ONLINE EDUCATION FOR NATURAL DISASTER PREPAREDNESS

Prof. Aldo T. Marrocco

Abstract

Educational internet resources have been searched that may motivate and facilitate the study of emergency preparedness. The teaching tools available on the web, and presented in this paper, propose basic skills such as those related to a safe evacuation from buildings and a management of living spaces that limits risks and difficulties. The ideas and suggestions presented in this paper consist of text, images, videos, cartoons, games, quizzes and interactive animations, and are all in English. Some documents deal with the possibility of promoting disaster reduction in advance of disasters. This is done by, for example, a careful selection of the sites where buildings can be constructed avoiding unsafe places; some concepts about earthquake resistant buildings are also given. The resources can be used with whichever method is more appropriate, according to the teacher and the group of students.

Keywords: natural disaster, earthquake, landslide, fire

Resumen

Los recursos educativos en el internet que han sido examinados pueden motivar y facilitar el estudio de la preparación para las emergencias. Los instrumentos de enseñanza disponibles en la web, y presentados en este documento, proponen destrezas básicas como las relacionadas a una evacuación segura de los edificios y al manejo de espacios de vivienda que limiten los riesgos y las dificultades. Las ideas y sugerencias presentadas en este artículo consisten de texto, imágenes, videos, caricaturas, juegos, pruebas cortas y animación interactiva, y todos son en inglés. Algunos documentos tratan con la posibilidad de promover la reducción de desastres antes de los desastres. Esto es hecho, por ejemplo, por una selección cuidadosa de los lugares donde pueden ser construidos los edificios evitando los lugares inseguros; algunos conceptos sobre edificios resistentes a terremotos también son ofrecidos. Los recursos pueden ser usados con cualquier método que sea el más apropiado, de acuerdo al maestro y al grupo de estudiantes.

Palabras claves: desastre natural, terremoto, derrumbe, fuego
INTRODUCTION

According to the delegates of the World Conference on Disaster Reduction held in Japan in 2005, we are far from powerless to prepare for and mitigate the impact of disasters. The declaration of this conference encourages the development of a culture of prevention and associated pre-disaster strategies. In order to find stimuli for getting young students interested in the subject “Safety”, internet resources have been searched that may motivate and facilitate the study of emergency preparedness. The study can increase awareness on the importance of a safe behavior and, at the same time, stimulate the study of the underlying linguistic knowledge.

The resources available on the internet, presented in this paper, propose basic skills such as those related to a safe evacuation from buildings and a management of living spaces that limits risks and difficulties. Some documents deal with another aspect of prevention, which consists of promoting disaster reduction in advance of disasters. This is done by, for example, a careful selection of the sites where buildings can be constructed avoiding unsafe places. The ideas and suggestions presented in this paper consist of text, images, videos, cartoons, games, quizzes and interactive animations, and are all in English. The resources can be used with whichever method is more appropriate, according to the teacher and the group of students.

The teaching unit, for instance, might cut across English, science and geography. The sources quoted have been the basis of this manuscript, the topics mentioned in the discussion have been selected by the author for the interest that they may have. The subject is very complex and this manuscript, written on the basis of the cited sources, is just an introduction to the study thereof.

DISCUSSION

Earthquakes are phenomena known to be caused by movements of the earth’s crust; they can also cause tsunamis, landslides and house fires. Their study as a lesson for a group of students should be part of the curriculum of all grades in all schools. One interesting approach to gain students attention in this topic could be a short video that shows an earthquake drill in a
class and the children take shelter under the desks until the ground stops shaking, then, they evacuate the school.\(^2\)

Another possibility could be a video, overlaid with explanations, partly dedicated to the safe behavior during an earthquake.\(^3\) During an earthquake, a table can serve as a shelter, even for moving within a building; it is important to remember that most people are injured by falling objects or flying broken glass, rather than by ground movement. People who are outside are advised to remain far away from buildings, power lines, trees, bridges or tunnels, if possible.

A great tool to be integrated in a lesson is a document from FEMA that suggests, among other things, how to manage the living spaces in order to limit the possibility that objects can fall hurting people.\(^4\) For instance, it is better to avoid pictures, mirrors and shelves being located above where people sleep or sit. It is also important to remind students that children need to be able to call the emergency numbers. The need to help infants, elderly and people with disabilities needs to be also emphasized. There are resources that work this topic, in fact, there is a document dedicated to emergency management with disabled people.\(^5\) The site also advises some checks to be performed after the earthquake, provided that the stability of the building allows reentering in the house. Among other things, it is important to check for gas leaks, electrical system damage, sewage and water pipe damage.

