduced, whether they are eruptive or effusive, and whether the forms are linear or circular. Tips are given to students about how they should respond to earthquakes, and how they always must be accompanied by grown-ups when they are in the vicinity of erupting volcanoes. In book 2 of the series, natural disasters are specifically discussed just briefly on a single page and from a historical point of view. The risk of natural disasters is emphasized as a prevalent threat.

A special textbook on Iceland's geography and history is provided to children with disabilities (Kristinsdottir, 2010). It is written in accessible text accompanied with large and captivating photos. Out of 32 pages, one page is dedicated to volcanoes and one page is dedicated to earthquakes.

The increasing availability of online educational material is also worth noting. A website dedicated to natural disasters is divided into three parts depending on whether a disaster is caused by weather or the Earth or is man-made (http://islandia.is/hamfarir/index.html). Another website created by the National Centre for Educational Material contains different kinds of material that often relates to contemporary events that are capturing the attention of public and the media (http://vefir.nams.is/dagsins/dagur). For instance, when Eyjafjallajökull Glacier erupted in April 2010, a discussion and explanation of volcanic eruptions, causes, and consequences was made accessible to teachers and students.

Table 4. Evaluation of textbooks in Iceland (ages 6-10)

<table>
<tr><th></th><th colspan="2">Framework</th><th>No. Pgs.</th><th colspan="4">Topics</th><th>Labs</th></tr>
<tr><td>Grade</td><td>Natural disasters</td><td>Earth Science</td><td></td><td>Volcano-related</td><td>Earthquake-related</td><td>Hazard maps</td><td>Tectonics-related</td><td>Behaviours</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>Updated</td><td></td><td>Adequate</td></tr>
<tr><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>5</td><td rowspan="3">} 1</td><td rowspan="3">} 19</td><td rowspan="3">} 20</td><td rowspan="3">} B</td><td rowspan="3">} B</td><td rowspan="3"></td><td rowspan="3">} B</td><td rowspan="3"></td></tr>
<tr><td>6</td></tr>
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Overall, the Icelandic textbooks touch upon most of the topics in Table 4. More informative discussion on seismic zones could be useful, for instance, a detailed overview of the inhabited areas most at risk due to the active ridge dividing the country. Seismic zones in other parts of the world are not presented, except a rough map of world tectonics. The most disastrous hazards in Iceland's history are mentioned but none in other parts of the world.

4. INTERACTION BETWEEN SCHOOLS AND THE SCIENCE WORLD

It is important to raise awareness about earthquakes in an exciting environment, by creating initiatives and participation in projects with the support of universities and laboratories, similar to the School-University partnership offered in the US in earthquake engineering education. This exposes students to basic engineering principles, and gives them an opportunity to design their own structures from simple materials like LEGO or k'Nex (see peer.berkeley.edu, per example). The concept of learning by playing is not new. In fact, one learns best by doing—by being involved in the proposed activities and the process of reflection. Note that we generally remember 20% of what we hear, 40% of what we see and 80% of what we do (Adapted from Wiman and Merihenry, 1960). Also in a school environment students may carry out collaborative projects related to earth sciences and define research questions that could be analysed and discussed using different approaches.

For instance, in Portugal, the civil protection of Lisbon Municipality (CML) developed a space, also known as "House of Tinoni", directed to a target audience ranging from 5 to 10 years old, where each child learns to identify and respond to risks involved in their day-to-day life, but also an exceptional event like an earthquake. Some pedagogical information is provided, and the experience culminates in an interactive game that systematizes the contents disseminated through the activities (http://www.tinoni.com/casa-do-tinoni.php). The same institution developed multimedia material which is available to 1st CEB schools aiming at raising earthquake awareness in school children and teaching them how to develop and implement an earthquake emergency plan.

Recently, the Portuguese Education Council launched a Recommendation on Education for Risk (Diário da República, 2.ª série — N.º 202 — 20 de Outubro de 2011). This document recognizes and has a prospective that "urges action and promotion of Education for Risk". These decisions may be the result of a process involving schools, municipalities, museums, the media, etc. This recommendation points to the school as a centre for the production and dissemination of information on Education for Risk.