A site of United States Geological Services (USGS) offers a variety of information and interesting activities.\(^6\) Other sources propose, among other things, animations on plate tectonics, earth structure, earthquakes and volcanoes.\(^7,8\) Notoriously, in certain geographic areas, the earthquakes are stronger than in others, but it often happens that even in locations very close to each other, the intensity of ground motion may be very different. This depends on topographic characteristics of the places and type of ground on which the buildings are constructed. A manuscript by Prof. L. A. Raymond is dedicated to the selection of safe sites for the construction of buildings.\(^9\) A site analysis carried out by expert personnel, which considers topographic and lithologic factors, may reduce earthquake risks. The best foundations for structures are provided by solid bedrock, and it is important to avoid, for example, fault zones, unstable slopes, cliffs, narrow ridges and alluvial soils. In some cases, narrow and steeply walled valleys may be
risky for both landslides hazard and the lithology of the soil. In fact, ground shaking on alluvial materials may be increased up to 4.3 times, as compared to what happens in the adjacent bedrock. A short animation that helps to understand this concept would be a great addition for a class lesson.\(^{10}\)

For older students and adults, there are guides online dealing with the construction of low cost houses, often built in traditional manner with local materials, resources and manpower. These guides suggest some easily understandable design principles that are important for the stability of a house in the event of an earthquake. According to the manual of Prof. G. Minke, the more compact the plans, the better the stability.\(^{11}\) Hence a circular dwelling is more stable than a square and this latter performs better than a rectangular one. L-shaped plans are less stable. In addition, doors and windows weaken the structure, therefore, they need to be carefully designed and often require reinforcements.

On one of the sources, there were guidelines for earthquake resistant construction of non-engineered masonry in earthquake affected areas which, among other things, included simple drawings dealing with the openings.\(^{12}\) This source included information about the importance of building stability. It pointed out that, for greater stability of the building, walls, ceiling and floor must be well tied in with each other, doors and windows must not be located in the corners, and the distance between two openings should not be too small. It also mentioned that the use of round stones for building walls must be avoided.

According to the general concepts written in “Guidelines for earthquake resistant non-engineered construction”, asymmetry is dangerous, because it leads to torsions during earthquakes.\(^{13}\) Hence, constructions with a symmetric shape, both in plan and in elevation, are more stable than the asymmetric ones. It would be preferable that doors and windows are symmetrical in both placing and sizing. A long and narrow rectangular building is also more vulnerable to the torsional effects of the earthquake. Ornamentations, unless they are reinforced, may be dangerous during an earthquake. The guides also describe, with drawings, indications relevant to the choice of the safest places in which to build houses. A simple interactive animation provides the opportunity to...
observe how a building reacts to earthquakes of various intensities, depending on soil and construction characteristics.\textsuperscript{10}

**Tsunamis**

Tsunamis are usually triggered by earthquakes that affect the bottom of the sea, sometimes they are caused by landslides that involve marine environments. A video produced by USGS entitled “Tsunami Preparedness along the U. S. West Coast” shows the evacuation of a coastal area when a tsunami is forecast in advance because it was provoked by an earthquake occurring far away.\textsuperscript{3} The authorities inform the population that, then, has enough time to evacuate calmly following the signs. The video also shows the case where people feel an earthquake or see the sea recede, or hear a loud ocean roar. Even only one of these signals is enough to suggest the urgent need to reach safe areas immediately, without waiting for official notices announcing the tsunami. If it is impossible to reach any heights, a high floor of a building, provided it is a very solid one, is generally considered a safe place. Many other waves, even stronger than the first one, may follow. For this reason, safe areas are not left until the authorities say to do so; the communication may arrive even after several hours. It is necessary that people should never be surprised by the tsunami, being informed, for example, through signs, about what are the dangerous areas, the safe ones, and the best routes to reach the latter.