Since 2001, the Earthquake Engineering Research Centre in Iceland has invited pupils, mostly in grades 5, 6, and 7, to visit the centre and participate in a course on earthquakes and training on how to respond to them. The response time is measured before and after the training. The pupils' awareness is raised by having them do their own check-lists for their homes and schools as a part of a preparedness plan in case of earthquake (Ákason, 2004). "This initiative began by a request from school teachers from Reykjavik asking to bring a class for a visit to the Centre to learn about what it does" (Thorvaldsdóttir et al., 2012). The centre has also co-operated with "Alvidra" which is an education centre of the Icelandic Environment Association (non-governmental organization, see http://www.landvernd.is/alvidra/), located in the countryside, close to Selfoss, the hometown of EERC. The basis for students' education during visits to "Alvidra" is the three-book series on physics, chemistry, and geology mentioned above (Grímsson, 2001, 2002). This interaction between the schools and the science world has suffered the last couple of years due to the economic crisis triggered by the banking collapse in 2008[1].

Italy's National Institute of Geophysics and Vulcanology (INGV) is the major scientific public institution for studying earthquakes and volcanoes. Aside from research, it has been very involved in public outreach activities over the past 10-15 years. During this period special projects for risk education have been funded by the National Civil Protection Institute, but every year a special division of the institute in charge of public outreach invites students to visit "scientists at work" and offers

[1] For further information on interaction between school and science world in Iceland, see Thorvaldsdóttir et al. (2012).

courses on earthquakes and volcanoes to schools all over the country. Since 2003 science festivals lasting for several weeks have been offered to the general public in two major cities, Genova (http://www.festivalscienza.it) and Bergamo (http://www.bergamoscienza.it/), hosting in cooperation with others, both activities and exhibitions devoted to risk education and in general to Earth Science. In 2011 INGV launched a new outreach activity called ScienzAperta (http://www.scienzapertaingv.it/), considered the “spring of science” for the general public. This is a several-week period in which students and families have easy access to exhibitions and activities intended to raise awareness of what earth science. Museums as well as national and regional parks in areas at high seismic and volcanic risk offer activities for risk education

5. DISCUSSION AND CONCLUSIONS

The comparative study presented in this paper gives an overview of education on earthquake and volcano hazards and risk in four European countries. None of the countries provides a special course dedicated to the topic. Rather, they include it within different subjects, such as geography, geology, physics and history, although most often within the natural sciences. The number of hours on natural sciences can be difficult to define for each grade as, for example, in the Icelandic curriculum where each school authority can decide how the hours are divided between the grades within the different school levels. Even more difficult to evaluate is how much of the time spent on natural sciences is dedicated to earth sciences (and natural disasters).

Since education on natural hazards depends in large degree on the curriculum of each school and the teachers’ emphasis, the analysis of textbooks on the subject is a better tool for comparing education between the countries. The quality of the books was evaluated on the basis of the information covered on natural hazards and risk, and this varied greatly, ranging from B (with more than half of the topics (not all) presented) to C (with less than half of the topics presented). Textbooks no doubt shape children's knowledge and understanding and thus, judging by this study, an opportunity to improve education on natural hazards in the countries definitely lies in more informative textbooks.

The four countries share the rule of having children begin attending compulsory schools at age 6. The countries also have curriculum guides that do not emphasize education on natural sciences (or natural hazards and risk) to the first graders. The children's ages range from 8 to 10 years when they first receive education on the subject. Valuable time may be lost by not teaching children earlier about natural hazards and especially risk that might help them reduce their own risk, for by the age of six, they have already achieved the ability to understand and think (see Montessori, 2008, cited in Komac et al. 2010, p. 8).

The interaction between schools and the science world varies between the countries, from being formally defined in a curriculum to being informally initiated by teachers and scientists. Both the formal and informal approaches are valuable for the educational system, but when the interaction depends on individuals, institutions and /or non-governmental organization, steadiness can be lacking, due to more unstable finances.

As discussed above, local awareness of seismic hazard can balance the lack of sufficient education in schools by, for instance, training children living in high-risk areas to evacuate their schools in case of an earthquake. One of the objectives of the H task group, presented in the introductory chapter, is to analyze the interplay between the local authorities and schools in the areas under study. Such analysis can be used to develop strategies for strengthening children’s ability to protect and/or save their own lives and their neighbours' lives, in times of disasters.

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