According to a Food and Agriculture Organization (FAO) document entitled “The role of coastal forests in the mitigation of tsunami impacts”, mangroves, beach forests and plantations can provide significant mitigation of tsunamis and storm waves.\textsuperscript{14} This would surely be an interesting topic to cut across English, science and geography curricula. The source explains how the flow depth, the velocity of the water and the inundation area are reduced, thus lessening losses of human lives and damage to properties. Where beach forests or mangrove no longer existed, the damages caused by the 2004 tsunami were severe; the villages behind dense mangroves exhibited the least level of damage. Some exceptions and limits to this rule are widely discussed in the same paper. Behavioral differences, in the event of tsunami, among different tree species and diverse types of coastal forests or plantations, are also widely discussed.
According to K. Kathiresan and N. Rajendran (2005), dense coastal mangrove forests, where present, have helped reduce the damage caused by the tsunami that struck South Asia in 2004.¹⁵ Mangroves in the study area, unlike other types of coastal vegetation, showed no visible damage as a consequence of the tsunami. Other positive and negative situations involving coastal vegetation are discussed in the paper. The authors reported that the Governments of Tamil Nadu and Kerala planned to protect the coastline with forests. Still according to the authors, in a situation of continuing degradation and destruction of mangroves, there is an urgent need for their conservation and restoration as protection in the event of a tsunami. A document entitled “Mangroves in the Northern Territory” was published to assist public knowledge of Australian mangrove ecosystems.¹⁶ An important cause of the quick mangrove deforestation is their conversion to aquaculture, especially shrimp farming.¹⁷ A publication provides principles for a more sustainable shrimp farming.¹⁸

**Landslides**

Landslides are often caused by heavy rains that make the land heavier and diminish its cohesion. Earthquakes, volcanic activity, wildfire and man-made construction activities on the slope too may trigger landslides sometimes. Freeze-thaw conditions may be responsible for rock falls, as shown in an educational animation.²⁰ Landslides can occur in seconds, or over the course of weeks and longer. An online guide dealing with landslides can surely be another great assistive material for a lesson because it describes their various types and their causes; it provides a few tips on how to prevent them, and also devotes space to the selection of safe places for constructing new buildings.²¹ Sunken or down-dropped roads, tilted trees or poles, or the so-called “trees with knees” shown in the guide, is evidence of landslides that occurred in the past. These observations are important since slopes that in the past have been involved in a landslide, have a high probability of movement in the future. It is also advisable to exclude areas with slopes greater than 10-15 degrees, those near rivers, and those in which forest cover has disappeared due to fire or other causes.

Among warning signs of a landslide there are, for example, cracks in the building, sticking doors and windows, leaks from water or gas pipes. Further study opportunities
can be found on the “Frequently Asked Questions” section of the USGS webpage. The forest cover often reduces the risk of landslides in sloping ground, mainly due to roots that stabilize the soil. This rule, its limitations and exceptions were discussed by F. Berger et al. (2009) and A. Stokes (2006). In a manuscript written by A. Stokes et al. (2009), Figure 1 can be used to show schematically the stabilizing action of the roots in the soil.

Fire

Regarding fire, it is important to understand how the fire works and what are the conditions that ignite, sustain, intensify and suppress it. Another document provides tips on how to behave before, during and after a domestic fire while home safety is discussed in different sites. It is recommended that the student inspects the house with the aid of an adult to detect possible situations of fire risk, hence making the home more safe, if necessary. Also, it is important to remember that, during the evacuation, is necessary to get low under smoke and go up to the exit.

One of the leading causes of fire is the heating system. Several documents about heating safety can be downloaded from the National Fire Protection Association (NFPA) website, as well as, several educational cartoons, from another webpage, which mostly deals with home fire safety. To protect the house, fire sprinklers can be installed in each room; the heat of a fire that is beginning makes the sprinkler spray water, thus, protecting the house.

Sometimes forest fires can also involve the nearby houses. To mitigate this risk, it is necessary that the trees around the houses are spaced out enough and the grass cut, to reduce fire spread. The roof and the area immediately surrounding the house should be free from any combustible material. At least in the vicinity of the houses, it is necessary that the lower branches of large trees and the plants underneath them are removed; this eliminates a vertical “fire ladder” from the ground to the crown of the tree. Compliance with these tips can make the place safer, for the home and for the firefighters. A document provides tips to develop a fire safe landscape, by selecting fire resistant plants and following proper maintenance practices that decrease their flammability and
accessibility to fire. Another document contains a drawing with useful information on how to undertake safe debris burning in the garden.

Flood

Notoriously, fires in natural environments can deprive the soil of grass and tree cover. As a consequence, after heavy rains, the water encountering no resistance from the vegetation that was burned streams down very quickly, thus, creating flood risk. Snowmelt and heavy rains and, in the coast, high tides amplified by storms may cause a flood. Different documents provide information on how to manage the environment to protect people and properties from flooding and proper behavior in case of flood. The furnace, water heater, and electric panel should be located at a height unreachable by water. When a flood is forecast, all electrical appliances and all the chemicals should be taken to safe places. Before the flood, in order to prevent electrical accidents, it is necessary to shut off electrical power at the main switch of the house, but this is dangerous if the room is already flooded and must not be done. Flood waters can be electrically charged, from underground or from downed power lines. In this case, it is dangerous to approach, and it is necessary to notify the authorities. Walking in 15 cm of fast flowing water can lead to the risk of falling; when moving through flooded areas the use of a stick may prevent tripping hazards.

After a flood, the streets may be damaged and could fail under the weight of a car. Floodwaters may be contaminated with chemicals or sewage. In order to prevent water contamination and health problems, a wise action is to turn off the main water supply of the home and plug all basement sewage connections. Before returning home, it is necessary to wait until authorities say it is safe to do so, and to know whether the community’s water supply is safe to drink. Before returning to a house after the flood, there are some hygienic measures to be taken. For example, it is necessary to disinfect the affected areas. A flood could have damaged the building, particularly at the foundations; any damage to sewage systems is a serious health hazard.

When helping animals during a flood, they can be frightened by the emergency and, therefore, difficult to control. A document entitled “information for pet owners” gives advice in this regard. When returning home after the flood, it is necessary to
remember that, at least in some geographic areas, wild animals, including poisonous
snakes, may have found shelter in the house. Masonry and asphalt surfaces are
impervious to water and prevent both the infiltration of water in the soil and
evapotranspiration. For this reason, after heavy rains in urbanized areas, the water runoff
is more intense than in natural environments and this concept is represented by an
animation. Notoriously, even from a natural environment, after heavy rain the soil
cannot store further water, there may be a huge runoff and floods may ensue. An
animation of Melbourne Water Education, allows us to observe the water flow in the
town during storms of different intensities. The students can learn how houses, streets
and parks are affected, what is done to respond to floods and what the consequences of
individual actions can be.

Another document deals, among other things, with the risks in underground areas
and facilities. Some locations are particularly prone to flash floods, sometimes without
such typical warnings as heavy rain; this may happen, for example, in canyons or near
streams and canals. According to Prof. L. A. Raymond, if a landslide occurs in a narrow
valley, the dam which may be consequently produced, causes flooding upstream and
then, if the dam produced by the landslide collapses, flooding may occur also
downstream. In several climatic areas, a season of heavy rains is followed by long dry
periods. In this case, the problem is not just to cope with the floods, but also to store and
save water for drought periods. Two educational tools “Interactive house” and
“Rainwater tanks in schools” provide a few suggestions for that purpose.

**Hurricane and Storms**

It is vital to know what to do before, during and after a typhoon or a hurricane, in
the event of such emergency. If ordered to evacuate, it is necessary to do so
immediately. In this case, it is necessary to know a safe route to reach the emergency
shelter, and to have the evacuation kit ready for any emergency (food, water,
medications, documents, money, etc.). During the storm, standing near a window should
be avoided because the risk is greater there; to stay in an interior room is safer. Also,
being located in easily flooded areas is risky.
It is important to remember that the wind stops when the eye of the storm is passing, then changes direction and regains its strength. The winds are stronger at higher elevations and on coastal areas. It is important that outside the houses there are no objects which can fly as a consequence of strong winds, creating further danger; sometimes, the wind can carry away mobile or manufactured homes.

Other Safety-Related Topics Sites and Sources

A BBC website offers short animations and another document deals with precautions to avoid avalanches in the mountains. More safety documents are mentioned, although not specifically concerning to natural disasters. Different sites deals with kitchen safety, the search for hazards in the home and, among other fun and games, a crossword puzzle on safety and an online game about house safety.

CONCLUSION

Based on the teaching tools presented and the information discussed, teachers can increase awareness on the importance of a safe behavior and emergency preparedness, contributing to develop a culture of prevention among the students.

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AUTHOR

Prof. Aldo T. Marrocco – Former Mathematics and Science teacher at I. C. Comprensivo “Toniolo”. Pisa, Italy. Electronic mail: aldo_marrocco@yahoo.it

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